Chapter 9
Green Structures in Sustainable City Development

9.1 The benefits of urban greenery

The urban green structures is a component of urban space, the surface area a city is built on. The other components of urban space are the built structures and the transport structures of the city. Urban space includes all area for which a city has planning responsibility and monopoly, both in a master plan and detailed plans.

Urban planning is a single integrated concern, as for each part of a city the three alternatives mentioned are all possible – it may become a (green) area, a street (traffic) or give place for a building. Still it is not always that management of urban space is integrated. City departments dealing with parks and green areas are not necessarily well coordinated with city departments dealing with traffic, or with those authorising building permits. This leads to sub-optimisation, even conflicts. *Integration of urban planning*, a main sustainability strategy, is too often neglected.

The green area in a city is a limited and expensive resource. In Europe it is larger than one normally is aware of. Several studies report about 50 %, then including not only parks but also green edges of streets and traffic corridors, private gardens, and a multitude of bushes, trees small lawns etc. Studies show that the availability and character of green structures are important when people choose where to move when leaving a city for another. Such green areas provide opportunities for recreation, social contacts, playgrounds, concerts and other cultural events etc. all contributing to a rich and attractive city life.

It is important that these areas are available on a daily basis. Some sustainability studies use the indicator "distance from nearest green structure", using 300 meters as the norm, which should not be surpassed. To promote *availability of the green structure* is an important sustainability strategy. It is supported by research showing that individuals feel better and in fact have fewer sick days if they can spend some time in green areas, and are able to see a green area outside the window where they live.

Green structures usually are taken to include areas with surface water, or *blue structure*. Also these blue water areas are attractive to the inhabitants of a city. To

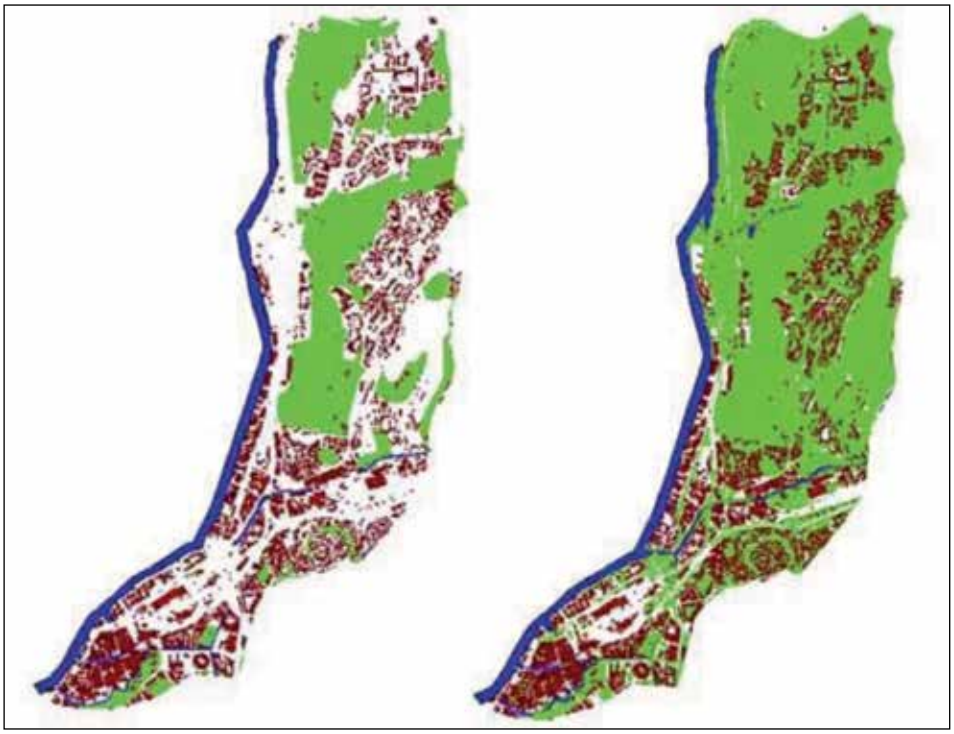

Figure 9.1. Green Gothenburg. The maps show substantial quantitative differences between the formal green structure (left map) and the actual green structure (right map) in a part of Göteborg, Sweden. Source: Urban Green Structure - A hidden resource Elisabet Lundgren Alm, Chalmers University of Technology. http://www.balticuniv.uu.se/buuf/

live by a waterfront is very popular as reflected in prices of homes and apartments. Many cities make their waters more visible and accessible, e.g. by bringing into light previously hidden small streams, or removing obstacles to make rivers and waterfronts easier to reach. Many cities have seen their citizens in large numbers spend lunch hours, afternoons, etc socialising along newly arranged riverfronts.

Greenery also has a function in protecting and conserving *biodiversity*. Today cities are often more biodiverse than rural areas, as they are more varied, provide food easily and offer much shelter. To promote biodiversity by carefully arranged green areas is another important sustainability strategy. This function is also contributing to easily accessible opportunities to learn about nature, not the least for school children, apart from the fact that biodiversity is a sustainability value in itself.

Figure 9.2. Urban green structure is especially important for children and elderly people, as these groups often are reduced to stay in the city while other groups easier can go to bigger nature areas outside the cities. Source: Urban Green Structure - A hidden resource Elisabet Lundgren Alm, Chalmers University of Technology. http://www.balticuniv.uu.se/buuf/

Green areas do also provide *ecological services* of many other kinds. Thus wetlands and shallow surface water in general function to reduce eutrophication (nitrogen and phosphorus overload), and in general clean the water. A special category of surface water is storm or run off water in a city. To arrange wetlands, and channel storm water in surface canals is also a sustainability strategy, of which several cities have very good experiences. Such artificial wetland areas also promote a rich bird life and, if carefully managed, opportunities for beautiful plantations.

The expectation that green areas and parks "clean the air" seem not to have much scientific ground. Green/blue corridors across the urban landscape may, however provide a *ventilation function* in some cases. This is particularly true for cities with a river passing through the entire cityscape. Green corridors may also support biodiversity in the comparatively small scale that a city provides.

The monetary value of these ecosystems services of cities have been studied in several recent research projects and found to be considerable. To insert the rural in the urban is thus one way to decrease the ecological burden of cities.

In conclusion, the green areas of a city are important for making the city an attractive and rich environment for its inhabitants. This is main concern in sustainable urban development.

9.2 Functions and history of urban greenery

During the last 300 years greenery within towns have been developed mainly for aesthetic, social and hygienic purposes. Inspired by English, German, French town planning the concept of city park was introduced all over the world only in

XIXth century, although already in XVIIth century residential squares furnished with centrally located gardens for residents started to be introduced in French and English cities. The most famous Parisian green residential squares: Place de Vosges, Place Vendôme and London's: Bedford, Red Lion, Leicester, Soho Squares and some other serve until today as popular recreational urban places.

In 1898 E. Howard introduced *Garden City concept*, in which greenery and advantages of a country life played significant role. He envisioned a new city for thirty thousand inhabitants. In his scheme the Garden City is laid out in a circular plan divided into six wards (neighbourhoods) by six main streets. A circular space at the centre contains a park surrounded by public buildings such as the town hall, concert and lecture hall, theatre, library and a hospital. Around this Central Park of 6 hectare is the "Crystal Palace" – a wide glass arcade with shops – divided by radial boulevards. Beyond this is the residential area containing 5,500 house lots of 7,5x30m in size, allowing for a density of about 37-42 dwelling units/ hectare. Each house is provided with a garden. Circular avenues give further definition to the plan. One of these, Grand Avenue, contains sites for school and churches in a park-like setting. The outer ring of town is a permanent agricultural greenbelt of 2,000 hectares devoted to small farms.

In 1926, geographer Sernander was the first, who suggested preservation of green habitat corridors from the city centre to nearby green recreation areas and nature reserves. The approach to greenery in the city changed dramatically from that time.

Urban green structure today can be defined as all land of the urban landscape that is neither covered nor sealed, including parks, playgrounds, sport fields, allotments, private gardens, green space of housing districts, industrial properties as well as along streets and rail roads etc. Ulf G. Sandström refers to the green structure in an urban environment as to all non-hard and non-built areas, including surface water areas and a of 1-2 km zone between town and countryside, that are more or less connected to each other. The structure should be organised with an overruling strategy, i.e. it must be possible to recognize a system in the structure. Accordingly a green infrastructure is a network of patches of natural character including surface water and greenways, penetrating an urban built-up area.

The concept should not be limited by administrative considerations; i.e. both public and private lands are included in a green infrastructure. The City Architect Office in Lund, Sweden, supports the approach stating that: "green structure include both the landscape and its nature in the city neighbourhood as well as all non-hard ground in the city. This means that the green structure in a local government plan includes not only determined green areas but also non-hard areas in

housing areas, day nursery gardens, school yards, institutions and sports grounds, cemeteries, verges, green squares, allotments and adjacent sectors of the landscape. Also non-hard ground without any value for recreation, e.g. safety zones for traffic or industrial establishments, belongs to this category."

An EU research team *Green structures and Urban Planning* (2000) supports the above definition by classifying the green structure as follows:

- Paved city spaces with plants: courtyards & patios, roof gardens & balconies, tree-lined alleys, promenades, city squares and schoolyards
- Parks, gardens and sports grounds: public parks, pocket parks, gardens, public sports grounds, public recreation areas and public playgrounds
- Burial places: crematorium, burial ground and churchyard
- Private open spaces: institution grounds, residential home grounds, health services grounds, private sports grounds, private estate grounds, local authority services grounds and commerce grounds
- Domestic gardens: house gardens, allotments, communal semi-public gardens and communal private garden
- Farmland and horticulture: arable, pasture and orchard
- Transport corridor verges: canal sides, rail sides and roadsides
- Water margins: wetland, riversides and lakesides
- Water: still water, running water
- Woods: woodland, timber/bio-fuel woodland, wild wood and semi-natural woodland.Green structure in the sustainable city fulfils multiple functions and influences:
- Urban climate: noise moderation, air cleaning, surface water treatment, wind and snow, sun protection
- As an indicator of environmental changes
- Cultivation of energy plants
- Biodiversity: protection of valuable urban species coming from rural biotopes, acts as spreading green corridors
- Social and cultural values: health: recovery and rehabilitation, beauty and comfort, space for passive and active recreation, setting for cultural heritage and education
- Urban design: provides digestible city structure connecting different scales and parts of the urban landscape.

9.3 The classical green structure – parks

A park is an area of open green space provided for recreational use, usually owned and maintained by a local government. Parks are meant to resemble savannas or open woodlands, the types of landscape that human beings find most relaxing. Grass is typically kept short to discourage insect pests and to allow for the enjoyment of picnics and sporting activities. Trees are chosen for their beauty and to provide shade.

Parks have been there since the origin of cities but earlier mostly made for the nobility. For example La Alameda de Hércules, in Seville, Spain was built in 1574, within the historic center of Seville. It was later made public. The earliest purpose built Public Park, although financed privately, was Princes Park in the Liverpool suburb of Toxteth in 1842. The creation of Princes Park showed great foresight and introduced a number of highly influential ideas. First and foremost was the provision of open space for the benefit of townspeople and local residents within an area that was being rapidly built up. Secondly it took the concept of the designed landscape as a setting for the suburban domicile.

Parks, just as buildings or cities, are more or less famous and some are world heritages. Among the best know we find *Central Park, New York*, at the center of Manhattan in New York City, USA. This famous urban park, opened in 1857, is has 35 million visitors each year and spans over 300 ha. *Hyde Park in London*, England, a large city park in central London, famous for its Speakers' Corner, is a beautiful green lung in the center of the busy city. *Monsanto Forest Park, Lisbon*, Portugal is a heaven for nature lovers with trees covering much of the park, and efforts have been made to manage both plant and animal species. *Luxembourg Garden, Paris*, France, the second largest park in Paris, is the garden of the French Senate, which is itself housed in the Luxembourg Palace. It has beautiful lawns, formal gardens and fruit orchards, statues and fountains, but there are also jogging paths, tennis courts and fitness equipment.

Parks can be very small, so–called pocket parks just a few m^2, up to rather large forest areas, forest parks. Parks are often there for beauty, e.g. rose gardens or other plantations, for nature such as botanical gardens, for manifestations such as park of liberty, for performances e.g. concerts and theater. But most often they are recreation areas with an urban character and requires intensive development. They provide space for active recreation playgrounds: ball fields, swimming pools, gymnasiums, and skate parks. Passive recreation – rustic picnic areas, benches and trails – emphasizes the open-space aspect of a park and allows for the preservation of natural habitat.

9.4 A Post-Soviet case study – the parks of St Petersburg

St Petersburg is statistically a green city, with a large number of parks, gardens, squares, boulevards, green areas and urban forests, but the last decades of transition in Russia have affected the park situation economically, culturally and socially. Many parks are deteriorating due to lack of finances and the number of green areas is decreasing rapidly in favour to urban development.

By the time for the foundation of the city, parks and gardens surrounding the palace was a symbol of great status. In St Petersburg parks and gardens were established in and outside the city. Peter the Great started the tradition in 1704 and established the Summer Garden in baroque style by his summerhouse on the bank of Neva. The magnificent garden, designed by the Dutch landscape architect Van Rozen, was the starting point for the park culture in St Petersburg, followed by the imperial summer residences outside St Petersburg in Peterhof, Pavlovsk and

Figure 9.3. The mikro-rajon, the dwelling concept of Soviet Union in 1960-1990, involved a high ratio between green space and built up space. The open green space was seldom designed but planted and cared for by the new residents. A backyard in Kupchino, micro-district in the southern part of the city. (Photo. Ulrika Åkerlund).

Pushkin as well as the noble mansions like Tavrichesky and Oranienbaum. They were all built with great parks in baroque and landscape style.

Even though St Petersburg is most famous for its historical parks and gardens, 80 percent of the urban green areas were established during Soviet time 1917-1991. During this time St Petersburg, or Leningrad as it was renamed in 1924, expanded threefold. Hence most of the current urban green resource was established during the communist era, and is still characterized by the communist ideology and Soviet planning methods, in which green areas had three major functions; providing space for sports and recreation, sanitation (cleaning the air from industrial emission) and as memorial to Soviet history. The Soviet elements of the urban green resource, with a similar design, can today be found in any post-soviet city, from Tashkent to Minsk.

One of the classical Soviet urban green elements is the Park Kultury i Otdykha (park of Culture and Recreation), which illustrates the finest example of communist public parks. In the Soviet urban society, should devote spare time to sports and cultural activity in order to keep their body and mind fit. Hence these parks were designed and equipped with sports facilities as well as conveniences for specific cultural activities such as pavilions for reading, playing chess, theatre stage for performances and cafés.

Another typical kind of Soviet park is the lesopark (forest park). The term appeared in 1924 and was suggested to be "forest located not far away from the city" in order to be reservoirs of clean air in the industrial city and to be a place for recreation. According to their location, forest parks are classified as urban, suburban or semi-urban. Leningrad was the pioneer in planning of forest parks. The project of "Nevski" forest park was the first in the country (1936), but most forest parks were however not established until the 1960-1980's. The largest urban forest park in St Petersburg is Park Sosnovka (The Pine Park), in the northern part of the city. Its 302 ha of mixed forest was once located on the urban fringe, but is now totally surrounded by large roads and city districts of multi-family houses. Although a forest park is usually less well equipped with functions and facilities than a park of culture and recreation, they can have the same number of visitors as regular urban parks.

Development of the new modern Soviet urban society from the 1950's onwards was based on the concept of the mikro-rajon, literally meaning micro-district. The basic idea was to create smaller units of dwelling areas outside the city centre, entities where people had close to services, transports and recreation. Inspired by the Western architects and city planners, large blocks of houses, built in prefabricated elements, of five, nine and 15 storeys were put out on the Len-

Figure 9.4. Subbotnik, a public cleaning day in Tavrichesky Garden, organized during a Danish project (Photo. Cecil Konijnendijk).

ingrad wetlands. Each micro-district could house 6,000-15,000 people. Not all micro-districts were built according to the plan, leaving open space and vacant lots between the houses, designated as pustyr (literally vacant lot or non-built up space). In some cases the vacant lots have been invaded by nature and turned into wild areas and the local residents use the space for recreation. Together with the large backyards between the houses the vacant lots comprise a significant share of the urban green resource.

One of the main questions of the parks' future is for whom and what are the parks for? What function will the park fill in the future, and is then proposed restoration or development suitable for this purpose? To only return to the historical plan or to turn former public facilities into money generating activities, with a direct impact on the existing green areas, seems unlikely to be sustainable solutions.

Using the urban green space as social space is very common in St Petersburg today. This might be explained by several factors. There simply was a lack of private social space in the Soviet society and people met in parks and gardens. Another factor could be considered as the Russian heritage with the Russians having a close relationship to nature and especially to the forest, picking mushrooms, berries etc. The educational potential in parks is large as they often are located close to schools and kindergartens. In Moskowsky Park Pobedy and Park Sosnovka attempts were made to encourage teachers to use the park as a classroom for ecological and biological education.

Even though St Petersburg is developing, the apartments are still rather small and the tradition of using the parks, gardens and forests as an arena for social

and cultural activities, sports and recreation is still alive. Pensioners continue to gather in the Pensioners' Pavilion in Park Sosnovka playing cards a cold November day. Men meet by the Chess pavilion in Moskowsky park Pobedy, playing chess a sunny day in February. Children are skiing on the artificial mounds in Tavrichesky Garden, and teenagers can be seen hanging out, in parks all year round. Public cleaning days, subbotnik (deriving from the Russian's Saturday, expression for voluntarily working day), are still organized in parks and gardens and in the yards, gathering people.

The key to sustainable green development might not lie within keeping the number of square meters green space per inhabitant, but in an enhancement of the quality of the green areas and a proper distribution of green space throughout the city. A recent study in one of the micro-districts in south St Petersburg show that although the neighbourhood is very green, people would like to have more green areas. Improved planning, pustyry acknowledged as potential green space and not only as future land for exploitation, and suitable design and management could raise the quality level enormously.

9.5 Green buildings – the new wave

Plantation on buildings is not a new thing. On the contrary buildings from hundreds of years back often had plantations on the roofs and even some plant species, *Sempervivum tectorum houseleek*, adapted to roofs have names referring to this function. Greenery on walls and facades, e.g. with *Virginia creeper*, similarly is a classical way of making a building more beautiful and plants used are equipped with structures which cling to the walls. The new wave of green buildings are different in the sense that the greeneries are added to achieve a series of advantages from climatic services to food production – and in the middle of the city!

Green roofs are constructed for multiple reasons – as spaces for people to use, as architectural features, to add value to property or to achieve particular environmental benefits, for example, storm water capture and retention, improved species diversity, insulation of a building against heat gain or loss.

Vegetation on green roofs is planted in a growing substrate (a specially designed soil substitution medium) that may range in depth from 50 mm to more than a metre, depending on the weight capacity of the building's roof and the aims of the design.

Green roofs have traditionally been categorised as 'extensive' or 'intensive'. Extensive green roofs are lightweight with a shallow layer of growing substrate

Figure 9.5 Green facades in Sydney Australia (Source: https://upload.wikimedia.org/wikipedia/commons/a/aa/%281%29Central_building_Broadway_Sydney-1.jpg)

of less than 200 mm deep, requiring minimal maintenance. They generally have lower water requirements and use small, low-growing plant species, particularly succulents. 'Ecoroofs' or 'brown roofs' are terms used to describe these extensive green roofs. Roofs that are designed and planted specifically to increase local plant diversity and provide habitat (food and shelter) for wildlife are known as 'biodiverse green roofs'.

Intensive green roofs are generally heavier, with a deeper layer of growing substrate, and support a wider variety of plant types. Because they can support a heavier weight, they are readily accessed by people. Intensive green roofs need more irrigation and maintenance than extensive roofs, and are highly engineered landscapes, often built directly on structures with considerable weight load capacity, such as car parks. 'Roof garden' is used particularly for sites where less space is dedicated to the vegetation and growing substrate and more to hard infrastructure such as decking.

A *green wall* is comprised of plants grown in supported vertical systems that are generally attached to an internal or external wall, although in some cases can be freestanding. Like many green roofs, green walls incorporate vegetation, growing medium, irrigation and drainage into a single system. Green walls differ from green facades in that they incorporate multiple 'containerised' plantings to create the vegetation cover rather than being reliant on fewer numbers of plants that climb and spread to provide cover. They are also known as 'living walls', 'bio-walls' or 'vertical gardens'.

Green walls provide an attractive design feature, but also add to building insulation by direct shading of the wall surface. They create cooler microclimates and improve local air quality, and provide the possibility of growing plants in locations that would not normally support vegetation. A wide range of plants is used on green walls, usually herbaceous, though some small shrubs can also be suitable.

The provision of adequate light is an important consideration, particularly when planning an interior green wall, where artificial lighting may be necessary.

A well-designed green wall system will fulfil both design and functional aims by providing growing conditions suitable for the selected species, have a long lifespan, require minimal component replacement, and have achievable demands for maintenance.

A *green facade* is created by growing climbing plants up and across the facade of a building, either from plants grown in garden beds at its base, or by container planting installed at different levels across the building.

Climbing plants can attach directly to the surface of a building, or they can be supported on a structure independent of the building. The use of climbers that anchor themselves to a structure by twining stems or twining tendrils enables a green facade to be installed in front of solid walls or some other structure, to create a partition, privacy screen or sunshade. The degree of density of the façade coverage can be managed to suit the required function. For example, a facade designed to shade a building wall would ideally have greater foliage density than a screen installed near a window that is designed to allow at least partial views to the environment beyond the facade.

Green facades are often installed because they provide an attractive look to a building wall, or they may be used to block out a view, or to provide shade for a building. Green facades can create a cooler microclimate immediately adjacent to a building, primarily through direct shading of the building facade, but also from cooling from plant foliage (transpiration of water through the leaves), and evaporative loss of water from the growing medium.

All climbing plants will provide some retention of stormwater, shading of the building, protection of its surface, and capture of airborne particulate matter and volatile gaseous pollutants. These benefits will be greater for evergreen species that retain foliage cover year-round.

The distinction between green walls and green facades is not always clear. As the design and use of plants on vertical surfaces expands, systems become harder to define. For instance, a ‘hybrid living wall’ system has been created in Adelaide that uses both green wall and green facade technologies. This blurring

of definitions is akin to the already acknowledged difficulties in classifying green roof types, where new designs merge what were previously considered different categories.

9.6 Green roofs as urban ecosystems: ecological structures, functions, and services

There is a range of benefits that can potentially be provided by green roofs, walls and facades. Some provide benefits to the public at large and some only benefit the building owner or occupants. It is important to recognise that the following benefits are only realised if the roof, wall or facade is planned and constructed well and has the supporting management required to sustain it.

Green roofs (roofs with a vegetated surface and substrate) provide ecosystem services in urban areas, including improved storm-water management, better regulation of building temperatures, reduced urban heat-island effects, and increased urban wildlife habitat. Green roofs can lengthen the lifespan of a traditional roof surface. They protect a roof's waterproof membrane from solar radiation and add insulating materials (vegetation, substrate and other layers) to reduce severe temperature fluctuations on the roof surface.

Stormwater management. Green roofs absorb and retain rainwater and can be used to manage stormwater run-off in urban environments. They can also filter particulates and pollutants. Stormwater run-off can be reduced or slowed because it is stored in the substrate, used by or stored in the foliage, stems and roots of

Figure 9.6 Green buildings in Tongyang South Korean (Source: https://upload.wikimedia.org/wikipedia/commons/5/58/Tongyang_-_downtown_-_apartment_complex_-_CIMG9860.JPG

plants, and also evaporates directly from the substrate. Additional water storage capacity in green roof systems can be provided through incorporation of a water retentive layer or drainage layer at the base of the green roof.

Several factors influence the extent to which a green roof can reduce the volume of water runoff into the stormwater system, including depth and properties of the growing substrate, type of drainage layer used and roof slope. Plants and drainage systems are important considerations in the design of a green roof for stormwater management.

Improved thermal performance. A significant benefit of green roofs, walls and facades is the potential for reducing building heating and cooling requirements. Green walls and facades can reduce heat gain in summer by directly shading the building surface. Green roofs reduce heat transfer through the roof and ambient temperatures on the roof surface, improving the performance of heating, ventilation and air conditioning. While there is great potential to cool buildings, research data and the results of modelling studies vary greatly in relation to the extent of the difference in temperature and the energy savings that are predicted for buildings with green roofs versus conventional roofs.

Cooling a city – urban heat island effect. Hard surfaces in urban environments, such as concrete, brick, glass, asphalt and roofing, have a high thermal mass, collecting the sun's heat during the day and re-radiating it slowly back into the atmosphere. This contributes to a rise in ambient temperature in cities, creating large, stable masses of hot air (urban heat islands), especially during periods of calm, still weather.

Temperatures can be reduced by covering a roof or wall with a layer of vegetation that shades building materials which would otherwise absorb heat. Evapotranspiration provides cooling effects, as water is evaporated from the soil and plants and plants transpire by taking water in through roots and releasing it through leaves. Energy from the sun that would otherwise heat the roof or wall surface and increase ambient air temperatures is instead used in the evapotranspiration process, resulting in latent heat loss that lowers surrounding air temperatures. When green wall and facade plants are grown on a support system that leaves a gap between the wall and the planting, hot air moves up by convection through the space between the wall and the vegetation, providing passive cooling.

A city-wide strategy to implement green roofs, walls and facades could help mitigate some of the negative consequences of urban heat islands, and consideration should be given to appropriate plant selection and substrate depth to maximise cooling potential.

Creation & preservation of habitat & ecological biodiversity. Green roofs can contribute to and enhance biodiversity by providing new urban habitats and specific habitats for rare or important species of plants or animals. Green roofs can also provide a link or corridor across urban 'ecological deserts' and assist in migration of invertebrates and birds. Designing for biodiversity requires consideration early in concept development with regard to plant species, food sources, habitat values, access points and building heights.

Aesthetics, open space and urban food production. The liveability of cities is increasingly dependent on the availability of and access to green open space. Green roofs, walls and facades can increase amenity and provide opportunities for food production, recreation, relaxation or commercial ventures. In dense, rapidly growing urban areas, the contribution of green roofs, walls and facades to overall green space should not be underestimated. In inner-city areas especially, most space is occupied by buildings and related infrastructure and the opportunities for new parks and gardens is extremely limited. Green roofs, walls and facades can be used for multi-level greenery designs that connect with ground level green spaces.

Cleaning the air. Green roofs, walls and facades can contribute to the removal of gaseous pollutants from the air, although their effectiveness varies with plant species and area of cover. Plants with a high foliage density or with textured leaf surfaces that trap small particles also assist in removing particulate pollution, through dry deposition on the foliage or through rain wash. On a larger scale, green roofs, walls and facades can help to reduce overall environmental heat gain (re-radiation of heat from building materials with high thermal mass), in turn improving air quality as less photochemical pollutants are produced at lower air temperatures.

In interior environments, plants have been shown to have a significant capacity to reduce volatile organic compounds from the air. Carpets and other soft furnishings and office equipment are common sources of these gaseous pollutants; inclusion of vegetation, such as a green wall, can help to improve the air quality of the indoor environment.

9.7 Urban agriculture, urban farming

Urban agriculture or urban farming is the practice of cultivating, processing, and distributing food in or around a village, town, or city. Urban agriculture can reflect varying levels of economic and social development. In the global north, it often takes the form of a social movement for sustainable communities, where

organic growers, 'foodies,' and 'locavores' form social networks founded on a shared ethos of nature and community holism. These networks can evolve when receiving formal institutional support, becoming integrated into local town planning as a 'transition town' movement for sustainable urban development. In the developing south, food security, nutrition, and income generation are key motivations for the practice. In either case, more direct access to fresh vegetables, fruits, and meat products through urban agriculture can improve food security and food safety.

The cultivation may either be made in traditional lots around the houses or on the houses. Such lots have a long tradition in the East and start to be very popular also in the west. People grow their own vegetables fruits and berries not only for economic reasons but as well to have more tasty food and often more healthy that the alternatives offered in the supermarket.

Greenhouses attached to the residential buildings is an interesting possibility. Such greenhouses often also have an important social function as people, not the least the elderly, here find a place for meeting, having a cup of tea and talking while they are mending the plantations often vegetables.

Green buildings offer a number of options for growing vegetables, fruit, berries and flowers on roofs, walls and facades. A system for hanging plants on walls (and also e.g. in greenhouses) can be made without using soil at all. Just a pot of water with the needed nutrients. Such pots can be easily mounted on walls. Some system for the plants to support themselves may also be needed, although for example some of them may simply just hang.

For animals it is often more complicated in a city. Beehives are used to produce honey and in some cases hen are kept to provide eggs. Larger animals than that are normally not allowed in a city area. Pollinating insects are needed for fruit trees and berry bushes. Bees are excellent but bumble bees is an alternative. Places for bumblebees to live can be constructed from e.g. bamboos or any other small hollow tubes of the right size. Flowers are part of the system and are not only beautiful but also an essential component in the ecosystem which allows for fruit and berry production.

Different ways of urban farming are shown in figures 9.7- 9.9.

9.8 The strategic boundary zone between town and country

One of the new features of resilient citylands is the built/ green-blue interface zone between more urban and more rural functions. Nordic cities had traditionally, and still have, a very long green/blue interface line between settlements

Figure 9.7 Urban greenhouse established in the Mistra urban cultivation project. Source: http://www.mistraurbanfutures.org/sv/node/1274

Figure 9.8 On their way from hay in Kstovo close to Nizhny Novgorod Russia. Photo Vladimir Menkov https://en.wikipedia.org/wiki/Urban_agriculture#/media/File:Kstovo-hay-1536.jpg "

Figure 9.9 Growing Tomatoes, Leeks, Strawberries, Cucumbers and more on a wall for the Los Angeles Food Bank, USA. (Source: http://www.greenroofs.com/content/green_walls005.htm

Figure 9.10. Cultivation in the new fringe zone. In many suburban areas there is a direct contact with forests, fields and water and yet there is very little attempts to make use of the production values and other values related to urban farming. In this example large green areas have been transformed into productive land. Source: Per G Berg and Lars Rydén Chapter 11 Urbanisation and Urban-Rural Cooperation in Ecosystem Health & Sustainable Agriculture

and human cultures on the one hand and glades, meadows, forests, parks, arable fields, lakes, seas and rivers on the other. Throughout the history of civilization, edges between town and nature have proved to be the most preferred locations for habitation. For citylands the edge line is expanded to a wider zone: in this zone will be the important district green areas for neighbourhood recreation (district parks, play grounds, sports grounds, orchards, stables for sheep, cows, horses and pigs); in this zone there could be room for urban agriculture with green houses and community gardens, where fruit and vegetables can be grown for urban and sub-urban dwellers; in this zone there is room for clean companies and clean micro-production; in this zone there is land for industrial combines, refining the primary produce into food, fuel, fibre, boards and other building material; in this zone there is room for new recycling of waste industry; and in this zone there is room for the new generations or renewable energy (wind and wave power, Photovoltaics and solar heat collectors and bioenergy cultivations) and energy carriers (storage of bioenergy and electricity).

The future town-country relationship will therefore rely strongly on the organization and design of both inner boundary zones of the cities (settlements turning towards parks and community forests, fields and waters), but also between settlements and the outer nature, and between built areas and outer cultural

landscapes. Preliminary theoretical research and map studies of the morphological dynamics of city growth indicate that a long and winding interface zone between urban and rural functions are strategic for creating resilient citylands accessible for many citizens to experience urban and rural recreation, urban and rural culture and urban and rural production.

Furthermore, supplementary small-scale, peri-urban production systems for food and bioenergy and urban agriculture may play a more important role than previously.

It is reasonable to assume that world trade will continue to play a role in life support of world cities, but a relocation to relatively more local eco-cycles – where a larger proportion of basic bio-production and consumption may occur – seems to be a logical consequence of global change, the need for food security and local labour markets supplementing the global. An advancement of current knowledge about urban-rural: soil-plant systems; resilient crop production systems; forest ecosystems; microbial systems; ecotechnology systems; and resilient food systems in different scales will play key roles in the long-term survival and development of the renewed cities, countrysides and citylands in the future.

9.9 Biodiversity

Greenery in cities is not only important to humans. It contributes considerable to biodiversity. Thus birdwatchers have reported that Berlin – that has a very high percentage of green areas – has the largest number of bird species in Germany (Oberdorfer, 2007). It is also notable that many species which were earlier only found in the countryside today is increasingly moving to the cities for finding food, which is less accessible in industrialized agriculture, that "too" efficiently takes care of the harvest. For children and adolescents, the parks, green playgrounds and plazas in cities are more easily available than far away countryside. It is a highly valued resource for getting children acquainted with nature, for learning about nature protection and for play and moving the body.

The links between green areas in the city play here of crucial role. First of all undisturbed green connection including water is significant for transfer of plant material, which supports wildlife. It can be maintained in form of green corridors, which can consist of all forms, mentioned in classification of green structures. Green roofs might appear efficient for nesting, open water bodies for fish, home gardens and allotments for animals and plants. Secondly the undisturbed green connection equipped with pedestrian, bicycle routes is valuable for health of city dwellers, because of their restorative qualities. Besides that it can help to create

a preferred, more psychologically acceptable urban environment at a whole city scale.

Traffic infrastructure is here a difficulty. In some cities and countries links between green areas have been created as tunnels or bridges for wild life over or under streets and busy roads. They are important for frogs, hedgehogs, does and badgers, all animals which tend to be killed on roads. But they are also important to the traffic which is made safer if conflicts with wildlife are avoided.

Importance of greenery along streets, in squares and all other urban interiors should be obvious not only because of aesthetical reasons. Creation of well-connected urban green structure adds valuable new qualities to an urban environment. Maki addresses linkage as the most important characteristic of the urban exterior space, stating that: "Linkage is simply the glue of the city. It is the act by which we unite all the layers of activity and resulting physical form in the city… urban design is concerned with the question of making comprehensible links between discrete things. As a corollary, it is concerned with making an extremely large entity comprehensible by articulating its parts."

Chapter 9 sources:

Section 9.1 Lars Rydén *Urban Sustainability Strategies – the urban green structures* in "Green Structures in the Sustainable City" Baltic University Urban Forum publication Urban Management Guidebook V, p.7 http://www.balticuniv.uu.se/buuf/

Section 9.2 Dorota Wlodarczyk *Introduction* in "Green Structures in the Sustainable City" Baltic University Urban Forum publication Urban Management Guidebook V, pp 9-11. http://www.balticuniv.uu.se/buuf/

Section 9.3 Lars Rydén

Section 9.4 Ulrika Åkerlund and Jasper Schipperijn, Urban Green Space in Transition Historical parks and Soviet pustyr in St Petersburg, Russia in in "Green Structures in the Sustainable City" Baltic University Urban Forum publication Urban Management Guidebook V, pp 57-65. http://www.balticuniv.uu.se/buuf/

Section 9.5 – 9.6 Sidonie Carpenter et al. *A guide to GREEN roofs, walls and facades in Melbourne and Victoria, Australia* pp 3-10 http://www.growinggreenguide.org/wp-content/uploads/2014/02/growing_green_guide_ebook_130214.pdf

Section 9.7 Lars Rydén

Section 9.8-9.9 Per G Berg and Lars Rydén Chapter 11 *Urbanisation and Urban-Rural Cooperation* in Ecosystem Health & Sustainable Agriculture, Book 3 Rural Development and Land Use Rural Development and Land Use (Editors: L. Rydén and I. Karlsson, eds).
http://www.balticuniv.uu.se/index.php/boll-online-library/825-ehsa-3-rural-development-and-land-use