TOWARDS PRODUCTIVE AND SOCIO-NATURAL URBAN LANDSCAPES: TAPPING URBAN AGRICULTURE'S POTENTIAL AS A TOOL FOR SUSTAINABLE DEVELOPMENT

B. STEURI & G. VIGNOLA

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EDITORIAL

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE MASTER OF SCIENCE (M. Sc.)DEGREE IN

RESOURCE EFFICIENCY IN ARCHITECTURE AND PLANNING

HAFENCITY UNIVERSITY HAMBURG, GERMANY

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DECEMBER 2015 / REV.02/16

ACKNOWLEDGEMENTS

WE WOULD LIKE TO THANK OUR SUPERVISORS, **UDO DIETRICH** & **ANKE JURLEIT** FOR THEIR SUPPORT AND THE CONSTRUCTIVE DISCUSSIONS WE HAD DURING THE TIME OF THE THESIS, AS WELL, AS DURING THE TIME OF OUR STUDIES IN HAMBURG.

A THANK YOU TO ALL THE **FRIENDS** OF THE **FIFTH REAP GENERATION** AT THE HAFENCITY UNIVERSITY. THE TIME SPENT WITH YOU INSIDE AND OUTSIDE THE SCHOOL HAS BEEN INCREDIBLY ENRICHING. WE WILL KEEP THE MEMORIES OF THE MOMENTS SHARED WITH YOU IN A SPECIAL PLACE IN OUR HEARTS.

SPECIAL THANKS GO TO OUR **FAMILIES** AND OUR **CLOSEST FRIENDS** - FOR SUPPORTING US DURING THESE LAST TWO INTENSE YEARS. THANK YOU FOR VISITING US, FOR CALLING US, FOR SENDING US A MESSAGE OR A BUNCH OF CHOCOLATES, OR FOR TAKING YOUR TIME FOR MEETING US WITH SHORT NOTICE OR JUST BEFORE JUMPING INTO THE TRAIN. AND THIS AGAIN, AND AGAIN, AND AGAIN. THANK YOU FOR GIVING US A HOME WHEN NEEDED, FOR SHARING YOUR FOOD, FOR OFFERING YOUR BEDS, YOUR CAMPING MATTRESSES, YOUR COUCH, AND YOUR FLOOR. THANK YOU FOR YOUR FRIENDSHIP AND LOVE.

This work is published on: www.beng-ar.ch


urban agriculture
community gardens
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gardens
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green space
compact city
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EXECUTIVE SUMMARY

Worldwide, the percentage of people living in urban areas will increase from 50% in 2010 to nearly 70% by 2050 (UN, 2014). While in many parts of the world, human development is expanding rapidly on the urban fringe and at the expense of rural hinterlands, some cities decided to focus on densifying the built environment (Lin et al., 2015; BSU, 2014).

Since densification leads to a quantitative reduction of open spaces, the pressure on the remaining ones is significantly increasing. On the one hand, open spaces should meet the requirements of its users, on the other hand, they have to fulfil expectations regarding climate adaptation and operating efficiency. Thus, to satisfy these claims, urban open spaces have to be endowed with multi-functionality.

Urban agriculture, in turn, offers indispensable opportunities to solve - or at least deal with - urban challenges regarding sustainability, health, economy, society, urban design and local food supply. Due to its cross-cutting and multi-dimensional nature, it has the potential to meet a good many of requirements on open spaces. Nonetheless, it still inherits a rather low visibility on the agenda of urban planners (Pothukuchi et al., 1999).

This situation could stem from various reasons, whereby a gap in the understanding of urban agriculture's capability seems to be a major cause. To this day, there exists no comprehensive literature on the subject - neither a holistic view on urban agriculture's multifaceted benefits nor its impacts on urban open spaces. Thus, the purpose of this study is to tap urban agriculture's potential and to emphasise its *raison d'être* in sustainable urban planning.

Section ONE focuses on urban open spaces and their role in times of urban growth and spatial consolidation. Particular attention is paid to the increasing utilisation pressure, and, furthermore, an attempt at a solution is briefly sketched.

Section TWO provides an insight into urban agriculture, its spheres of action and the role of its stakeholders. Special importance is given on the examination and illustration of its benefits. With the aid of four layers - society, health, ecology and economy - urban agriculture's impacts are regarded from different perspectives and, a comprehensive overview is compiled. It becomes clear that urban agriculture's benefits are wide-ranging and go far beyond the well-being of individuals or a group of like-minded people.

Section THREE is merging the findings of section 1 and section 2. Thanks to urban agriculture's versatility, it has the potential to play a key role in removing some of the pressure on urban open spaces: firstly, it can be combined with wide-ranging types of urban open spaces; secondly, it entails an array of benefits that correspond to the requirements of urban open spaces. Thus, urban agriculture mobilises often overlooked as well as rather mono-functionally used spaces of the urban territory, and, simultaneously equips them with a multi-functionality. Juxtaposing urban agriculture, urban open spaces and the urban environment makes clear that an array of reciprocal relationships can be created -

the city fulfils some of urban agriculture's needs, which in turn, fulfils the demands of the urban environment as well as the requirements of urban open spaces.

Section FOUR summarises the challenges that urban agriculture is currently facing. These barriers - in which many stakeholders play an important role - disallow urban agriculture to obtain the necessary acceptance to become an acknowledged strategy for advancing sustainable development. The challenges can be divided into the following categories: 1) scepticism, sociocultural biases and institutional constraints; 2) constrained access to resources, inputs and financial means; 3) special risks of cultivating in the city, and 4) organisational constraints. To understand, which barriers are most likely be a threat for the implementation of urban agriculture, a risk analysis has been carried out and strategies, as well as recommendations, have been discussed. Even if the list of strategies is by no means complete, it is a first basis for discussion to address the barriers.

Section FIVE highlights this study's uniqueness - while most researches on the subject focus on the missing link between urban planning and food, this study looks at the opportunities given by urban open spaces and provides a comprehensive understanding of urban agriculture and its benefits. By merging these two principal themes, the reciprocal relationships become apparent and, therefore, substantiate the potential win-win situation. Altogether, urban agriculture`s cross-cutting and multi-dimensional nature creates indispensable opportunities to deal with urban challenges regarding sustainability, health, economy, society, urban design and local food supply. Thus, it manifests its *raison d'être* in sustainable urban planning on a broad foundation of convincing reasons.

Even if it will take some time to create productive and socio-natural urban landscapes, tapping urban agriculture's potential and using it as a tool for sustainable development today, will surely bring its fruits in the long-term while making urban open spaces a better place for us, for the generations to come, and for the environment.

INTRODUCTION

WORLDWIDE, THE PERCENTAGE OF PEOPLE LIVING IN URBAN AREAS WILL INCREASE FROM 50% IN 2010 TO NEARLY 70% BY 2050 (UN, 2014). WHILE IN MANY PARTS OF THE WORLD, HUMAN DEVELOPMENT IS EXPANDING RAPIDLY ON THE URBAN FRINGE AND AT THE EXPENSE OF RURAL HINTERLANDS, SOME CITIES DECIDED TO FOCUS ON DENSIFYING THE BUILT ENVIRONMENT (LIN ET AL., 2015; BSU, 2014).

SINCE DENSIFICATION LEADS TO A QUANTITATIVE REDUCTION OF OPEN SPACES, THE PRESSURE ON THE REMAINING ONES IS SIGNIFICANTLY INCREASING. ONE THE ONE HAND, OPEN SPACES SHOULD MEET THE REQUIREMENTS OF ITS USERS, ON THE OTHER HAND, THEY HAVE TO FULFIL EXPECTATIONS REGARDING CLIMATE ADAPTATION AND OPERATING EFFICIENCY. THUS, TO SATISFY THESE CLAIMS, URBAN OPEN SPACES HAVE TO BE ENDOWED WITH MULTI-FUNCTIONALITY.

URBAN AGRICULTURE, IN TURN, OFFERS INDISPENSABLE

OPPORTUNITIES TO SOLVE, OR AT LEAST DEAL WITH, URBAN CHALLENGES REGARDING SUSTAINABILITY, HEALTH, ECONOMY, SOCIETY, URBAN DESIGN AND LOCAL FOOD SUPPLY. DUE TO ITS CROSS-CUTTING AND MULTI-DIMENSIONAL NATURE, IT HAS THE POTENTIAL TO MEET A GOOD MANY OF REQUIREMENTS ON OPEN SPACES. NONETHELESS, IT STILL INHERITS A RATHER LOW VISIBILITY ON THE AGENDA OF URBAN PLANNERS (POTHUKUCHI ET AL., 1999).

THIS SITUATION COULD STEM FROM VARIOUS REASONS, WHEREBY A GAP IN THE UNDERSTANDING OF URBAN AGRICULTURE'S CAPABILITY SEEMS TO BE A MAJOR CAUSE. TO THIS DAY, THERE EXISTS NO COMPREHENSIVE LITERATURE ON THE SUBJECT - NEITHER A HOLISTIC VIEW ON URBAN AGRICULTURE'S MULTIFACETED BENEFITS NOR ITS IMPACTS ON URBAN OPEN SPACES.

THUS, THE PURPOSE OF THIS STUDY IS TO TAP URBAN AGRICULTURE'S POTENTIAL AND TO EMPHASISE ITS *RAISON D'ÊTRE* IN SUSTAINABLE URBAN PLANNING. ON ACCOUNT OF THIS, WE HAVE DELINEATED THE

FOLLOWING RESEARCH QUESTIONS, WHEREBY THE LATTER IS THE PRIMARY ONE:

1 :: WHAT ARE URBAN OPEN SPACES AND WHAT REQUIREMENTS DO THEY HAVE TO MEET IN DENSIFYING CITIES?

2 :: WHAT IS URBAN AGRICULTURE AND WHAT ARE ITS BENEFITS?

3 :: WHAT ARE THE RECIPROCAL RELATIONSHIPS BETWEEN URBAN AGRICULTURE, URBAN OPEN SPACES AND THE URBAN ENVIRONMENT?

4 :: WHAT BARRIERS HAVE TO BE ADDRESSED IN ORDER IMPLEMENT IT IN SUSTAINABLE PLANNING?

5 :: WHY SHOULD URBAN AGRICULTURE BE USED AS A TOOL FOR SUSTAINABLE DEVELOPMENT?

THE RESEARCH WAS CARRIED OUT ON THE BASIS OF A LITERATURE REVIEW, EXPERT INTERVIEWS AND PERSONAL EXPERIENCE. THE LITERATURE WAS IDENTIFIED BY STRUCTURED SEARCHES IN SCIENTIFIC DATABASES, LIBRARIES AND ADDITIONAL CROSS-REFERENCING. FURTHER SEARCHES WERE CONDUCTED ON THE AUTHORS' OWN KNOWLEDGE OF POTENTIALLY RELEVANT WORK. THE CITED LITERATURE - SPECIALISED BOOKS AND PEER-REVIEWS JOURNALS - PRIMARILY INCLUDES PUBLICATIONS IN ENGLISH, FEW ARE IN GERMAN. FURTHERMORE, ARTICLES WITH HIGHLY VALUABLE

SUPPLEMENTARY INFORMATION WERE CONSIDERED TOO.

THE STUDY WAS LIMITED BY A LACK OF RELIABLE AS WELL AS COMPARABLE DATA ON THE TOPIC OF URBAN AGRICULTURE. FURTHERMORE, THE SCOPE OF THIS THESIS FOCUSES ON THE GLOBAL NORTH, REFERENCES TO THE GLOBAL SOUTH ARE OCCASIONALLY MADE. SINCE URBAN AGRICULTURE IS A FAR-REACHING TOPIC, THE FIELD OF RESEARCH HAS BEEN DELIMITED.

AS SHOWN IN FIGURE 1, THE STUDY IS STRUCTURED INTO FIVE SECTIONS, WHEREBY THE FIRST AND THE SECOND ONE ARE AN ANALYSIS OF URBAN OPEN SPACES RESPECTIVELY URBAN AGRICULTURE. THE THIRD SECTION IS A MERGING OF THE TWO ANALYSES AND SHOWS RECIPROCAL RELATIONSHIPS BETWEEN URBAN AGRICULTURE, URBAN OPEN SPACES AND THE URBAN ENVIRONMENT. THE FOURTH SECTION DEPICTS EXISTING BARRIERS AND FURTHERMORE, PROPOSES POSSIBLE STRATEGIES TO ADDRESS THEM. LASTLY, URBAN AGRICULTURE'S *RAISON D'ÊTRE* IN SUSTAINABLE PLANNING IS JUSTIFIED.

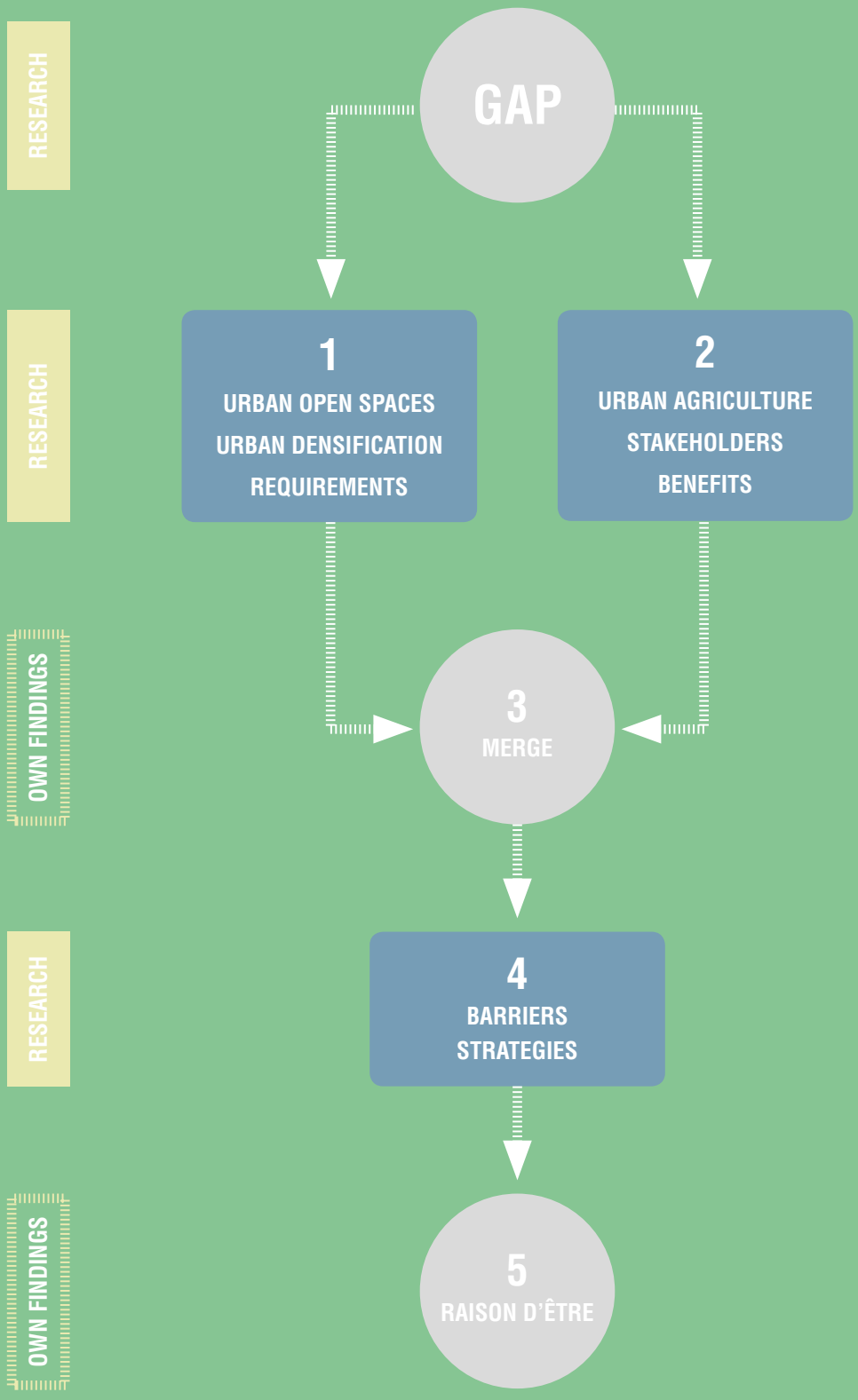


Figure 1. Towards productive and socio-natural urban landscapes: Tapping urban agriculture's potential as a tool for sustainable development. Own graphic.

Figure 2. View of the "Lohsepark" in the middle of the Hafencity, Hamburg's newest district.

SECTION ONE

URBAN OPEN SPACES

URBAN OPEN SPACES

ACROSS THE GLOBE, CITIES ARE FACED WITH A GROWING POPULATION AND ARE THEREFORE EXPANDING TOWARDS THE RURAL HINTERLANDS AND / OR DENSIFYING THE EXISTING BUILT AREA. THEY ARE CHALLENGED TO OFFER THEIR RESIDENTS A GOOD QUALITY OF LIFE, WHILE HAVING TO COPE WITH SUSTAINABLE PRACTICES FOR ASSURING A FUTURE TO THE GENERATIONS TO COME.

AS POINTED OUT BY THE EUROPEAN PARLIAMENT, URBAN OPEN SPACES ARE A FUNDAMENTAL PART OF THE BUILT ENVIRONMENT AND PLAY AN IMPORTANT ROLE IN THE GENERAL WELL-BEING OF CITIES AND THEIR INHABITANTS. ESPECIALLY WHEN A CITY DENSIFIES ITS BUILT STRUCTURE, PARTICULAR ATTENTION SHOULD BE PAID TO SUCH OPEN SPACES, BECAUSE THEY HAVE TO MEET AN ARRAY OF DEMANDS THAT ARE CLAIMED BY THE CITY DWELLERS, THE CHANGING CLIMATE AND CONCISE MUNICIPAL BUDGETS.

TO MEET THESE REQUIREMENTS, IT COULD BE NECESSARY TO WIDEN THE CURRENT UNDERSTANDING THAT PLANNERS AND OTHER AUTHORITIES HAVE OF URBAN OPEN SPACES IN ORDER TO DETECT UNDERUTILISED OPEN SPACES.

FURTHERMORE, ALLOWING AND REGULATING VARIOUS USAGES OF NEW AND EXISTING SPACES - EVEN TEMPORARILY - CAN REDUCE COMPETING LAND AS WELL AS CREATE NEW SYNERGIES.

ALTOGETHER, THIS CHAPTER FOCUSES ON URBAN OPEN SPACES, THE CONSEQUENCES OF SPATIAL CONSOLIDATION AND THE CONSEQUENTIAL REQUIREMENTS ON URBAN OPEN SPACES.

URBAN GROWTH & URBAN DENSIFICATION

By coining the word 'Anthropocene', the Nobel Prize winners Paul Crutzen and Eugene Stoermer defined the time interval we live in, as a time, in which processes and conditions are altered by human activities (2000). Even though the term is not yet formally added to the Geological Time Scale, its description is a good attempt to explain a period that has started about 300 years ago. During these years, the mankind has exponentially exploited resources that were generated in several million of years, as well as to change - through the use of wasteful practices - geochemical cycles, the composition of the atmosphere and the oceans. Some of the effects of this actions are known as global warming, ocean acidification and the ozone hole. Dirk Sijmons, a professor of landscape architecture at TU Delft, explains that these changes are irreversible in the sense "that we can mitigate the effects, but these complex systems will never exactly return to their point of departure" (2015, p. 31).

Even though there is still al lot to do in the policy-making field, there is a general consensus on the measures that have to be undertaken to mitigate the effects created by the lavish growth seen in the last centuries: greenhouse gases have to be reduced, chemical releases as well as excessive consumption patterns have to be regulated, biosphere resources have to be established, and endangered species, populations and critical resources have to be protected (Burns, 2012).

Cities offer their inhabitants a wide range of services and thereby created the conditions for a rural-to-urban migration: in 1960, about 34% of the total global population lived in urban areas; in 2014, the global urban population already accounted for 54% and it is expected, according to the United Nations, that by 2050 it will amount to 66% (2014). Along with the population growth, also the demand for infrastructures and services increases. As a result of this, cities have to grow - either by expanding to urban peripheries or by densifying and redeveloping the existing built environment (World Bank, 2003).

Cities, urban and sub-urban centres have - and will have - an enormous responsibility in the near future: from the one hand they have to be able to cope with the problems caused by years of unsustainable development, and from the other hand they have not only to be able to manage the growth of population but simultaneously maintain or even enhance their inhabitants' quality of life in a densifying environment.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

To cope with the side effects created by the growth of cities and the exploitation of natural resources, sustainable development is needed. In most of the cases, urban sprawl, even if can be seen as a natural expansion of the city toward its borders, embodies characteristics such: low building density, car dependency, and segregation of land uses. These peculiarities have consequences that range from the loss of environmentally fragile land to higher energy consumption, and from ecosystem fragmentation to reduced diversity of species (Johnson, 2001). Therefore, urban sprawl is considered less sustainable than other urban forms, where dense neighbourhoods are served by a good system of public transport, where there is a good mix of services and goods, and where neighbours have the possibility to walk or cycle instead of being car-dependent (Haaland et al., 2015; Farr, 2008).

EFFECTS OF DENSIFICATION ON OPEN SPACES

Densification in the urban context can have positive effects for the functioning of the city itself - for instance by reducing the per capita resource use (Farr, 2008), but at the same time causes a high pressure on open spaces. Defining the effects that densification has on open spaces, the city of Hamburg, in the publication named *More city within the city - together for more open space quality in Hamburg* (BSU, 2013), summarises quantitative and qualitative effects as it follows:

Quantitative effects:

- reduction of open spaces through building construction and access to services
- creation of new open spaces through urban development done in new planned city zones

Qualitative effects:

- the city will be and will appear denser
- more people use the remaining open spaces increasing the pressure on the spaces
- new Milieux and new user requirements drive towards the modification or mutation of the use of open spaces
- housing-related open space requirements can not always be met or built in the area of housing sites; therefore they are shifted on public open spaces

Summarising these effects, the main challenges of urban open spaces are that from the one hand the quantitative offer is reduced, and from the other hand, new user requirements, and a higher use of the spaces, lead to the fact that the quality of use and the (multi-) functionality of the remaining spaces needs to be improved.

To understand open spaces' potential in the urban context, it is necessary to clarify what an urban open space is and to understand the different dimensions of requirements in the context of sustainable development.

URBAN OPEN SPACES // DEFINITIONS

> "Towns are not only buildings: open space forms a fundamental part of the urban environment and the historic heritage of a town. [...] Open space is an essential part of the urban heritage, a strong element in the architectural and aesthetic form of a town, plays an **important educational role, is ecologically significant, is important for social interaction and in fostering community development and is supportive of economic objectives and activities.** [...] It has an important educational role, facilitating through its use an understanding of and identification with the city; it is ecologically significant, not just in maintaining or bringing vegetation into urban areas but also in encouraging wild life and promoting understanding of nature; it is important for social interaction, the well-being of individuals, and plays a significant role in the development of a community and in the

creation of community pride, and so helps reduce the inherent tension and conflict in deprived parts of urban areas in Europe; it has an important role in providing the recreational and leisure needs of a community and has, finally, an economic value in that environmental enhancement, in which the improvement of open space plays a major part, assists the economic revival of cities, not just through creating jobs but in increasing the attractiveness of a town as a place for business investment and sought-after residential areas." (Council of Europe, 1986, p.3)

For having a general overview on open space related benefits, see *Public Space: The Management Dimension*(Carmona et al., 2008, p.7).

As the Council of Europe clearly pointed out in its recommendation on urban open spaces, they inherit manifold beneficial impacts on educational, ecological, social and economic aspects. Hence, their role for the sustainable development of town and cities is essential and should not be underestimated.

Due to their multidimensional nature, it is rather complex to define the term "urban open space". In landscape and urban planning, urban open spaces can take different connotations and nuances and are therefore referred as open spaces, green spaces, urban open spaces, public open spaces. In literature, "open space" is usually defined as:

Different definitions of urban open space as defined by the US Environmental Protection Agency, the International Federation of Landscape Architects, and the London Department for Transport, Local Government and the Regions.

- "Any open piece of land that is undeveloped (has no buildings or other built structures) and is accessible to the public." (EPA, n.d.)
- "All exterior urban spaces - with or without vegetation - which are elementary components of social infrastructure of a city or town which are usable for communication and recreation, and therefore an essential part for the public welfare. Public open space becomes more and more a place for closer contact with culture and nature." (IFLA, 2010, p. 799)
- "That part of the urban area which contributes to its amenity, either visually by contributing positively to the urban landscape, or by virtue of public access. It is therefore defined as combining urban green spaces and civic spaces." (DTLR, 2002, p.8)

As we understand from these definitions, the terminology used can refer to a multiplicity of components. The definition given by the US Environmental Protection Agency (EPA) refers to land that is undeveloped, mentioning the component of accessibility to the public. The International Federation of Landscape Architects (IFLA), as well as the report on public spaces in London (DTLR), make a distinction between green and not-green spaces and mention the sociological layer - "social infrastructure" and "civic spaces". Even though functions of the spaces are not clearly stated, by reading between the lines, it is possible to point out the functionality of urban open spaces; both for social activities - "communication and recreation" - or spatial - "by contributing positively to the urban landscape".

To simplify the planning process - be it for new developments or the maintenance - it emerges the fact that urban open spaces are often grouped either in a typological or hierarchical structure. In the publication "Urban open spaces" - one of the most complete works on this topic - Helen Woolley provides an overview of typologies and hierarchies (2003). The most used typologies are generally divided into: parks and gardens (regional, metropolitan, district, local, small local, linear), squares, plazas, playgrounds, playing fields, streets,

▼ FORM | SCALE ▶	CITY	INTERMEDIATE	RESIDENCE
TRANSPORT FACILITIES	harbours, airports, train station parking	transit stations, city gate areas	driveways, parking areas
STREETS	central boulevards	street space	pedestrian alley, paths
PLAZAS	large formal plazas	smaller neighbourhood plazas	interior courtyards
RECREATIONAL SPACE	stadiums, greenbelts, beaches	sports facilities, playgrounds	houseyard playspace
INCIDENTAL SPACE	natural features, semi-wild areas	empty lots, transit borders	marginalised space between buildings
PARKS GARDENS	major formal park, garden space	institutional gardens, small parks, cemeteries	household gardens
FOOD PRODUCTION	orchards, agricultural fields	grazing commons, community gardens	kitchen gardens, small horticulture

Source: Stanley et al., 2012, p. 1094. Own Graphic. Grey Space Grey / Green Space Green Space

Table 1. A transdisciplinary typology of urban open spaces spanning ancient and modern history.

incidental and natural, wastelands. By classifying these groups in a hierarchical structure, the typologies are ordered by their importance in the urban context - e.g. domestic, neighbourhood, civic (2003). Other categories can include ownership (private, private with public access, public), or physical form (vegetated land or hard-surfaced; see Al-Hagla, 2008).

Stanley et al., in a study about the role of open spaces in history, took a transdisciplinary approach to defining typologies while ordering them by form and function (Table 1). In this way, they embedded the importance of form, which is of primary importance for archaeologists and historians, with function, that due to the complexity of purposes of open spaces in modern times is valuable for urbanists (2012). What makes this matrix interesting, is the fact that the authors included typologies that normally are not considered by planners, but that in any case occupy physical space in the urban context and can, depending on the context, have a different importance. Incidental spaces for instance; even though they are widely researched and discussed because offer space for informal and "unplanned use" (especially in the intermediate and domestic scale; see Thompson, 2002; Jorgensen et al., 2012) are not normally taken into consideration in the planning agendas.

In addition to typologies, form and space, it is possible to describe activities that happen or could happen in a defined context. Jan Gehl for example, while focusing on the studio of human life in public spaces, divides the activities into two categories: 1) optional and, 2) necessary activities. Both categories are divided into further sub-categories: walk, stand, and sit (Gehl et al., 2013). By following this categorisation, it is possible to describe almost every activity that occurs in urban open spaces; be it sitting to enjoy the sun (optional activity), walking for going somewhere (necessary activity), or stand to eat something (between optional and necessary), just to cite a few.

J. Gehl is one of the most known urban space "transformers" of our time. During the last 50 years he (and his team) developed methods to study and assess urban public spaces, and helped on developing public space strategies in cities all over the world.

These definitions, classifications and categorisations - by form, function, typology or activities - can help planners, policymakers, and lawmakers to understand the framework in which they work. But actually, what is hidden behind these three words, is a much

broader spectrum of places, uses, and times that shape the context in which we live, as well as our being, both as individuals and as part of the society. In the next two pages forms and activities concerning urban open spaces are summarised in a graphical form (see Figures 3 & 4). Due to the complexity of the topic, the illustrations are only an attempt to show partially how variegated and multifaceted the definition can be.

At every point of our lives, we find moments in which we use open spaces: actually, whenever we are not between the four walls of our house or at our working place we can make use of open spaces. We use streets, gardens and parks to play, discover, and enjoy the near environment; we use them often, as places for seeing (or being seen by) other people, developing and finding our role in the society; we enjoy open spaces as a place for relaxation, leisure, and possibly for maintaining a good physical form, or we can enjoy these spaces for contemplation, for observation or simply as places where we can find someone to chat with.

Even thought open spaces are primarily considered important for their users, and for the well-being of the society, as previously described, there are other requirements that they should fulfil. In the next section we are going to explore them, as well as the opportunities that it is possible to create in cites that look at urban development in a holistic way.

REQUIREMENTS OF URBAN OPEN SPACES IN THE 21ST CENTURY

For historians, urban open spaces find their roots in the Greek "agora", one of the most known ancient places where democratic practices started (Stanley et al., 2012). With the time passing, these socio-political spaces evolved, incorporating as well informal, religious and commercial aspects. During the Roman Empire, the principle of the "agora" was transformed into the "forum", a space that enhanced the quality of life of the Romans where a wide offer of social, cultural, shopping and spiritual space was given (Carmona et al., 2008).

Later on, in the middle age, the streets became more egalitarian, and vibrant public spaces and the piazzas started to be seen, especially in the Renaissance, as noted by Girouard, an "expression of civic dignity" (quoted in Carr et al., 1992, p.55), where aesthetical principles were an essential part of the urban design (Carmona et al., 2008). In the 19th century, as an answer to the industrial revolution, urban parks were created to tackle the insufficient health, hygiene, and recreational conditions of the urban workers and the middle class (MacMaster, 1990; Carmona et al., 2007; Stanley et al., 2012).

Even though in the first half of the twentieth century standards for requirements of open spaces where finally put into legislation, bureaucracy, institutionalisation, as well as insufficient capital budget have led to a general decline of this urban public good (Carmona et al., 2007). Between the 1920s and the 1970s, thanks to new and proofed technologies, the construction of new spatial levels have been extensively put into practice: high rises and tower buildings, bigger streets and underground railways are just a few of the elements that changed the urban landscape of cities, as well as the city dweller's perception and freedom of action. With these new understanding of urban planning, associated with the

rising of car use, pedestrians were the ones who suffered most experiencing "the urban space as a transit and acceleration space, reduced to a network of routes and distances" (Bendikat, 2002, p. 2).

In the 1960s, people started to understand the consequences that the new urban design principles had on the quality of life of urban citizens, and begun to discuss critically the quality of urbanisation. Probably the "battle" between Jane Jacobs and Robert Moses about the planning of New York City (Flint, 2011), has helped to open the eyes of planners and citizens. From this decade on, the understanding of the virtue of urban open space as a social space has been re-established, with urban planners rediscovering the "dwelling of the collective" cited by Walter Benjamin in its "Arcades project" (original: "Das Passagen-Werk", 1983; Bendikat, 2002, p. 2).

Since the recent paradigm shift towards an ecological society, many things have changed in the approach to understanding, designing and implementing urban open spaces. Nowadays - at least in countries, where policies related to sustainable development have been implemented - there is an understanding of the built and unbuilt form that incorporates its manifold aspects; sustainability is required in order to minimize our impact and to protect biodiversity (Newman et al., 2009), resiliency to mitigate, "adapt, change and incorporate external influences into new and improved status" (Andersson, 2015, p.24) and the needs of the community have to be taken in account, to create a sense of belonging and identity that can create a healthy and productive society (UN Habitat, 2015).

A paradigm shift is "a time when the usual and accepted way of doing or thinking about something changes completely" (Cambridge Free English Dictionary and Thesaurus, n.d.).

By researching in scientific literature, in reports and strategies published by municipalities, as well as other formal and informal bodies, we have tried to get an overview of the requisites that urban open spaces should feature in today's times and we have divided them into the following categories:

- Creating an inclusive city
- Supporting a healthier society
- Creating a resilient city
- Establishing & maintaining economically feasible spaces

In the next paragraphs, while getting into depth in the research done, these categories will be examined, the requirements related to open spaces will be emphasized, and possible strategies will be discussed.

CREATING AN INCLUSIVE CITY

Meeting, recreation & inclusion

As we have already seen in the previous chapter, the social aspects of urban open spaces are of great importance and are widely accepted. When thinking about the parks and gardens of the 19th century industrial cities, one of the requirements they had was to "fulfil the social role of acting as an integrating force between the different social classes" (Stiles, 2009, p. 27). Today we would say that these public goods, together with offering space for informal meeting, leisure and recreation, and a sense of well-being (see Dallimer, 2012), need to give a sense of inclusion that permits its accessibility to a broad variety of

OWNERSHIP

TYPOLOGY

SURFACE

PUBLIC

URBAN FOREST // PARK

PERMEABLE

PUBLIC

PATHWAY

MIX

Figure 3. Typologies and activities in urban open spaces. Own graphic.

PRIVATE	PUBLIC	PUBLIC	PUBLIC
PRIVATE HOUSE	SIDEWALK	STREET	SQUARE
SEALED	SEALED	SEALED	SEALED

Figure 4. Typologies and activities in urban open spaces. Own graphic.

users: from single visitors to groups, from kids and teenagers to elderly, from riches the to the poor, from active users to passive users, and from local communities to fringe groups.

Sense of place and identity

The sense of place, as described by McMahon, is an ensemble of characteristics and qualities that give a location a meaning. These qualities can be visual, cultural, social and environmental (2012). Even though it is an abstract term, to use other words, we could say that sense of place can exist when a space is connected with the physical and mental activities of its users, thus creating identity, memory, attachment to the space (Ghiasvand, 2015). Because of the multifaceted and multi-layered importance, it would be superficial to consider "sense of place" a requirement of urban open spaces. Nevertheless, sense of place could be considered an indicator that "shows" the relation between users and spaces, and can be researched for understanding the importance of a place for a community (Stedman, 1999; Ghiasvand, 2015).

Fostering communities

The role of public spaces in the fostering communities has been broadly investigated, and should get beyond the provision of opportunities for meeting and gathering (Woolley, 2003; DTLR, 2002). As a study done in different cities in England observes, parks and green spaces can be centres for capacity building and community strengthening. In the cities of Sheffield and Doncaster for instance, in reaction to the degradation of public parks in the 1990s, local residents took the initiative to make these spaces "theirs" again, by doing consultation sessions with the municipal councils first, and later by planning and transforming the spaces together with volunteers. By doing that, the spirit of these communities was created. Years later, it has been observed that these spaces offer "free, non-discriminatory and unlimited access" and it emerges that they have a clear role in invigorating community activity "often resulting in wider and unforeseen community benefit" (DTLR, 2002, p. 81).

Places for education

The study done by Stoneham shows that the benefits from using outdoor spaces effectively include: improvements in sensory perception, social skills, cooperative skills and work patterns;improvements to children's behaviour; a reduction in aggressive behaviour; greater variety of patterns of play, both in a physically demanding, adventurous sense and in the provision of quieter, restful opportunities (1996).

Open spaces are of great importance for the development of a human being. Especially in the first years of our life, we need them to let out our creativity and imagination, and to experience and value the environment (DTLR, 2002). The chance to see wild plants and hear animals in the urban context is something that can add value to the quality of life and quality of learning of the younger citizens (Stiles, 2009), and it has also been proved that it can be a chance to enhance the social integration and the educational development of children with special needs (Stoneham, 1996; Hussein, 2010). There are many ways of providing educational opportunities. it acn be done as family activity during the free-time, it can be done in the formal educational sector by implementing adequate spaces for learning outside the classrooms, or it can be done by the voluntary sector in creating programmes that take place in greener or wilder space of the city (Woolley, 2003).

Aesthetics appreciation

Even though it is difficult to evaluate, and it is normally linked to other functions, the aesthetical appreciation plays a role in the value of open spaces (Woolley, 2003). Visual elements can create an attractive space that can influence the behaviour of individuals or group of people in a positive way (DTLR, 2002). Studies done in this field, show that

an important element that can enhance aesthetical appreciation in urban open space is nature: be it urban greenery or a natural landscape (Woolley, 2003; Kaplan et al., 1972).

Security

Security is surely one of the most important aspects, when thinking about the public realm, which is related to safety needs of the human being (see Maslow's hierarchy of needs, 1954). It goes without saying, that if a place does not give a sense of safety, it will not have many chances to be used by a large variety of users. Social control is described as a "tool" to decrease misuse or anti-social behaviour of open space (Stiles, 2009). There are studies that assume that the architectural form can have an important role in creating spaces that provide social security (Newman, 1973). On the other hand, there are confirms that one way of tackling the roots of criminal activities - be it vandalism, drug taking or anti-social behaviour is to give meaningful alternatives to people that are considered "at risk". Active recreation and sports are part of these alternatives, and many of these activities can be done in urban open spaces. Thus, this spaces could be an answer to the problem if an offer and adequate room are given for active recreation (Woolley, 2003).

Safety needs, as described in Maslow hierarchy of needs include: security; stability; dependency; protection; freedom from fear, anxiety and chaos; need for structure; order; low; limits; and more.

SUPPORTING A HEALTHIER SOCIETY

As the World Health Organisation reports, "Global health is being influenced by three trends: population-ageing, rapid unplanned urbanization, and globalization, all of which result in unhealthy environments and behaviours" (WHO, 2010, p. 10). As the report "Global Health Risks" confirms, physical inactivity and overweight and obesity, are the third and respectively fourth causes of mortality risks after high blood pressure and tobacco use (WHO, 2009).

Outdoor physical activities - be it playing, jogging, walking, cycling, etc. - have benefits that span from the reduction of risk of hearth attacks and strokes, to reduction of blood pressure, and from improved weight control to prevention of bone strength loss, just to cite a few. Clearly, urban open spaces can play an important role in the provision of space for such activities (Woolley, 2003).

Deaths attributed to 19 leading risk factors:
1. High blood pressure
2. Tobacco use
3. High blood glucose
4. Physical inactivity
5. Overweight and obesity
6. High cholesterol
7. Unsafe sex
8. Alcohol use
9. Childhood underweight
10. Indoor smoke from solid fuels
11. Unsafe water, sanitation, hygiene
12. Low fruit and vegetable intake
13. Suboptimal breastfeeding
14. Urban outdoor air pollution
15. Occupational risks
16. Vitamin A deficiency
17. Zinc deficiency
18. Unsafe health-care injections
19. Iron deficiency

(WHO, 2009, p. 10)

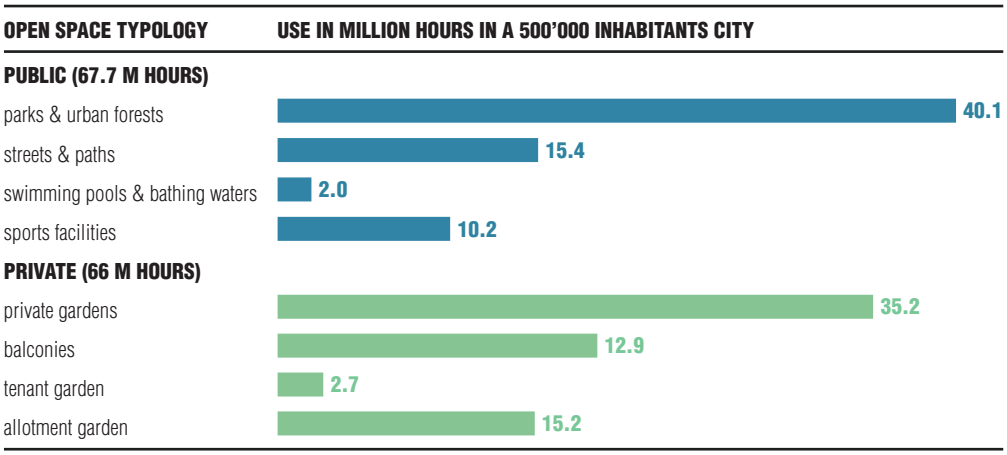
Active recreation

In every phase of our live, physical activities are important: for children at least 60 minutes a day of activities are recommended, whereas for adults, between 75 and 150 minutes per week (and more) is a good start to keep in shape (WHO, 2012). In recent years, there have been many projects on open spaces that address these needs, and sometimes even small interventions have been considered great gestures. As an example of this kind of interventions, it is notable that in cities like Hamburg or Copenhagen (but also many more), planners have started including outdoor gymnastic tools for adults near to playgrounds for kids; so while the children play freely, the adults will not simply have the chance to do some social control, but they also have the chance to do physical activities.

Passive recreation

Active recreation, as described above, is important for our physical well-being, but another important aspect for which open spaces are responsible for, are the ones concerned with passive recreational activities. Meeting friends, reading the newspaper, looking at children, eating lunch outside, watching a concert, are just a few of these (Woolley, 2003). It is proved

Table 2. Time spent in urban open spaces by the inhabitants of a 500'000 city.



Source: Bund, 2014, p. 10. Own graphic.

that places such urban parks, for example, can help creating social interactions and that urban green spaces can help in reducing the stress created by the urban environment as well as to help increase work productivity and mental health. (Nowak et al., 2007).

By looking at the table 2 - where the essence of two studies on urban open space usage in cities of 500'000 inhabitants are summarised - it is possible to observe that in public spaces, the use of parks, urban forests and streets are of high importance, whereas the typologies dedicated to active recreation account just for about the 15% (BUND, 2014; see also Nohl, 1991; Wittig et al., 1998). Spaces for passive recreation are a necessity for cities, and if given in abundance can become a reason of attraction for new citizens, as well as a matter of proudness for local residents (FMC, 2012).

Connection to nature

A further reason, why spaces for passive recreation - such as urban forests, parks or gardens - are of major importance for city dwellers lies in the fact, that contact to nature influences human being's attitudes towards the environment (Pyle, 2003; Lohr et al., 2005). Due to the advancing urbanisation - and digitalisation - of our world, the conventional ways that humans have experienced nature are disappearing, along with biodiversity (Louv, 2011a). According to Louv, nowadays many children, as well as adults, suffer from the so-called *nature-deficit disorder*, which leads to an "atrophied awareness, a diminished ability to find meaning in the life that surrounds us, whatever form it takes" (Louv, 2011a, p. 18). This dwindling of our lives has a direct influence on our mental, physical and societal health (Louv, 2011a).

Richard Louv is the author of the books Last Child in the Woods (2005) and The Nature Principal: Human Restoration And The End Of The Nature Deficit Disorder (2011). He coined the term *nature-deficit disorder*, which broadly describes the human costs of estrangement from nature (Louv, 2011b).

Nonetheless, this process is not only reversible but also can also be prevented, if children - especially if raised in urban settings - have the chance to bond with natural places and organisms (Cobb, 1977; Wilson, 1984; Pyle, 1993 Kellert, 1993; Kahn, 2001; Louv, 2005). Furthermore, we have to diverge from the idea that nature is somewhere "out there" (Louv, 2011a, p. 78), rethink the current role of nature in the city and thereupon offer city dwellers - whether your or old - manifold opportunities to (re)connect with nature.

As already discussed in the section "Effects of densification on open spaces", the offer of

CLIMATIC PARAMETERS	CHARACTERISTICS	CITIES COMPARED TO
AIR POLLUTION	gaseous pollution	5-25 times more
SOLAR RADIATION	global solar radiation	15-20% less
	ultraviolet radiation	15-20% less
	duration of bright sunshine	5-15% less
AIR TEMPERATURE	annual mean average	0.5 - 1.5° C higher
	on clear days	2 - 6° higher
WIND SPEED	annual mean average	15 - 20% less
	calm days	5 - 20% more
RELATIVE HUMIDITY	winter	2% less
	summer	8 - 10% less
CLOUDS	overcast	5 - 10% more
PRECIPITATION	total rainfall	5 - 10% more

Source: Gilbert, 1991, p. 26. Own graphic.

Table 3. Average difference in climatic parameters of built-up areas compared with surrounding rural areas.

this public goods has to be multifunctional, contributing to a more qualitative use of space, and meeting the requirements for creating an inclusive city and support a healthy society.

CREATING A RESILIENT CITY

The concept of resiliency is a matter of discussion in many different but interconnected fields: ecology, economy, political sciences, mathematics, social science and archaeology (Elmqvist, 2013). As already written at the beginning of the chapter, resilience implies "adaptation" (Andersson, 2015). Furthermore, as The Stockholm Resilience Centre explains, the concept of resiliency is "the capacity of a system – be it a forest, city or economy – to deal with change and continue to develop; withstanding shocks and disturbances (such as climate change or financial crises) and using such events to catalyse renewal and innovation." (Moberg et al., 2014, p. 18).

Resiliency: 1) the capability of a strained body to recover its size and shape after deformation caused especially by compressive stress; 2) an ability to recover from or adjust easily to misfortune or change (Merriam-Webster's Collegiate Dictionary, 2003).

Together with the younger generations, we have to deal globally with problems as big as climate change, loss in biodiversity, modification of different natural cycles (nitrogen and phosphorus), ocean acidification, and many more (Rockström et al., 2009). Thus, coming back to the concept of resilience, ecological systems should be understood in a much wider scale than the city. Nonetheless, also urban scale strategies can be of major importance - be it to deal effectively with the aforementioned issues or with "single and frequent disturbances" (see "Urban Sustainability and Resilience—Why We Need to Focus on Scales"; Elmqvist, 2013).

For deepen the understanding of ecological resilience, one of the most cited articles is "Resilience and Stability of Ecological Systems" by C.S. Holling (1973).

In the urban context, we see (and can measure) the effects that development has brought into the city scale. It is proven that between rural and urban areas there are differences on air temperature, solar radiations, relative humidity wind speed and rainfall patterns (see table 3; Gilbert, 1991; Heidt et al., 2008). These effects are related to the massive presence of heat-absorbing surfaces in combination of high energy use in cities, as well as the manifold processes that take place in the urban context. Added to that, in cities there is a tendency for impermeable and sealed surfaces, which increases problems related to

stormwater management, especially during short duration intense rainfall (Hoyer et al., 2011; Sadeghian et al., 2013).

Natural spaces & green infrastructures

So, when thinking about urban open spaces, what are the typologies of space that can not only deal with the changes created by the cities but additionally have a positive impact on pollution control, urban heat island effect, water management, as well as preservation of biodiversity and animal species? Well, as simple as it sounds: natural spaces. Or in other words, green infrastructures as well as spaces that supply cities with ecosystem services.

Trees, plants and greenery own many properties that can influence the urban environment in a positive way. Many authors (e.g. Bowler et al., 2010; Haq, 2011; Jim, 2004; Lin et al., 2015; Viljoen et al., 2005) have studied and summarised in recent times the effects that urban greenery have within the city perimeter. The following is a comprehensive summary presented by Novak et al. (2007):

- lower temperatures and regulate micro-climate;
- remove air pollutants;
- reduce energy consumption in buildings (by shading buildings and reducing air temperatures in the summer, and by blocking winds in winter);
- absorb, transform, and contain contaminants;
- reduce the rate and volume of stormwater runoff, flooding damage, stormwater treatment costs, and other problems related to water quality;
- reduce urban noise;
- enhance biodiversity and urban wildlife.

Every urban context needs to deal with local issues by finding specific strategies and solutions. Nevertheless, many cities have already seen and proved the effects that ecosystem services have both for enhancing the quality of life of residents, and as well as to mitigate the issues created by the densifying urban fabric.

ESTABLISHING & MAINTAINING ECONOMICALLY FEASIBLE SPACES

As we have seen in the previous sections cities, require open spaces that are multifunctional for their users, in the sense that personal and community needs can be met by the offer of a wide range of possibilities for enjoying different activities. Urban open spaces, especially if supplied with ecosystem services, can contribute to developing resilient cities by providing the needed infrastructures for facing climate change, as well as issues created by over-exploitation of space and the built environment.

When thinking about the economic requirements that cities and its inhabitants have on urban open spaces it could be enough to say that: 1) the creation of such spaces should be economically feasible, and the financial viability should be provided by calculating and proof the direct and indirect economic benefits to investors, as well as the socioeconomic benefits to the public; and 2) the maintenance and the preservation has to be assured in the long term, either by the municipality, local governments, or by the residents (Sorensen et al., 1997).

Even though it is easy to say, it could look much more difficult to put these requirements into practice. How is it possible to say if the costs for an urban open space are "too high"? Obviously, a lot depends on which kind of open space have to be built or maintained. For spaces where the benefits have a monetary value (e.g. revenues coming from the direct use of public space) the decisions can be taken after having done a *cost-benefit analysis*, and after having seen which options are more effective regarding benefits against estimated costs (Mishan et al., 2007).

But one of the most difficult challenges occurs when city planners try to give a value to the city's green resources. It is possible for example to calculate the benefits of activities that happen in open spaces; the products of urban agriculture, for example, can be assumed and calculated by using the *market price* of the harvested goods; or by estimating the value of *damages avoided* it is possible to calculate the benefits of flood control. As Sorensen et al. mentioned, other approaches are possible for evaluating the benefits of non monetary goods: a *cost-effectiveness analysis* could be of help by comparing costs and benefits with accepted best practices standard and examples; or, again, the *replacement cost method*, mostly used in the insurance sector, could be another option. (Sorensen et al., 1997).

Depending on the size of the open space, three important aspects are of help for the creation of economically feasible projects, and should be part of both the planning as well as the maintenance of the spaces: integrated planning, empowerment of local authorities and public participation.

The first is essential in big scale areas, to ensure that the multifaceted requirements of open spaces are used as a conceptual base for developing sustainable solutions. From the one hand, a cross-disciplinary approach is needed to understand the potential that the spaces offer on different levels (e.g. environmental, social, economic, physical). From the other hand, integrated urban planning can help in assuring that open spaces are an integral valuable "piece of the puzzle" connected to existing regional strategies that are applied by city governments in order to ensure a good quality of life to their residents.

"An integrated plan for sustainable urban development comprises a system of interlinked actions which seeks to bring about a lasting improvement in the economic, physical, social and environmental conditions of a city or an area within the city" (Joint European Support for Sustainable Investment in City Areas, 2010).

At the district scale, if endued with enough powers, local authorities are probably the most indicated official organ that can help in developing and managing urban open spaces. They are in direct contact with the city's planning administration, with the local communities and with the near environment. Therefore, they are more keen to see the potential and challenges that open spaces have or could have to meet the everyday needs of the local residents (Force et al., 1999).

The third aspects that can help in meeting the economical requirements of urban open spaces is public participation. Knowing the end user's needs, can help in finding focused and sustainable solutions, and avoiding expenses for features that can result irrelevant or useless in the long term. Related benefits that could come out by embedding local residents in the processes of planning and maintaining the spaces, are the possibility for the citizens to identify with the space developing a "sense of place", and the enhancement of democratic practices can be seen as an opportunity for the city to bind together with its citizens and communities (Force et al., 1999; Sorensen et al., 1997).

Public participation: "Involvement of the public as individuals or organized groups in decisions taken as part of the planning process, sometimes on the basis of legal provisions in the planning legislation" (IFLA, 2010).

WIDENING THE UNDERSTANDING OF OPEN SPACES AND PRACTICES

Since densification leads to a quantitative reduction of open spaces, the pressure on the remaining ones is significantly increasing. One the one hand, open spaces should meet the requirements of its users, on the other hand, they have to fulfil expectations regarding climate adaptation and operating efficiency (see figure 5). To include all these aspects within the known open space typologies seems quite ambitious.

Nonetheless, urban open spaces are a "dynamic and complex interplay between social, economic and environmental factors". Thus, now is the time to look at the opportunity of creating "spaces for all" - spaces that fit a new understanding of planning and living the city (James et al., 2009, p. 72; Woolley, 2003, p. 55). For this reason, we consider two preliminary steps as highly promising for the development and maintenance of these public goods:

1. widen the current understanding of open space typologies, including underutilised or vacant spaces such as brownfields, rooftops, road medians, urban interstices, incidental spaces as well as smaller typologies such as terraces and balconies (Stanley et al. 2012);
2. allow and regulate various usages (multi-coding or multi-purpose) on new spaces, as well as on existing spaces (even temporarily), and reduce competing land uses by the creation of synergies (Taylor, 2010).

As a matter of course, it is a challenge to design landscapes that include a wider range of functions. Especially, if new, yet unfamiliar synergies have to be created, the specific context has to be understood, and a new understanding of spaces and new externalities has to be explored (Taylor, 2010).

In our opinion, a socio-natural and productive urban landscape may be necessary to create an inclusive, healthy, resilient and productive city. And here we are not simply talking about the management of urban green spaces, that fortunately, thanks to the proofs that scientific researches have brought into the realm of knowledge in the last 20 years, are being re-evaluated and re-integrated in planning strategies.

What we refer to, are practices and uses of urban spaces, that - even if in the research community are widely investigated and their benefits extensively illustrated - are still underrated, overlooked, or not supported by most of the planning authorities, policy-makers and decision-makers around the globe (Deelstra et al., 2000; McClintock, 2010; Mougeot, 2000 & 2006; Taylor, 2010; Quon, 1999; Van Leeuwen et al., 2010).

In the central part of this work we are going to focus on the understanding of urban agricultural practices, including a brief historical review, the methods used by urban growers, the benefits and challenges that urban agriculture faces, as well as some case studies that are of help for understanding the multifaceted aspects of this uses of open spaces. After this analysis we are going to proof if urban agriculture may be able to meet the requirements that urban open spaces have, and finally we are going to see some methods and strategies that could tackle the divergences between decision-makers and urban growers, in order to be able to use the created opportunities as a tool for sustainable development.

PRELIMINARY STEPS

1
WIDEN THE CURRENT UNDERSTANDING OF OPEN SPACE TYPOLOGIES, INCLUDING UNDERUTILISED OR VACANT SPACES SUCH AS: BROWNFIELDS, ROOFTOPS, ROAD MEDIANS, URBAN INTERSTICES, INCIDENTAL SPACES AS WELL AS SMALLER TYPOLOGIES

2
ALLOW & REGULATE VARIOUS USAGES (MULTI-CODING OR MULTI-PURPOSE) ON NEW SPACES, AS WELL AS ON EXISTING SPACES (EVEN TEMPORARILY), & REDUCE COMPETING LAND USES BY THE CREATION OF SYNERGIES.

GOAL	REQUIREMENTS FOR URBAN OPEN SPACES	POSSIBLE STRATEGIES
CREATING AN INCLUSIVE CITY	PLACES FOR MEETING, RECREATION, INCLUSION PROVIDE SENSE OF PLACE & IDENTITY FOSTER COMMUNITIES PLACES FOR EDUCATION AESTHETIC CONTRIBUTION PROVIDE A SENSE OF SECURITY	OFFERING OPEN SPACES THAT CONTRIBUTE TO A MORE QUALITATIVE USE OF THE PUBLIC GOOD AND THAT ARE BENEFICIAL TO DIFFERENT TYPES OF USERS.
SUPPORTING A HEALTHIER SOCIETY	SPACE FOR ACTIVE RECREATION SPACE FOR PASSIVE RECREATION SPACE FOR CONNECTING WITH NATURE	
CREATING A RESILIENT CITY	CONTRIBUTE TO POLLUTION CONTROL REDUCTION OF ENERGY CONSUMPTION WATER MANAGEMENT (STORMWATER RUNOFF, FLOODING DAMAGE, STORMWATER TREATMENT) REDUCE URBAN NOISE PRESERVE BIODIVERSITY ENHANCE WILDLIFE	TAKING ADVANTAGE OF THE EFFECTS PROVIDED BY ECOSYSTEM SERVICES. THUS, MAKING USE OF GREEN OPEN SPACES & OTHER GREEN INFRASTRUCTURES.
ESTABLISHING & MAINTAINING ECONOMICALLY FEASIBLE SPACES	JUSTIFY THE ECONOMIC VIABILITY OF NEW SPACES BY OUTLINING THE ECONOMIC BENEFITS TO INVESTORS AS WELL AS THE SOCIO-ECONOMIC BENEFITS TO THE PUBLIC ENSURING THE MAINTENANCE & PRESERVATION OF OPEN SPACES IN THE LONG TERM	METHODS: COST-BENEFIT ANALYSIS, MARKET PRICE, DAMAGES AVOIDED, COST-EFFECTIVENESS ANALYSIS, REPLACEMENT COST METHOD, ETC. INTEGRATED PLANNING, EMPOWERMENT OF LOCAL AUTHORITIES, PUBLIC PARTICIPATION.

RESULT: SOCIO-NATURAL & PRODUCTIVE LANDSCAPE

Figure 5. Urban open spaces: goals, requirements, possible strategies as well as preliminary steps. Own graphic.

Figure 6. Urban agriculture in "Motte" // Hamburg.

SECTION TWO

URBAN AGRICULTURE

URBAN AGRICULTURE

IN ONLY A VERY FEW PLACES, URBAN AGRICULTURE IS A RECENT PHENOMENON. AROUND THE WORLD, THERE ARE TRADITIONS OF FARMING WITHIN AND AT THE FRINGE OF CITIES. OVER THE CENTURIES, URBAN AGRICULTURE HAS DEVELOPED FURTHER AND NOWADAYS CONSISTS OF A DIVERSE MIX OF FARMING SYSTEMS AND CULTIVATION TYPOLOGIES.

THROUGHOUT THE WORLD, IT IS NOWADAYS AN INCREASINGLY COMMON ELEMENT OF URBAN AREAS AND RECOGNISED AS - ALTHOUGH OFTEN INFORMAL - URBAN SPACE TYPOLOGY.

ITS POTENTIAL FOR SOCIAL EMPOWERMENT IN COMBINATION WITH VARIOUS ENVIRONMENTAL AND ECONOMIC BENEFITS MAKES URBAN AGRICULTURE PARTICULARLY INTERESTING FOR DEVELOPED, BUT SOMEWHAT FATIGUED, WESTERN CITIES.

THUS, THE MOVING CAUSES, WHY URBAN AGRICULTURE IS - VOLUNTARILY - PRACTICED IN THE GLOBAL NORTH,

ARE NOT FOR FOOD PRODUCTION PER SE, BUT CLOSELY RELATED TO PHYSICAL AS WELL AS MENTAL HEALTH.

USING FOUR CATEGORIES - SOCIETY, HEALTH, ECOLOGY AND ECONOMY - URBAN AGRICULTURE'S IMPACTS ARE ANALYSED, AND A COMPREHENSIVE OVERVIEW IS COMPILED.

IT BECOMES CLEAR THAT URBAN AGRICULTURE'S BENEFITS ARE WIDE-RANGING AND GO FAR BEYOND THE WELL-BEING OF INDIVIDUALS OR A GROUP OF LIKE-MINDED PEOPLE. FURTHERMORE, THANKS TO ITS DIVERSITY, URBAN AGRICULTURE IS EQUIPPED WITH AN IMPRESSIVE ADAPTIVE CAPACITY, WHICH LETS IT WELL-EMBED AS WELL AS POSITIVELY INTERACT WITH ITS SURROUNDINGS.

ALTOGETHER, THIS CHAPTER PROVIDES AN INSIGHT INTO URBAN AGRICULTURE, ITS SPHERES OF ACTION AND BENEFITS.

YESTERDAY, TODAY & TOMORROW

The aim of this chapter is to highlight urban agriculture's development over time. In a first section, urban agriculture's yesterdays are explored by means of its foundation stones. In the second section, its recent development, as well as its contemporary form and moving causes, are outlined. Lastly, a few projects are presented that refer to urban agriculture's potential future development.

YESTERDAY // 8 FOUNDATION STONES

In only a very few places urban agriculture is a recent phenomenon. Around the world, there are traditions of farming within and at the fringe of cities. These established practices are not only deeply enrooted in cultural and social practices, but also in local conceptions of community and city. Over the centuries, urban agriculture has developed further and nowadays consists of a diverse mix of farming systems. According to Jac Smit, often referred to as "the father of urban agriculture", primarily eight factors have been shaping urban agriculture to its present form (2001a):

1 // continuity of historical practices: There are abundant examples of urban agricultural practices, which's origins date back to bygone decades or even centuries. They have continuously moved with the times and therefore adapt to contemporary conditions. These include, inter alia, the centuries-old Chinese practice of reusing cities' night soils to fertilise nearby farms; vegetable patches in Africa's colonial cities with their origins in ancient communal customs; *chinampas*, a specific farming method of Mesoamerican agriculture, which antedate the arrival of Christopher Columbus; European allotment gardens that were introduced in the the second half of the 19th century.

2 // nature of plant and animal domestication and its relationship to people: Plants and animals, which are used for urban agricultural practices, are distinguished from the ones of rural agriculture. This distinction is based on various reasons: 1) horticultural crops , livestock and fish have to be robust in order to survive the rather antagonistic urban environment, 2) the urban market demands a wide range of products, 3) the costly land value requires products of higher value.

3 // conception and management of natural and man-made environments: Some cultures have constituted technologies and management practices that enclose agriculture as an urban activity, some others have separated the "settled and the sown" (Smit et al., 2001a). Typically, these different approaches mirror varying mindsets, to what extent natural and man-made environments are connected with each other.

4 // industrial agriculture revolution: With the growing industrialisation in the late 19th century, machines increasingly substituted manual labour in many forms of agriculture. Furthermore, production and processing units as well as marketing became larger. In response to this rural-dominated development, urban agriculture began to focus on niche markets, currency trade, barter deals and reuse of waste. Additionally, household and community organisations were established to foster food security.

5 // global information revolution: Due to the information revolution, the know-how of

urban food production is disseminating across national and cultural borders. Due to cities greater connectivity, new forms of marketing have evolved and specifically adapt to the urban context.

6 // rapid post-World War II urbanisation: In a majority of countries, urbanisation has progressed more rapidly than economies and population. Thus, the burden of nourishing cities is increasingly transferred to urbanites themselves. All over the world, the relative shortage of land has induced more intensive production methods and prolonged growing seasons.

7 // settlement patterns resulting from contemporary urbanisation: Particularly in the past half century, the character of human settlements - especially urban settlements - has undergone a substantial metamorphosis. Although the formations of clustered networks of cities, so-called megalopolises, gained substantial attention, the amount of untilled - and thus cultivable - interspaces and peripheral zones are barely noticed. Interestingly - despite impressions to the contrary - recent urban development has been fairly low in density. As a consequence, urban agriculture has increasingly greater opportunities to unfold within urban settlements.

8 // great expansion of low-income segments of the urban population: At the end of the 20th century, poverty has become a growing urban phenomenon. Food security is the first concern of the urban poor. With the aid of their imaginativeness, urban agriculture has been reinvented in order to suit the post-industrial city.

While first three factors refer to urban agriculture's historical origins and describe continuities as well as modified practices, the last five factors are rather contemporary phenomena. Hence, urban agriculture in its present form is based on the legacy of ancient as well as recent historical developments. However, it is not yet completely resolved whether urban agriculture arose from gradual modifications of food production when urban concentrations took shape, or was established in a systematic way by the first urban settlers. Both of them are likely (Smit et al., 2001a).

TODAY // OCCURRENCE & MOTIVATIONS

Urban agriculture - as it is practised in contemporary Europe and North America - finds its origins in periods of crisis, such as the World Wars and the Great Depression in the 1930s. In the USA, the "War Gardens" (World War I) and the "Victory Gardens" (World War II) were seen as an instrument to encourage the populace to grow food in order to contribute actively to the nation's war effort and develop a "patriotic spirit". By contrast, during the Great Depression in the USA, the "Relief Gardens" provided thousands of unemployed with comestible goods, income as well as morality, self-respect and a sense of independence (Pack, 1919; Basset, 1981).

Europe was suffering from serious food shortages, especially during World War I and reliant on the North American food exports (Pack, 1919; Basset, 1981). As a consequence, much urban terrain was brought into cultivation after the war (Deelstra et al., 2000). In Germany, allotment gardens or so-called "Schrebergaerten" provided an opportunity to grow own food, especially for the urban poor. In Great Britain, the "Dig for Victory"

campaign encouraged townsfolk to grow their own food in order to reduce the country's dependence on imports (Deelstra et al., 2000).

Referring to gardens, this period was expressed by neat, lusciously green lawns, and trimmed hedgerows (Press et al., 2011).

The time after the wars not only entailed a reduced food demand, but it also introduced the commencement of the neighbourhood supermarkets and refrigeration (Press et al., 2011; Mok et al., 2014). Thus, "direct engagement with food production" was upstaged and replaced with consumerist behaviour in order to reassert a "successful reconversion from war to peace" (Press et al., 2011; Cohen, 2004). To put it bluntly, the economic boom has given rise to the assumption that urban dwellers will purchase food, not grow it themselves (Deestra et al., 2000).

Not until the late 1960s and early 1970s, the interest in food production - in community as well as in backyard gardens - resurfaced. Various ideological and economic reasons, such as the counter movement against conformity, industry and consumerism as well as an increasing environmental awareness, motivated people to grow their own food for the coming decades (Bassett, 1981; Hynes et al., 2004; Press et al., 2011; Mok et al., 2014).

However, irrespective of urban agriculture's historical importance as well as its cross-cutting nature, it inherited a rather low visibility on the agenda of urban planners (Pothukuchi et al., 1999). Even so, within the last two decades it has become an increasingly common feature in the built fabric of many urban areas in the Global North. Nowadays, it is widely understood as movement as well as a - although rather informal - utilization of urban space. The reasons, why urban agriculture voluntarily practiced in the Global North, are not for food production per se, but closely related to physical as well as psychological well-being (Follett, 2009; Press et al., 2011; Cohen et al., 2012; Mok et al., 2014; von der Haide, 2014; RUAF, n.d.):

- The swelling need for high-quality open spaces as a consequence of urban concentration.
- The growing demand for close-to-home green open spaces as a consequence rising transportation costs.
- The search for alternative areas of activity, public visibility and the participation on urban development.
- The increasing ecological awareness and the desire for healthy, seasonal as well as locally produced eatables.
- The release of powerful and awakening book releases and documentaries about state-of-the-art agricultural practices.

Among these evocative works are The Omnivore's Dilemma (Pollan, 2006), Food, Inc. (Kenner, 2008) and We Feed the World (Wagenhofer, 2006).

Although the last mentioned point might surprise, at first sight, it was the one that also aroused attention among mainstream audiences and supplied it with "compelling critiques of the industrial agricultural system" (Mok et al., 2014, p.24), while simultaneously introducing alternative production techniques. As a result of these varying reasons, urban agriculture has become an essential facet of a movement, which is based on environmentally and socially sustainable motives, (re)connection with nature as well as community building (Follett 2009; Press et al., 2011; Mok et al., 2014).Be it as it may, it becomes apparent that urban agriculture is generally practiced by people without agricultural background, who increasingly adopt and co-design the urban landscape (Berges et al., 2014; von der

Haide, 2014; Bohn et al., 2010). Based on this public commitment, urban agriculture has transformed from a fringe interest to one at the centre of contemporary architectural and urban discourse (Bohn et al., 2014a). Furthermore, this development leads to the assumption that urban planners will be more frequently confronted with urban-agriculture-related ideas and claims, which originate in citizen-triggered activities. This public willingness is fairly in line with Jane Jacobs' (1961, p. 238) oft-cited quotation: "Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody".

However, urban agriculture's fast-paced evolution has led to an irregular mix of planning, policies as well as design guidances. Furthermore, only a handful of cities have formally acknowledged it as an integral part of urban development. Nonetheless, it has not prevented the establishment of successful initiatives across the globe and resulted in the fact that practice is often outstripping formal regulations (Bohn et al., 2014c).

Because of the high land prices and an array of competing land uses in cities, urban agriculture may not seem like a wise choice for urban space utilisation in the first instance (Taylor, 2010). But, the potential for social empowerment in combination with various environmental and economic benefits makes urban agriculture particularly interesting for developed cities. According to de Graaf (2013), it has the potential to "help us re-arrange our advanced, but somewhat tired, western cities" (p. 35).

Regardless of the numerous convincing arguments, to this day there exists no comprehensive literature to the subject - neither a holistic view on urban agriculture's multifaceted benefits nor a detailed analysis of reciprocal relationships with the urban landscape. Thus, its raison d'être remains unclear and the statement of Pothukuchi et al. (1999) has not forfeited its currentness.

TOMORROW // EXPECTED FUTURE DEVELOPMENT

Throughout the world, the number of urban agriculture projects is steadily extending and an astounding variety of initiatives can be found. Nonetheless, some urban farmers are widening their product palette and incorporate "foods other than fruits and vegetables, with the aim of providing more of the necessary foods for a complete diet" (Ackerman, 2012).

Even if aquaponics and hydroponics are part of this future development, there are several low-cost types of urban agriculture, which are becoming increasingly popular. Some of them are rich in tradition, but advanced with a pinch of innovation, some others are still part of an underground movement. Moreover, animals - such as bees, worms, chicken, goats and sheep - might play an increasingly important role in urban agriculture projects. The following paragraphs briefly introduce some projects, which prepare the way for future initiatives. While the first four projects involve animals, the last three specifically focus on plants. In excursus #6, there are some pictures of the projects.

URBAN BEES

In the last few years, bee-keeping has undergone a genuine renaissance: for years, bee-keeping stood for an old man's hobby, is currently (re)discovered by young townsfolk.

Along with this movement, several systems have been developed, which facilitate bee-keeping in the urban environment. Such "bee-boxes" are not only mountable on rooftops and even balconies, but also require significantly less time than traditional bee-keeping (BienenBox, 2015).

If human beings did the bee's at a (Norwegian) wage, a pot of honey would cost $182'000 (Deshayes, 2015).

Oslo, Norway's capital, has gone one step further and is currently creating a so-called "bee highway"- a sustainable and safe passage though the city for bees and other pollinators. Even if Norwegian bees are not as gravely threatened by intensive agriculture as bees in the United States or other European countries, still one third of the 200 wild bee species is considered endangered. Thanks to this pioneering project and in close collaboration with the community, nectar-bearing flowers and shelters are provided throughout the city (Deshayes, 2015). Along with the development of the "bee highway", Snøhetta has elaborated a project called "Vulkan Bigård" - beautifully designed bee houses, which are inspired by the natural honeycomb geometry (Snøhetta, 2014). Altogether, Oslo seems to be very committed to pollinators and is actively engaged in a variety of projects.

URBAN GOATS & SHEEP

According to adjunct Mayor René Dutrey, the City Hall paid only €260 for its *moutons tondeuses* (Luleva, 2013; Rotsztain, 2013).

Maintaining grassy areas with the aid of goats and sheep is beneficial from various points of view. First, they eat invasive plant species and, therefore, take care of weed control and reduce the need for herbicides. Secondly, they lower the need to mow and hereby reduce fuel expenses, pollution and noise. Thirdly, they naturally (and organically) fertilise the areas and herewith reduce the need for fertilisers and other chemical additives (Sinclair, 2013). Fourthly, by having these animals in the urban context, they can act as a reminder of nature in the middle of the city (Inslee, 2013). Based on such reasons, Bertrand Delanoë - Mayor of the 19th arrondissement in Paris - decided to launch a pilot project called "eco-grazing". Thus, a flock of four little sheep was maintaining the verdant field next to the Paris' municipal archive building until October 2013. Although no study report could be found, the project seemed to be successful and sheep will be encountered more frequently in France's capital (Hervez, 2014).

URBAN CHICKEN

In recent years, "an underground urban chicken movement" has swept across Western cities (O'Caroll, 2008). More and more city dwellers are interested in growing backyard poultry. With a small flock of three to four hens, chicken farmers are steadily supplied with fresh eggs. Furthermore, the home-raised chickens consume food leftovers, produce precious fertiliser and even peck at unwanted weeds (Watson, 2008).

Also Edmonton, a Canadian city, was faced with increasingly more applications for poultry keeping. Along with the "Food & Urban Agriculture Strategy", Edmonton ventured at a pilot project that will permit chicken coops inside the city (Nolette, 2014). Together with local non-profits, the implications of permitting urban backyard hens have been evaluated and surprising findings, such as the following ones, were obtained: 1) noise from cackling is about 60 decibels, which is comparable with a normal conversation, 2) one average, one dog produces more excrements than 10 hens, 3) chicken themselves are odour-free and, 4) in order to survive Canadian winters, they need insulated coops (Nolette, 2014). The pilot project ended in August 2015 and the city council is still debating whether chickens will prospectively be allowed or not (The City of Edmonton, 2015). Whatever will be decided,

the project has delighted many of Edmonton's citizens - on the internet, there are plenty of blogs, which document the progress of the numerous coops.

URBAN WORMS

Another small animal is becoming increasingly popular among urban growers, namely earthworms. These creatures - most often "Red Earthworms" (Lumbricus rubellus) or "Red Wigglers" (Eisenia foetida) - are favoured, because they are excellent producers of worm compost. By decomposing organic material - inter alia ground eggshells, coffee filters, tea bags, bread crusts and vegetable peels - worms create worm compost, also referred to as vermicompost. It is a nutrient-rich, organic fertiliser and can also be used as soil conditioner. Furthermore, its is rich of microbial life, which fosters the breaking down of nutrients into a form that can be absorbed by plant roots (Growing Power, 2014a).

"Growing Power", an established non-profit organisation and land trust in Milwaukee, aims to support people from various backgrounds by establishing equal access to "healthy, high-quality, safe and affordable food for people in all communities" (Growing Power, 2014b). Since 1993, it is providing hands-on training and on-the-ground demonstration as well as technical assistance for other community food systems. "Growing Power" is not only growing food, but also processes, markets and distributes it in a sustainable manner. One product they are well-known for, is its vermicompost. According to Will Allen from "Growing Power", the worm compost is sold as value-added products on markets and in shops (Growing Power, 2014a).

GUERILLA GRAFTERS

Guerilla Grafters - not to be confused with Guerilla Gardeners - intend to turn established sterile trees into fruiting trees (Davis-Geronov, 2013). Fruit bearing branches are grafted onto non-fruit bearing, ornamental fruit trees and over time, nutritious fruits are readily accessible for the public. Thus, tree-lined roads are being transformed into food forests (Guerilla Grafters, 2015).

Guerilla Gardeners primarily focus on beautifying neglected spaces (Davis-Geronov, 2013)

According to Tara Hui, founder of San Francisco based "Guerrilla Grafters", they do not "haphazardly graft"; each grafted tree has an "adoptive parent" who monitors the progress of the graft and the overall health of the tree as it morphs into abundance. Each grafted tree is given an "adoptive parent", who monitors its health and its process "into abundance" (Davis-Geronov, 2013). As the term "guerilla" already indicates, grafting is illegal. Ironically, exactly this characteristic fosters camaraderie and relationship among inaugurated neighbours (Davis-Geronov, 2013).

URBAN MUSHROOMS

Another trend in urban agriculture is the cultivation of mushrooms - either grown and intended for human consumption or selectively paired with other plants through mycorrhizal symbiosis. The latter fungi surround plant roots and hereby play a critical role in the capture of nutrients from the soil and are therefore beneficial for plant nutrition (Smith et al., 2008; Ackerman, 2012)

Also GroCycle, an innovative social enterprise based in Devon, is dealing with mushrooms. Right in the heart of the city, it reconstructed a neglected office building into an urban

mushroom farm. Each week, it collects hundreds of kilos of coffee grounds from the city cafés and then uses it to grow oyster mushrooms, which are delivered to the gourmet restaurants and food outlets across England's South West. The waste from their growing cycle is turned into fertile compost and used locally. What makes this project unique, is the fact, that they developed a "Mushroom Grow Kit". With this user-friendly kit, city dwellers are enabled to grow easily their own mushrooms within two weeks (GroCycle, n.d.).

PHYSIC GARDENS

Another type of urban agriculture focuses on plants and herbs that have medicinal properties. Such gardens - for example the Urban Physic Garden in London - demonstrate the potential of food as medicine and, thus, as a means to tackle urban food growing, education, nutrition and healthy cooking (UPG, 2015).

The Urban Physic Garden sees its beneficial impact beyond the health of individual citizens - it heals an underutilized site, brings together communities and provides a platform tor collaborations between urban growers, artists, designers and health practitioners across a diverse range of cultures and backgrounds. Thus, a physic garden has the ability to connect like-minded people in order to mutually explore the role of plants in health, well-being, science and the environment (UPG, 2015).

ATTEMPT AT DEFINITION(S)

COMMONLY USED DEFINITIONS

Urban agriculture is a dynamic concept and has rapidly developed in the last twenty years. Thus, there exist multiple interpretations of the term *urban agriculture*. Although each one indicates nuances of different contexts, two definitions protrude from the rest. The first one is from the publication "Urban agriculture: Food, jobs and sustainable cities", which has been authored and edited by Jac Smit, Joe Nasr and Annu Ratta for the United Nations Development Programme (UNDP). It was published in 1996 as a contribution to the UN Conference on Human Settlements (Habitat II) in Istanbul. The book was an "immediate success" (Nasr, 2011) and rapidly became the second-most popular published work by the UNDP. Since the publication was revised multiple times, the most up to date definition is quoted here (Smit et al., 2001b, p. 1):

> "Urban agriculture is an industry that produces, processes, and markets food, fuel, and other outputs, largely in response to the daily demand of consumers within a town, city, or metropolis, on many types of privately and publicly held land and water bodies found throughout intra-urban and peri-urban areas. Typically urban agriculture applies intensive production methods, frequently using and reusing natural resources and urban wastes, to yield a diverse array of land-, water-, and air-based fauna and flora, contributing to the food security, health, livelihood, and environment of the individual, household, and community."

The second definition was elaborated by Luc J. A. Mougeot, a Senior Program Specialist at the International Development Research Centre (IDRC) and was published along with his

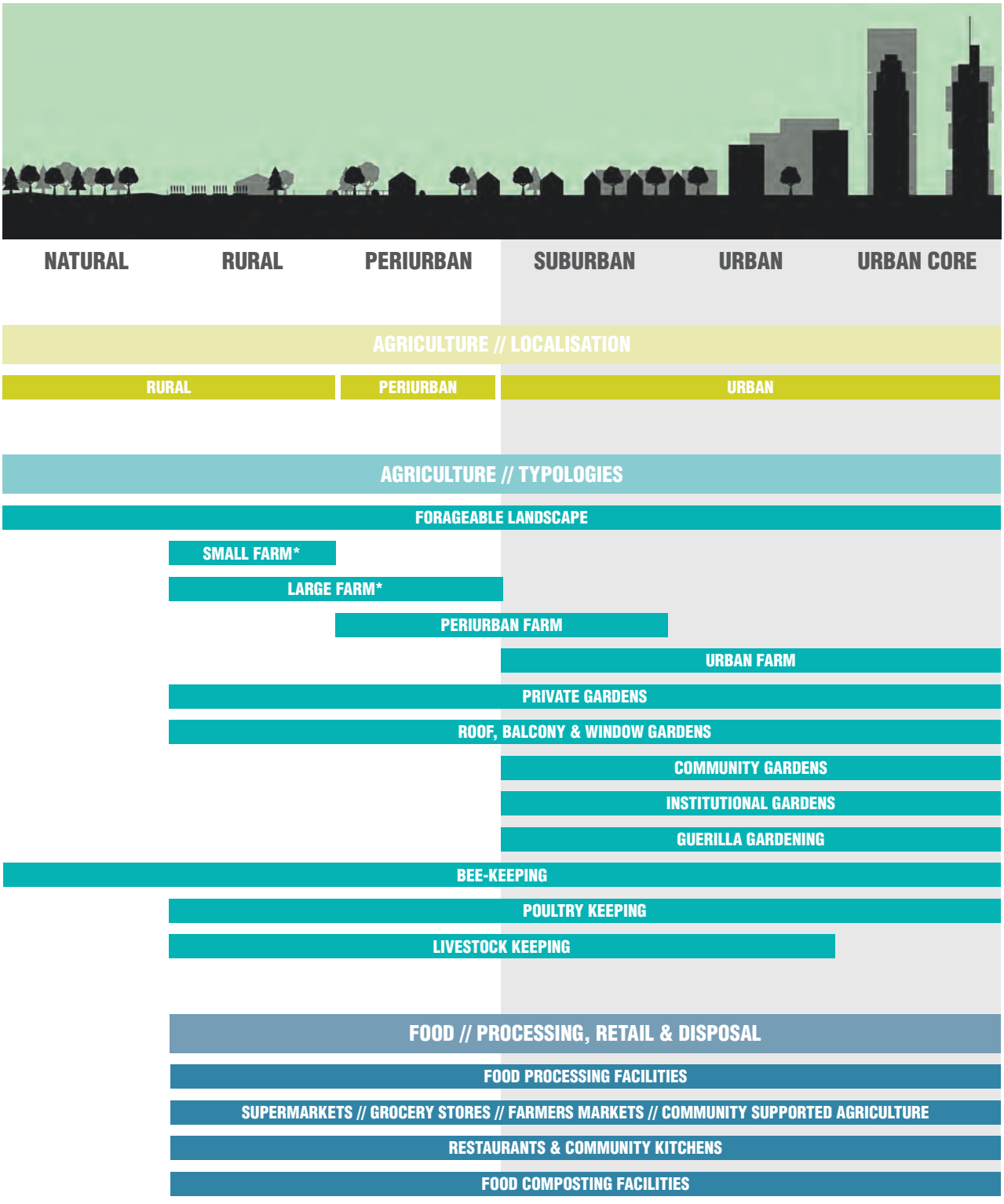


Figure 7. Agriculture and the food system in the spatial continuum from natural-to-urban landscape. This graphic provides a general overview on agriculture as well as on components of the food system in relation to their respective localisation. It is recognisable that urban agriculture - highlighted in grey - exits in multiple forms and for multiple purposes - from commercial farms in the suburbs to community gardens and farmers markets in the city centre. Source: adapted from Hodgson et al., 2011, p. 2. Own graphic.

renown book "Growing better Cities" (2006, p. 82):

> "An industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city, or a metropolis, which grows or raises, processes, and distributes a diversity of food and nonfood products. It (re)uses on a daily basis human and natural resources, products, and services largely found in and around that urban area and, in turn, supplies on a daily basis human and material resources, products, and services largely to that urban area."

Both Smit's and Mougeot's definitions are currently the most commonly used ones. According to Bohn and Viljoen, they are appreciated for their "simplicity, openness and implicit inclusion of cradle-to-cradle approach" (2014b). However, we value the definition of the Resource Centre on Urban Agriculture & Food Security (RUAF, n.d.), because it explicitly refers to the fact, that urban agriculture is not only located in urban areas, but it is an integral, interacting part of the city's ecosystem:

> "Urban agriculture can be defined shortly as the growing of plants and the raising of animals within and around cities. The most striking feature of urban agriculture, which distinguishes it from rural agriculture, is that it is integrated into the urban economic and ecological system: urban agriculture is embedded in -and interacting with- the urban ecosystem."

THEMATIC FOCAL POINTS

The previously quoted definitions imply, that urban agriculture is not solely restricted to the process of food growing, but also involves many accompanying and supplementary activities (see fig. 7). Thus, urban agriculture is an extremely wide-ranging topic and interacts on various scales with the urban system. As already described in the introduction, in this study we strongly focus on urban agriculture and its potential connection to open space (see fig. 8). For that reason, an array of activities and practices, which are usually seen as part of urban agriculture, will be excluded. On account on this, the focal points of this study are the following ones:

- Cultivation methods that are not only are applicable on numerous urban open space typologies but are also low-energy and inexpensive (see fig. 8).
- Cultivations that include different types of crops - mainly vegetables, fruits, berries, herbs and edible flowers. While they provide the highest yields per square metre of urban ground (see excursus #1), they are also for the benefit of other urban species, such as bees and birds.
- The edible output is solely used for personal consumption. Commercial activities, such as processing, distributing and marketing of food as well as appertaining non-food products (fibre, fuel, ...) are therefore left aside.

DISAMBIGUATION

Since the three thematic focal points outline a specific area of urban agriculture and simultaneously exclude a significant part, one is drawn to the conclusion that the term "urban agriculture" might be misleading. Probably "urban gardening" or "urban horticulture" or

even “urban farming” might be more appropriate. However, the distinctions between all the mentioned terms - agriculture, gardening, horticulture and farming - are rather blurry, and the distinguishing features are often recognisable at second sight: “urban gardening” often relates collaborative activities and is primarily devoted to social benefits; “urban horticulture” mainly takes account of the practice and science of plant cultivation and rarely refers to an integration into urban spaces; “urban farming” predominantly focuses on the maximum yield (Bohn et al., 2014b). The expression “urban agriculture”, however, simultaneously encompasses a spatial observation - the vicinity and directness of the urban and the field (“agri”) - and a direct action, namely to grow (“culture”).

Furthermore, it might also be the vigorous contrast between the two words “urban” and “agriculture” that provokes creativity and triggers imagination of those who delve into the topic (Bohn et al., 2014b). Based on these exemplifications, we decided to utilise exclusively the term “urban agriculture”.

Although this study primarily aims to explore urban agriculture’s critical role as productive green urban infrastructure, it is of great importance to mention, that the excluded components are, notwithstanding, a substantial part of urban agriculture and each of them uniquely contributes to the city and its inhabitants (Cohen et al., 2012).

URBAN AGRICULTURE & ITS TYPOLOGIES

INTRODUCTION & MATRIX

As the previous chapter - an attempt at definition(s) - has pointed out, urban agriculture is quite a far-reaching topic. The areas of activity contribute to manifold issues - be it food security, health or reusing natural resources - and address the needs of various target groups. However, in order to plan with and for urban agriculture, we decided to structure urban agriculture’s diversity and divided it into five categories. These categories provide an overview on today’s types of urban agriculture and offer an idea of scope and key features. The five categories are:

- forest gardening
- ground-based cultivation
- container-based cultivation
- hydroponics
- aquaponics

These types of urban agriculture, especially due to their relation to the soil and the built environment, have different requirements and incorporate particular approaches to the relationship between people and nature (de Graaf, 2012; de Graaf, 2013). Within the individual categories, there is a multiplicity of unique projects - be it small-scale, but productive sidewalk gardens or a high-tech commercial rooftop greenhouse (Ackerman, 2012; Berges et al., 2014). In a variety of ways and intensities, each of them is supplying a city’s spatial, environmental as well as socio-natural needs. Although they reflect manifold, partially overlapping priorities, they complement each other in the services and

Although the five categories differ significantly, they complement each other with regard to the provided services and products.

products they provide. Therefore, the most appropriate type of cultivation for a specific neighbourhood can be determined on the basis of their respective key features (Ackerman, 2012; de Graaf, 2013).

In figure 8, the five categories are ranged in a matrix. The x-axis relates to space and describes each category's placing. This axis ranges from green space to building-integrated, whereby grey space marks the middle. To be more accurate, *green space* is defined as land that is predominantly composed of unsealed, soft and permeable surfaces such as grass and soil. The emphasis is put on *predominant*, because green spaces may include hard surfaced areas up to a certain point (DTLR, 2002). *Grey space* corresponds to land, that mainly consists of sealed areas, but may include green patches (see table 1). Although term *building-integrated* is quite self-descriptive, it exclusively refers to all spaces that are incorporated in and on a building. The y-axis describes the level of control and ranges from controlled to self-organised. Simultaneously, it highlights the demand for energy and financial capital. Accordingly, highly self-organised cultivations comply with a low input of energy and financial capital. In contrast, controlled cultivations are energy-intensive and require a substantial amount of financial capital in order to operate smoothly. Based on the determining axes, the cultivations were classified. While the filled text frames represent each cultivations placing as it is predominately described in established literature, the dashed line refers to spaces, which are just on the way to being recognised as suitable for urban agriculture. It is of importance to keep in mind, tha due to urban agricultures diversity, the matrix provides only a rough - and by no means inflexible - overview.

As we already pointed out in the previous chapter, this study addresses a specific area of urban agriculture and simultaneously leaves out a large portion of its overall scope. It means in effect that some of the typologies, namely aquaponics and hydroponics, are excluded from this thesis' investigation. This is due to several reasons: 1) they are hardly applicable on open spaces, 2) they require constant surveillance 3) they are usually energy-intensive are demand high financial investment, 4) they are strongly focused on food production, other benefits only weakly represented, 5) due to the required specialised knowledge they are subject to restricted accessibility. Subsequently, the five typologies of urban agriculture are described. While hydroponics and aquaponics are concisely addressed, the other three types - forest gardening, ground-based and container-based urban agriculture - are outlined with detailed information as well as practical examples.

HYDROPONICS

Howard M. Resh, a recognized authority worldwide on hydroponics, describes hydroponics as the "science of growing plants without the use of soil" (2013). Instead of soil, an inert medium - coco coir, gravel, peat, perlite, pumice, rice hulls, sand, sawdust and vermiculite - is used and then enriched with a nutrient solution, which contains all the essential components necessary for a plant's normal growth and development (Resh, 2013). Since many hydroponic methods utilise some sort of medium, it is often referred to as "soilless culture", while only water culture alone would delineate true hydroponics (Resh, 2013).

All around the world and in nearly all climates, hydroponics and its subtypes, such as nutrient film technique or drip feed systems, are used to vegetables as well as flowers throughout the year. Many greenhouse growers depend on hydroponic installations and

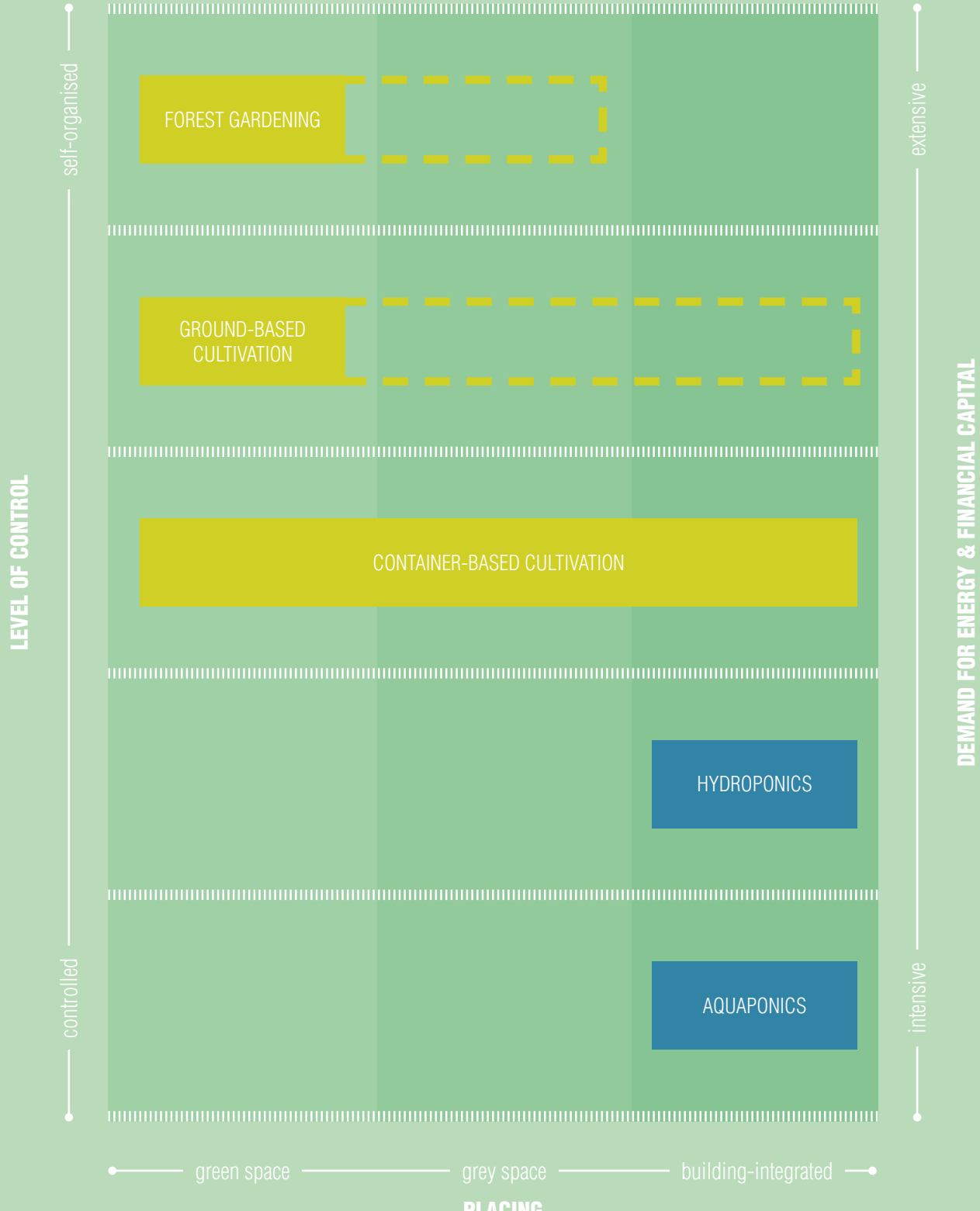


Figure 8. Matrix of today's typologies of urban agriculture. For this study, only the greenish cultivations - forest gardening, ground-based and container-based cultivation - are investigated. The dashed lines indicate that these typologies are adaptable to various - yet often excluded - locations. Source: adapted from de Graaf, 2013, p. 36. Own graphic.

it s broadly speaking a high-tech version of ordinary soil-based agriculture. In the urban context, hydroponics are often building-integrated, either in the interior space or on flat rooftops, and could potentially tap a building's waste energy and waste water streams. Hence, with regard to a city's metabolism, hydroponics are an element for sustainable redevelopment of buildings and districts (de Graaf, 2013).

Nonetheless, the required supply of water, oxygen, nutritions, air moderation and light makes hydroponics an energy-intensive type of urban agriculture (Commercial Hydroponics, n.d.). Furthermore, due to the needed specialised knowledge as well as the specific site requirements, hydroponics feature a comparatively low accessibility.

AQUAPONICS

Aquaponics is a merging of aquaculture and hydroponics. It describes the combined culture of fish and plants in recirculating systems (Love et al., 2015; Rakocy et al., 2013). It is a soil-less system and similarly to forest gardening, it works with polycultures and internally closed loops (de Graaf, 2013). Broadly speaking, its functionality principle works as follows: The aquaculture effluent flows through the hydroponic component of the recirculating system, where nutrients - mostly fish waste metabolites or microbial breakdown of organic wastes - are removed by nitrification and direct uptake by the plants. Hereby, the water is treated and then flows back to the fish-rearing component for reuse (Rakocy et al., 2013). Although aquaponics have several advantages, such as free nutrients for plants and regional food production, they require specialised knowledge and high investment costs (Love et al., 2015; Rakocy et al., 2013; de Graaf, 2013). The result of these fundamentals, the accessibility is restricted and hardly feasible on (most often) publicly accessible open space.

CONTAINER-BASED CULTIVATION

Overview & characteristics

Although urban agriculture appears in multitudinous shapes and sizes, container-based agriculture is probably the one, which fits most people's image of urban agriculture (de Graaf, 2012; Cohen et al., 2012). The spectrum of utilised containers is incredibly diverse and consists basically of everything that could hold soil, for instance: worn-out shoes, burst footballs, milk cartons, PET bottles, rice bags and even old car tyres (see excursus #4 // container-based urban agriculture). Thus, the concept of upcycling - according to the Oxford Dictionaries a process of reusing discarded objects or materials in such a way as "to create a product of higher quality or value than the original" (2015) - is greatly enrooted in this type of urban agriculture. Along with the surprising assortment of plant pots, also the plant selections often hold a considerable amount of creativity. For instance, there are pots labelled as "Three Sisters" - containing corn, winter squash and climbing beans - or there are plant containers, which are named after "Salsa Garden" and contain a bush-type tomato, onions and basil (Mills, 2012).

This is not only an originative way of cultivating plants, but simultaneously incorporates the methods of intercropping, in small gardens often referred to as companion planting (Wszelaki et al., 2012). These techniques take advantage of the size and growth rates of different plants and promote beneficial interactions among them (Pleasant, 2006; Simon

et al., 2013; Wszelaki et al., 2012). They are space-saving, production-increasing and additionally encourage biodiversity. Furthermore, the polyculture cultivation method leads to a reduced susceptibility to disease and therefore the use of pesticides can be reduced (Waterford, 2015; Pleasant, 2006; Simon et al., 2013). This is of importance, since container-based urban agriculture often involves intensive practice in order to utilise maximally the limited urban space.

Due to the nearly limitless options for planters, this cultivation is very flexible and fits to nearly every location - from windowsills to rooftops and any part of vacant lots. This is of major advantage compared to ground-based agriculture, which is often spatially limited by the site availability and the land values (Ackerman, 2012). In addition to the previously mentioned containers, raised beds - a box typically made of wood and filled with soil - is a commonly used unit. While the bed's length as well the shape can vary, the width should not exceed 120cm. Therewith, the plants can be accessed without having to step into the bed. This prevents soil compaction and air, as well as water, are allowed to move more freely through the soil (UF, 2013). According to Cohen et al., most raised beds measure 90cm by 150cm or 120cm by 240cm, which is a manageable size for nearly anyone to grow, and moreover, it can "produce surprisingly large yields" (2012).

Raised beds are particularly suited for physically impaired gardeners.

The raised beds' heights vary greatly and depend on the project. However, the media depth determines the plant selection that can be grown (Proschk, 2011). Thus, in beds with lower heights only crops with relatively shallow roots will thrive (Ackerman, 2012). Indeed, the volume of the growing media is of substantial importance for successful flourishing. A recently published study analysed the effect of pot size on plant growth. On average, the biomass production increased by 43% by doubling the pot size (Poorter et al., 2012).

In addition to the beneficial impact on plant growth, an approximately waist-high raised bed (height: 80cm to 100cm) features a convenient working height. Elderly as well as physically-impaired gardeners do not have to bend over and can cultivate with an upright posture (Mills, 2012). If there are wide, hard-surfaced paths in between the beds, also wheelchair users are enabled to be part of gardening activities (UF, 2013; see excursus #4 // container-based urban agriculture).

Since soil, as well as compost, are often a rare commodity in cities, raised beds often consist of various layers, whereas some of them are mainly used for the purpose of backfilling. As shown in figure 9, the bottom layers are composed of tree and shrub cuttings as well as organic waste. The interim layer is the actual growing media and consists of nutritious soil, compost or manure. In fairly new beds, the soil level drops every year by a few centimetres. This is due to the slow settling of the topsoil and compost mix. As a consequence, compost or composted manure has to be regularly added to maintain a certain soil level (Vanderlinden, 2015). The top layer often consists of mulch or straw. This helps to hold back weeds and keeps soil moist. This is of major importance because the soil in raised beds warms up faster and runs dry more quickly than soil at ground level. Consequently, irrigation is required to supplement natural precipitation during dry periods. Drip irrigation or soaker hoses are placed directly on the bed and are very efficient (UF 2013; Vanderlinden, 2015). Compared with overhead sprinklers, they do not get the foliage wet and prevent diseases from spreading (UF, 2013).

Thanks to the containers, it is also possible to practice urban agriculture on contaminated or sealed sites.

In view of the long history of human settlement and activity in many urban areas, there is the risk of historical soil contamination. Soil contamination originates from various sources, for instance from lead-based paint from old buildings, high-traffic roads or past land uses and can, therefore, range from heavy metals, asbestos, petroleum products, solvents as well as pesticides and herbicides (Boulding et al., 2003; Mok et al., 2014). Thus, according to Ackerman, urban soils are generally expected to be contaminated (2012). By identifying the site's previous history and by conducting a soil sampling, it is possible to find the degree of pollution and appropriate measures can be undertaken (EPA, 2011a). There exist various biological, chemical and physical technologies for soil remediation, but on heavily contaminated sites, however, it may be a lengthy undertaking (Heinegg et al., 2002; EPA, 2011b). Thus, it is often avoided to grow directly in the soil and container-based urban agriculture is applied instead. Not only contaminated, but also sealed surfaces - parking spaces, or accessible roof tops - as well as temporarily available spaces can easily and quickly be converted into flourishing urban oases.

Practical examples

Trädgård På Spåret - translatable with Garden on the Track - is a small scale urban agriculture project in Stockholm, Sweden. In 2012, the initiators got the opportunity to transform a former railway area into a place for cultivation and education (Gerlach, 2013). In hundreds of growing boxes - mostly raised beds made of pallets - vegetables and other

1: An astonishing variety of containers - such as shoes or rice bags - are used for growing plants. **2:** Due to its convenient height, the raised bed is suitable for physical impaired gardeners. **3:** An array of different plants can be grown - both in raised beds and other containers. **4:** A raised bed is composed of various layers - backfilling on the bottom, nutritious soil, composts and covering mulch on top. **5:** Containers can be used on sealed or contaminated surfaces and are therefore highly adaptable to various open spaces.

Figure 9. Exemplary section through container-based urban agriculture. Own graphic.

edibles are plantet. The gardeners do not seek self-sufficiency, *Trädgård På Spåret* is rather a space to experience how food grows and how to grow food (Trädgård På Spåret, n.d.). There is also space for art, events and markets as well as a café in an up-cycled trailer. Briefly worded, they have transformed an abandoned and neglected site into a green and vibrant part of the town.

Also the second project has transformed a site, which has been a wasteland for over half a century, into an urban garden. It is located in the geographical centre of Berlin, Germany, and is called "*Prinzessinnengarten*" (Clausen, 2015). On approximately 6'000m^2, there are a good many of transportable plant containers, such as rice bags and plastic bakery boxes, as well as a handful of converted shipping containers, which accommodate a bar, a kitchen, a workshop as well as various storage facilities. The "*Prinzessinnengarten*" is more than "just a place" to organically grow agricultural crops, it is a space for multifaceted kinds of activities (Clausen, 2015). Locals as well as interested people "learn about healthy eating, sustainable living and a future-oriented urban lifestyle" (Prinzessinnengarten, 2015). In a nutshell, the project aims to enhance the neighbourhood's social, cultural and biological diversity and "pioneer a new way of living together in the city" (Prinzessinnengarten, 2015).

Both projects have converted a formerly underutilised space into a thriving meeting place, which acts as a catalyst far beyond the respective districts. Due to the success of both projects, new layers of the populations are reached and are become acquainted with the possibility of cultivation in the city. These characteristics are perfectly in accordance with Luc Mougeot, the author of *Growing better Cities*, who stated: "unused urban space is a wasted opportunity - an asset denied to community's well-being and a brake on the city's development" (2006).

In "excursus #4 // container-based urban agriculture" there are a few photographs of container-based urban agriculture from the following projects: *Allmende Kontor* and *Prinzessinnengarten* in Berlin, the *Gartendeck* in Hamburg as well as the *Trädgård På Spåret* in Stockholm.

GROUND-BASED CULTIVATION

Overview & characteristics

Ground-based urban agriculture refers to growing of edible plants in full soil (de Graaf, 2013). In order to grow plants suitable for human consumption, this cultivation depends on healthy, uncontaminated soil. With this cultivation, many production systems are involved (Ackerman, 2012). However, the picture of a traditional kitchen garden corresponds quite well with what most people associate with ground-based cultivation. This type of urban agriculture is most often found in allotment gardens, private gardens as well as in some community gardens. Compared to forest gardening,which is also based on full soil cultivation, it requires more labour and usually does not include lignifying plants, such as trees and shrubs.

Since there is no confining container, an amazing variety of crops can be cultivated with ground-based agriculture (see figure 10). Nonetheless, in urban areas there are characteristics, which make an edible particularity suitable for cultivation: climate-adapted, high-value, high-yield and repeatedly harvestable during one season. Furthermore, if it is

desired to sell the reaped products, they should spoil quickly. At first sight, this state might surprise, but this provides the product a "competitive advantage to freshness" and with that supports local food production (Ackerman, 2012).

Low availability of cultivable land is a limiting factor for the expansion of ground-based urban agriculture.

One of the biggest challenges of ground-based urban agriculture is its dependence on available and cultivable land (de Zeeuw et al., 2000; Nugent, 2000; Whittinghill et al., 2013). Especially in growing and densifying cities, the availableness of suitable sites is low and concomitant land values are high. Both of them signify the main limiting factors for the expansion of ground-based urban agriculture (Ackerman, 2012). In urban centres, there are numerous competing land uses, with (highly profitable) building development leading the way (Nugent, 2000; Vagneron, 2007; Graefe et al., 2009; Whittinghill et al., 2013).

In order to make a to make a virtue out of necessity, alternative sites have been sought after. In fact, within cities there are many other areas, which could be converted into productive landscapes: marginalised space between buildings as well as underutilised open space areas within public parks, green belts as well as golf courses (Ackerman, 2012). Furthermore, also smaller incidental spaces bear a great potential for ground-based agriculture. Although these spaces are easily overlooked, they include for example the following units: easement areas, scattered vegetative patches and curbs (see excursus #3 // ground-based urban agriculture). Of course the suitability for agricultural activity has to be evaluated for each project individually - spaces in ecologically valuable areas or vacant lots with inadequate sunlight (overshadowed by trees and tall buildings) are ineligible for establishing an urban agriculture project (Ackerman, 2012).

However, one promising typology of urban open space are correspond very well to Le Corbusier's manifesto "Towards a New Architecture". In the second point, he calls for a productive use of rooftops in form of roof gardens, which "mean to a city the recovery of all the built-up area" (Le Corbusier, 1985). Hence, with the integration of green roofs, the forfeited green space during building construction can be replaced (Whittinghill et al., 2011).

Extensive and intensive green roofs are a promising alternative for ground-based urban agriculture.

Nowadays, there exist various green roofing technologies, which enable not the growth of vegetation, but also the cultivation of edible crops: intensive and extensive green roof systems as well as planting in some form of containers (see next chapter for more details). Usually, extensive green roofs are planted with low-growing plant communities, which require a rather low maintenance after establishment. Usually, the vegetation consists of a mix of drought-tolerant mosses, grasses, herbs, succulents and other ground-cover plants (IGRA, 2015). The height of an intensive green roof's system build up is significantly higher, therefore it can support herbaceous perennials, shrubs and even trees. But for all that, it requires continuous upkeep and irrigation as well as fertilisation have to be ensured. (Getter et al., 2006; Dvorak et al., 2010; Whittinghill, 2011; IGRA, 2015).

Water is an important element of rooftop agriculture. Not only the irrigation but also the waste water requires careful planning.

Depending on the purpose of the project, the design as well as the plant selection vary. Furthermore, also the benefits to be achieved have to be considered (Whittinghill et al., 2011). Even though there are possible benefits from incorporating urban agriculture into green roof technology, some potential constraints have to be considered. These include weight limitations, composition and depth of growing media, possible water-quality

concerns of effluent, impact on benefits attributed to green roofs as well as installation and maintenance costs (Getter et al., 2006; Oberndorfer et al., 2007; Mok et al., 2013). Similar to standard green roofs, certain factors influence the feasibility and the costs: structural capacity and integrity of the building, accessibility for installation, the system build-up, type of drainage system and the inclusion of an irrigation system (Whittinghill et al., 2011).

Especially the last point, the availability of an irrigation system, is of major importance. Although the indicated water needs for local agriculture provide fundamental information, they are higher on a productive rooftop than for ground-based urban agriculture in the same location. This is mainly due to challenging growing conditions, based on the rooftop's more intense exposure to wind and sun, which faster dry out the soil (Getter et al., 2006; Proksch, 2011). However, not only the water input, but also its output requires careful planning. One of the relevant environmental issues related to rooftop agriculture is the effect of fertilisers on the quality of the run-off (Whittinghill et al., 2011; Ackerman et al., 2014)

Since rooftops are apparently in conjunction with some kind of building, to a certain extent their accessibility influences the involved actors. According to Ackerman et al. (2014), these

1: An astonishing variety of crops can be grown - be it vegetables, herbs, edible flowers, perennials or even berry bushes. This polyculture cultivation, also known as intercropping or companion planting, takes advantage of the size and growth rates of different plants and promotes beneficial interactions among them. This practice is space-saving, production-increasing and additionally encourages biodiversity. **2:** Also in the subsoil, there are symbiotic relationships among the different plants' roots. **3:** In order to keep the soil nutritious, compost can be added on a regular basis. **4:** Irrigation mostly happens via drip irrigation or ordinary watering can. To keep the soil moist, it can be covered with mulch of straw. **5:** Biodiversity increases thanks to the heterogeneous plant selection and provides habitats for various animal species.

Figure 10. Exemplary section through ground-based urban agriculture. Own graphic.

are potential combinations:

- projects on residential buildings // primarily used by multiple building occupants
- non-profit operations supplying shelters or kitchens // often staffed by volunteers
- projects on schools with a focus on education // primarily used by instructors and their pupils
- projects on restaurants and hotels to supply the kitchen // staff
- projects on private residences // solely used by house owner

Green roofs are an excellent site for putting up a beehive and hereby encourage pollination.

With regard to rooftop agriculture - and actually agriculture in general - apiculture is worth mentioning. The benefits of bee-keeping surpass the production of honey. Bees are productive pollinators and hold an essential role in urban agriculture: a study in New York City discovered that 92% of crop plants grown in community garden are depending, to a certain extent, on bee pollination (Matteson et al., 2009). This ecosystem service is jeopardised - mainly due to colony collapse disorder, which is caused by various factors. Among other things, these include varroa mites (a pest of honey bees), exposure to toxic pesticides and fungicides, inadequate forage and herewith malnutrition as well as changes to the habitat where bees forage (van Engelsdorp et al., 2009; EPA, 2015). For these reasons, urban agriculture and apiculture could form a symbiotic relationship. Either, the urban agricultural projects include beekeeping in their activities, or they make use of so-called "bee hive rental". All around the world there are initiatives, which are specialised on the rental of fully managed beehives. One of them is "KIWI bees" from New Zealand, which aims to foster and promote sustainable bee-keeping across New Zealand. They offer the whole range of services - be it training and courses, pollination or the extracting and packaging of honey (KIWI bees, n.d.).

With regards to rooftop agriculture, bee-keeping is quite well-suited to be included. First of all, the honey bees can forage uninterruptedly on the roof habitat and secondly, the bee-keepers are more or less informed, who is accessing the area and can take necessary precautions. With this, the risk of bee-stings can be significantly reduced (Satow, 2013).

All in all, rooftops are an extensive resource that can be used for agricultural purposes and mitigate the space limitations, to which ground-based agriculture is faced with. Based on the rapid development of skills and materials by today's rooftop agriculture pioneers, it is likely to make a broader implementation much more realisable in the near future (Ackerman, 2012). Nevertheless, also yet untapped open green spaces bear a considerable potential and should definitely be included in the search for convertible spaces.

Practical examples

Throughout the world, there are a myriad of interesting and very successful ground-based urban agriculture projects - be it on the ground or on rooftops. In the following paragraphs some initiatives are presented, which we consider as standing out from the mass. The first project is the *Intercultural Garden* in Wilhelmsburg, a multicultural district in the South of Hamburg, Germany. Wilhelmsburg is characterised by a high rate of unemployment, low average incomes and social tensions. Due to the inhabitants diverse cultural backgrounds,

integration is a key issue. In 2006, the *Intercultural Garden* was launched to promote social integration as well as to create an inclusive society. It represents a space for peaceful coexistence and illustrates the importance of respect, appreciation and collective activities for the process of integration (BSU, 2009).

The second practical example is a project of the *Aristotle University of Thessaloniki* (AUTh) in Greece. At the outskirts of Thessaloniki, there is the faculty of agriculture's university farm - a space for laboratory workshops, research and internships. It consists of livestock husbandry and experimental fields. One part of the farm's area has been converted into organic kitchen gardens, which are rented by the citizens of Thessaloniki. Noteworthy is the fact, that the students act as teachers and instruct the tenants about sustainable farming practices. Hence, while the townsfolk is learning more about farming, the students simultaneously reinforce their lecture material (AUTh, 2015).

The third and fourth practical examples are both restaurants - the *Roppongi Nouen* in Tokyo and "Rosemary's" in New York. Although they pursue different strategies, urban agriculture is the connecting element. The first one, *Roppongi Nouen*, realised, that agriculture is seen as unsustainable and therefore unappealing for many young Japanese people. The restaurant transformed this "nation-wide dilemma" (Roppongi Nouen, 2015) into an opportunity and decided to provide a stage to the producers. At this place, they are the stars and are reconnected to the city dwellers with through various events: "*Meet the Farmer*" evenings as well as "*Dining Adventures*" in collaboration with local brewers, craftsmen and growers are important features of the concept. Furthermore, the restaurant's furnishing is equipped with small vegetative patches, where edibles are grown and right away included in the menu (Roppongi Nouen, 2015). *Rosemary's*, located in New York's West Village, opened in 2012 in immediately received wide acclaim - also thank to their impressive rooftop garden. Vegetables (from salads to pumpkin), edible flowers, herbs and even hops are grown in this garden. According to Wade Moises, chef at *Rosemary's*, the harvest is used throughout the menu, especially during peak season (Jones, 2014).

The fifth project is located in one of Amsterdam's many attractive streets - equipped with fully mature trees and framed with beautiful historical buildings. In the course of urban regeneration works, in which the street's buildings were newly developed or fully renovated, an impetus was given to the quality of the public space. Under the motto "make a garden street from the Banka street", the initiative developed and still successfully maintains 20 sidewalk gardens. *Bankastraat*, as the project is called, considers these little gardens as important components to contribute to a liveable and more attractive atmosphere and to develop community spirit through social interaction (Bloemhoff, 2006).

In excursus #3 // ground-based urban agriculture, there are some photographs of the projects and some more additional information.

FOREST GARDENING

Overview & characteristics

Forest gardening is characterised by a high level of self-organisation and requires - if managed correctly - only a minimal amount of maintenance (Jacke, 2008). Robert Hart, a pioneer of forest gardening, developed a system, which is divided into distinct levels

(see fig. 11). It is based on the archetype of natural woodland and incorporates a diverse range of useful, primarily perennial plant species (Hart, 1996). In its original form, a forest garden consists of the following layers:

- 1: canopy layer // large fruit & nut trees
- 2: low tree layer // dwarf fruit & nut trees
- 3: shrub layer // currants & berries
- 4: herbaceous plants // comfrey, beets & herbs
- 5: rhizosphere // root vegetables
- 6: soil surface // ground-cover plants
- 7: vertical layer // vines & climbers

Many gardens all over the globe contain the same units as a forest garden, but usually each is cultivated separately. What distinguishes forest gardens from ordinary gardens is, that all elements are cultivated together on the same piece of ground. Furthermore, they are grown one above the other and consequently utilise space horizontally and vertically (Whitefield, 2002).

This type of cultivation is also known under the name of "outdoor food forest" (de Graaf, 2013).

Due to the fact, that forest gardening mimics the patterns of natural woodlands, the greatest diversity of valuable plants can be grown in one space: from tall trees, which reach up to the light, to low-growing species that cover the soil surface (Jacke et al., 2005). It is a way to building up a garden as an ecosystem and requires - besides a considerable amount of patience - a comprehensive understanding of natural processes, interactions and cycles (de Graaf, 2012).

The diverse mix of plants makes a forest garden very productive and leads to a versatile edible output. Additionally, the yield includes medicinal plants and other non-food products, such as fibre and fodder (Jacke et al., 2005). Compared to other types of urban agriculture, the output, namely the produce, in proportion to the required input - mostly labour - is optimised (de Graaf, 2012).

Additionally, the heterogeneous plant selection creates synergies among the various plant species. Some of them are not primarily chosen for their ability to produce food, but to boost soil fertility. Among these plants, there are the nitrogen-fixing crops, whose roots create symbiotic a partnership with micro-organisms. With the aid of these bacteria, namely Rhizobia, nitrogen compounds can be fixed and become naturally available to neighbouring plants over time through root die back or leaf fall. Another category of fertility boosting plants are the so-called dynamic accumulators, whose roots draw up nutrients from the subsoil and store it in the leaves. With the leaf fall in autumn and the subsequent decomposition, the stored nutrients are then incorporated into the upper layers of the soil, from where shallow-rooted plants will benefit from them. As a matter of course, also a mulching with pruned and shredded fertility boosting plants supplies the remaining vegetation with these nutrients (Ussery, 2007). There are such plants for all layers of a forest garden, whereby dandelions, vetches and clovers are certainly the most renowned ones.

However, the plant selection is a key component of the seven-layer system and crucial

Figure 11. Exemplary section through a forest garden with all seven layers. Own graphic.

for a successful outcome (Hart, 1996). Since a vast majority of today's grown vegetables are sun loving plants and not perfectly suitable for the rather shady environment, a forest garden requires thorough planning (de Graaf, 2013). After all, this could be an opportunity to take back forgotten vegetable varieties, so-called heirloom plants. There are numerous organisations, which are dedicated to preserving heirloom seeds (Pro Specie Rara, 2015). This is not only of major importance in order to maintain genetic diversity, but offers exciting moments - be it the fascinating histories of such old-time varieties or their extraordinary appearance. Among the vegetables with appealing qualities are for example a French blue-violet potato called "Vitelotte Noire"; an Italian beetroot called "Chioggia", whose inside astonishes with a pattern of concentric with and red rings or an exceptionally sweet cherry tomato called "Black Cherry" (Pro Specie Rara, 2015).

Since the size of forest gardens is adaptable, they are viable in various open space typologies, such large parks, suburban lots, urban courtyards and even smaller spaces (Jacke et al., 2005). In contrast to many other types of urban agriculture, a forest garden provides a visually diversified outdoor environment all along the entire year - be it the blossoming fruit trees in spring or the colourful autumn foliage of various climbers. However, as de Graaf states, they usually do not make the city greener, but often improve the quality of existing green areas - both aesthetically and ecologically (2012). Regarding a city's metabolism, its considerable capacity for keeping and evaporating stormwater is valuable for integrating into sustainable development practices.

Practical examples

Forest gardening is "probably the world's oldest and most resilient agroecosystem" and is also nowadays practiced all around the world (McConnell, 2003, p. 1). However, due to the knowledge-intensive planning, many practical examples have simplified the system and work with fewer layers. One very successful project is *The Urban Orchard Project*, which aims to create "lush cities across the United Kingdom swathed in fruit and nut trees" (TUOP, n.d.). In partnership with communities, orchards in urban areas are planted, managed, restored as well as harvested. Through urban orchards, the initiative intends to improve the townsfolk's well-being, strengthen communities and establish London's resilience (TUOP, n.d.).

While *The Urban Orchard Project* primarily works with only one of Robert Hart's suggested layers, namely rather large nut and fruit trees, San Francisco's *Friends of the Urban Forest* (FUF) additionally incorporates so-called sidewalk gardens with shrubs and ground-cover plants. The non-profit organisation's mission is to "promote a larger, healthier urban forest as part of San Francisco's green infrastructure through community planting, tree care, education, and advocacy" (FUF, 2015). Since 19981, they have planted nearly 50'000 trees, which account for 47% of the city's street tree canopy (FUF, 2015).

Both projects show that forest gardens are applicable in various locations - even on small easement patches. Although in this case the term *forest* is maybe a bit misguiding, the combination of fruit or nut trees and supplementary vegetation is a very accessible type of urban agriculture. In "excursus #2 // forest gardening", the previously mentioned projects are presented with some photographs and additional information.

STAKEHOLDERS

Over the last two decades, there has been burgeoning interest in urban agriculture (Bohn et al., 2014b). Since this upsurge demand is mainly coming from the side of the citizens, less attention has been given to governance processes - for example the decisions of liable authorities and their cooperation, which is necessary for the successful establishment and long-term maintenance of such initiatives (Lawrence et al., 2013; Besse et al., 2014; von der Haide, 2014; Ugoloni et al., 2015).

Since Freeman (1984) announced the definition of stakeholders as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (p. 46), the concept gained a fair amount of theoretical and empirical attention (Haigh et al., 2009). Also in the far-reaching field of urban agriculture, a complex network of direct and indirect stakeholders is unavoidably involved - be it practical gardeners, public administrators of public green spaces, neighbourhood representatives or even donors. Frequently, their points of view, requirements, expectations, ways of proceeding as well as their willingness to contribute differ significantly (Ugolini et al., 2015). Thus, it is of major importance to identify the primary stakeholders and their role in urban agriculture's field of use in order to tap its full potential and multifunctional nature.

The subsequent paragraphs provide an overview on four key stakeholders and delineate their aims as well as their major contribution to urban agriculture. Furthermore, there is also an attempt to capture the natural environment's meaning and its placement in urban agriculture.

URBAN GROWERS

The moving causes, why city dwellers are voluntarily participating in urban agriculture are manifold and, as previously described, originate from numerous circumstances and motivations. Furthermore, there is a variety of supplementary - often community-conscious - objectives that accompany their work, such as:

- providing safe spaces for circumjacent residents and improve the neighbourhood's liveability by cleaning, shaping and beatifying vacant, underutilised as well as neglected spaces
- (re)connection to nature
- physical outdoor-activities and mental recreation
- building social capital & developing a community spirit
- educating people of all ages
- participation on urban development and striving for public visibility

The objectives on the right are collected from numerous sources: Wolley, 2003; TEEB, 2011; Cohen et al., 2012; Golden, 2013; Simon et al., 2013; von der Haide, 2014 and Mok et al., 2014

In order to achieve these goals, urban growers need an array of resources. As shown in table 4, they can be divided into physical and non-physical elements (Cohen et al., 2012). It is recognisable from the objectives as well as from the required elements; this key stakeholder is concerned with a multifaceted bunch of activities. Some of the important tasks, but by no means complete, are the following ones: 1) cultivation: seed propagation, growing vegetables and composting; 2) construction: knocking together seating facilities or

Table 4. A list of physical and non-physical components, which are necessary for practicing urban agriculture.

PHYSICAL COMPONENTS	NON-PHYSICAL COMPONENTS
(LEGAL) GROWING SPACE park decks, brownfield plots, along sidewalks, ...	OPERATING FUNDS
CONSTRUCTION MATERIAL waste timber, plastic bakery boxes, beanpoles, ...	LABOUR local residents, community organisations, ...
GROWING MATERIAL seeding & planting material, soil, mulch, straw, ...	PERMITS TO BUILD REQUIRED INFRASTRUCTURE system for rainwater harvesting, tool shed, ...
FERTILISERS compost, manure, worm castings, ...	TRAINING & TUITION learning from best practices, ...
TOOLS shovels, muckrakes, watering cans, pruning shears, ...	NETWORKING OPPORTUNITIES regular meetings, web-based platforms, ...
WATER water connection, irrigation system, ...	
APPERTAINING INFRASTRUCTURE tool sheds, bins to compost food waste, ...	

Source: based on Cohen et al., 2012. Own graphic.

climbing frames for twiners; 3) education and trainings: food systems, intercropping and well-being; 4) events: communal cooking and marmalade swaps.

All in all, urban growers are the main actors of urban agriculture - without their interest, labour and invested time this multitude of projects would not take place.

SUPPORT ORGANISATIONS

Such organisations - as the name already implies - support urban agriculture initiatives. This assistance includes the provision of training, materials or even funding. Furthermore, they encourage public administrators and government officials to develop policies and programmes that are beneficial for urban agriculture (Cohen et al., 2012). An additional work of support organisations, which is of major importance to tap urban agriculture's potential, is conducting research by monitoring, assessing and evaluating - existing and planned - projects. Although the extent of such support strongly depends on the city, their activities can be arranged in the following categories:

These five categories are largely based on the publication *Five Borough Farm: Seeding the Future of Urban Agriculture in New York City*. According to the authors, this work provides "the most detailed survey ever produced about urban agriculture in New York City" (Cohen et al., 2012, p. 1).

Technical assistance and training for urban growers

This support encompasses a broad assortment of skills and information - be it knocking together a raised bed from waste wood or pest management to leading a participatory process (Cohen et al., 2012). Generally, urban agriculture is practiced by people without agricultural background and, therefore, training in crop cultivation might be helpful to offset missing know-how.

Resources and Funding

On the one hand, support organisations place at the disposal "in-kind items" such as plant starts and growable soil (Cohen et al., 2012, p. 63). On the other hand, they provide loans for equipment as well as small grants. Inter alia, this also includes the assistance of grant writes, who can help to raise funds from donors (Cohen et al., 2012).

Advocacy and policy work

Support organisations participate in a large bandwidth of policy work and are involved in

different undertakings - be it legalising bee-keeping in New York City or growing so-called open source food with the aid of public space food plantings in Todmorden (Cohen et al., 2012; Paull, 2011). In densifying cities, advocating for preserving and extending the spaces available for urban agriculture is of major importance (Cohen et al., 2012).

Environmental education services
Some support organisations are specialised in educational programmes - be it how to set up an efficient irrigation system or to demonstrate, where food is coming from. They are not only giving classes, but also provide curricula and educate community members to become teachers in their community (Cohen et al., 2012).

Networking
There are support organisations that organise networking opportunities for urban growers and urban agriculture projects. For instance, there are web-based platforms or continuously held outreach events and group meetings (Cohen et al., 2012).

These five categories demonstrate, that support organisation provide a broad set of assistance. However, the common denominator - and key contribution to urban agriculture - is the provisioning of specialised knowledge and know-how.

GOVERNMENT OFFICIALS

Even if urban agriculture is often not explicitly mentioned in government programmes, government officials of various agencies are involved in urban agriculture in making urban agriculture possible. On numerous levels - federal, state and local - government agencies offers support in many ways, such as provisioning of equipment and auxiliary means, technical assistance and logistical support as well as help with construction and maintenance (Cohen et al., 2012).

The most important part, however, is the allocation of legal growing space. Without space, urban agriculture can not - or only limitedly - take place.

FUNDERS

There are multitudinous foundations that fund urban agriculture projects as well as appertaining support organisations (Cohen et al., 2012). With the growing interest in urban agriculture, financial support is increasingly granted by companies that include philanthropy in their corporate social responsibility. Since urban agriculture projects are often carried out on a voluntary basis, their financial ability is often limited and even little capital spendings have to be thought out carefully. For this reason - and even if they support urban agriculture projects in various ways - the provision of financial resources is the funders' key role.

SPECIAL CASE - NATURAL ENVIRONMENT

There is a long-time debate in the stakeholder literature, whether the natural environment should be considered a stakeholder or not (Haigh et al., 2009; Laine, 2010). Even if it is a rather complex discussion, it is carried on passionately and the justifications are manifold.

The proponents argue that the natural environment should inherently occupy a "prominent and visible position" in the stakeholder model (Laine, 2010, p. 74). For instance, Mitchell et al. (1997) acknowledge the natural environment as a stakeholder with compelling and justified claims. Similarly, also Stead et al. (1996) recognise it as a stakeholder. Moreover, they see it as the "ultimate stakeholder, since it differs fundamentally from the other stakeholder groups" (Laine, 2010, p. 74). In their opinion, the core idea is the planet Earth, which is the origin of all human activity (Stead et al., 1996). Wheeler et al. (1997) introduced yet another perspective on the natural environment's position. According to their fourfold stakeholder typology (primary/secondary, social/non-social), the natural environment is given a primary non-social position. This implies, that its rights might be affected, but it cannot directly communicate with other stakeholders. Thus, human proxies speak for its benefit (Stead et al., 1996; Fassin, 2009).

However, this "mute" character is one of the opponents main counterargument. Orts et al. (2002), for instance, object to the fact, that the natural environment cannot be a stakeholder because it neither has a mind or necessities as human beings understand them. Or, as Näsi et al. (quoted in Laine, 2010, p. 75) point it out: "nature cannot speak". Furthermore, would the natural environment be accepted as a stakeholder, the whole concept's theoretical rigour and explicitness become diluted (Fineman et al.,1996; Phillips et al., 2000; Orts et al., 2002).

Since it seems, that there is some truth behind both parties lines of reasoning, a kind of compromise has to be found. As Ingold (2000) states, the natural environment surrounds. This indicates that there is something, which is encircled by the natural environment. As a consequence, a particular stakeholder network would be placed and embedded in a "timely and spatially limited natural environment" (Laine, 2010, p. 77).

In this study, we are in line with Phillips et al. (2000) and Orts et al. (2002) and do not recognise the natural environment as a stakeholder such as human groups or individuals, but embed the key stakeholders - urban growers, support organisations, government officials and funders - in the natural environment. Hence, it represents the surrounding context in which urban agriculture's activities take place (see figure 12). Albeit it is positioned in the background, it is not thrust to the periphery, but occupies a visible and appertaining part of urban agriculture Laine, 2010).

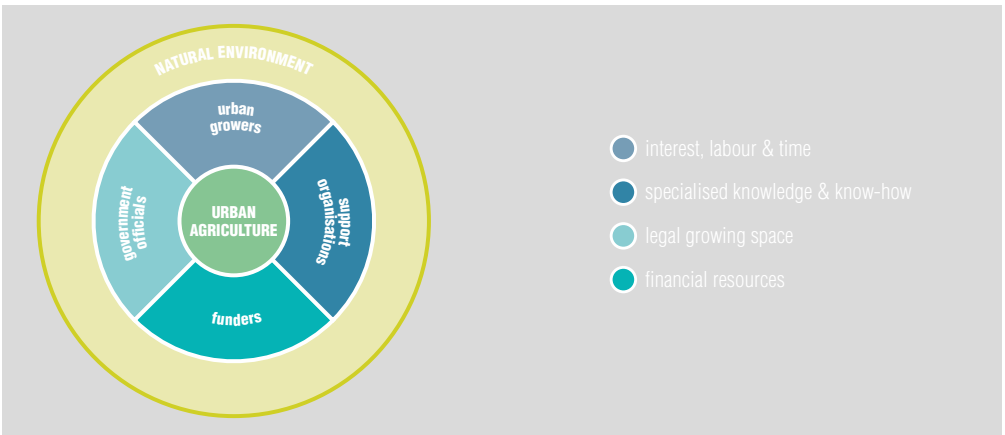


Figure 12. Urban agriculture, its stakeholders and the natural environment. This figure shows, that urban agriculture's key stakeholders are surrounded by the natural environment. Listed on its right side, there is each stakeholder's main contribution to urban agriculture. Own graphic.

BENEFITS

Thanks to urban agriculture's multidimensional nature, it can positively contribute to the well-being of the city and its inhabitants. Numerous studies and expert reports have analysed and evaluated these positive impacts. Nonetheless, these researches often focus on particular aspects or specific cultivation methods, thus, there is a lack of a comprehensive view onto urban agriculture's benefits. Therefore, the aim of this chapter is to provide an overarching compilation of urban agriculture's benefits, in order to reveal its diversity and fortify its reason for existence in the urban landscape. The benefits are structured into four categories:

- SOCIETY // benefits that co-create an inclusive city
- HEALTH // benefits that co-create a healthy city
- ECOLOGY // benefits that co-create an eco-friendly city
- ECONOMY // benefits that co-create a productive city

It is important to note that some of the cited literature do not explicitly refer to the term urban agriculture as such, but specifically address some of its numerous components. Since we previously outlined urban agriculture as a multifaceted topic, we have reference to these researches and cite them accordingly.

SOCIETY // CO-CREATING AN INCLUSIVE CITY

Throughout the literature about urban agriculture in developed countries, the most observed impact was its positive effect on communities as well as on the lives of residents and participants. It seems to be a matter of common knowledge, that urban agriculture is not practised for food production per se, but because of its potential for valuable community building. Urban agriculture creates important spaces for gathering as well as socialising and can be seen as an "agent of change" (Holland, 2004, p. 291) - it brightens up neighbourhoods, reduces crime, fosters a sense of pride in the community and promotes cultural and cross-generational integration.

Community building

With the aid of urban agriculture - in particular community gardens - underutilised or neglected spaces can be transformed into a public resource that provides opportunities for social interaction, and therefore, greater community cohesion (Ackerman, 2012). According to Armstrong (2000, p. 325), such gardens seem "to provide a symbolic focus", which evoked a feeling of neighbourhood pride and encouraged community involvement, shared values as well as mutual social support (Allen et al., 2008). Especially in low-income, underprivileged and/ or minority neighbourhoods, social networks and organisational capacities can be improved through community gardens - probably due to a larger number of oppressing issues in those neighbourhoods, which are apparently in want of attention (Armstrong, 2000). Furthermore, there is evidence that community gardens bring about further neighbourhood organising by offering a physical space for residents to meet, socialise, get to know more about other activities in their local community (Armstrong, 2000). Thus, gardens can have a catalytic effect on residents to not only start addressing issues collectively, but also to increasingly take advantage of potential synergies (Patel,

According to the University of California, a community garden is " any piece of land gardened by a group of people, utilizing either individual or shared plots on private or public land. The land may produce fruit, vegetables, and/or ornamentals." (UCANR, 2015).

1991; Armstrong, 2000; Holland, 2004; Teig et al., 2009).

With various measures - such as wheelchair accessible tables or ergonomic tools - urban agriculture projects can also accommodate people with a range of disabilities. It provides an opportunity to improve motor skills as well as being involved in groups and community activities (Better Health, 2015).

Urban agriculture is also a possibility to promote cross-generational and cross-cultural integration. There are numerous urban agriculture projects that focus on specific target groups. While so-called "intercultural gardens" intend to include gardeners with diverse cultural backgrounds, cross-generational gardens aims to foster the collaboration among children, youth, adults and pensioners (Armstrong, 2000; Golden, 2013). Both concepts represent opportunities to share gardening skills and pass on knowledge. Furthermore, they are capable of bringing together social strata that are normally remote from each other and herewith contribute to a mutual comprehension. Just as Tassew Shimeles, project director of „International Gardens" in Goettingen (Germany) states: "The soil connects us with our neighbors, with other people and institutions. The soil connects us with our innermost strength" (Cities of Migration, 2014).

Ironically, a substantial weak point of traditional community gardens is their person-specific nature. The people who typically benefit the most from such gardens are only those directly engaged in the activities. Public produce, in turn, creates for all citizens an opportunity to gather food. Thus, they constitute not only a valuable component of urban agriculture, but also a meaningful supplementary to community gardens (Nordahl, 2014). Still, public produce is contributing to community development, optimally explicable by means of two examples. Firstly, a fruit tree is not instantly productive; still it signals dedication to the community and the soil. Even if it takes several years to harvest the first fruits, once mature, such a tree produces more fruits than a single household can consume. Thus, sharing and the aspiration for new ways to enjoy the fruits are encouraged (Berthelsen et al., 2013). Secondly, across the globe there are organisations that connect so-called "urban foragers". With the aid of interactive maps, they highlight the finding places of fruit trees, berries, herbs and other wild plants in publicly accessible spaces. Thus, web-based platforms the locations are shared as well as experiences and cooking recipes exchanged (Mundraub, 2015). There are various urban foraging communities, such as *Fallen Fruit* (worldwide, mainly USA), *Mundraub* (worldwide, mainly Europe) and *Boskoi* (Netherlands, mainly Amsterdam). Although the exchange of ideas and knowledge among the users mainly takes place in the virtual world, such platforms make a contribution to community building - namely by connecting people with common objectives.

Public produce is a subset of urban agriculture and refers to herbs, fruits, vegetables and nuts that are cultivated in public spaces and are freely available to the public (Nordahl, 2014).

Since public produce comes along with a change of open spaces' visual appearance - edible crops at the expense of ornamental flowers and neatly cut lawns - it apparently does not correspond to all city dwellers likings (Viljoen et al., 2014). Nonetheless, statistics from "Incredible Edible Todmorden" have pointed out remarkable results: 96% of the respondents are happy with the publicly grown edibles; 67% regularly pick from the healthy offering and 57% have initiated related activities such as vegetable gardening or keeping chickens (Kuenzler, 2014).

Education

A further impact of urban agriculture includes providing a space for learning experiences, educational programmes as well as youth development opportunities (Golden, 2013). There are a good many of studies and reports, that describe projects with educational services - such as nutrition classes, after-school gardening for children or job training. The learning

achievements included, inter alia, increased awareness of environmental issues and social equity, food systems or healthy lifestyle (Alaimo et al., 2008; Allen et al., 2008; Cohen et al., 2012; Bradley et. al., 2013).

Along with civic participation, these learning outcomes enable residents to develop strong "strong civic virtues and critical perspectives" (Levkoe, 2006, p. 89). These, in return, empowered residents to have an effect on policymakers and to increase their level of political influence as well as advocacy to directly attenuate inequities and "anti-democratic forces of control" (Levkoe, 2006, p. 89; White, 2010).

Sense of pride

A further benefit of urban agriculture lies therein that it can transform neglected spaces - be it a vacant lot, underutilised lawn areas between high-rise residential buildings or even a vegetated strip along parking lots - into flourishing oases. As vast parts of urban land are owned by corporation or private instances, this can be of major importance in impoverished or high-density neighbourhoods. This is based on the fact, that urban agriculture can provide "a piece of land for people to call their own for a season at least" (Patel, 1991). Thus, it offers landless people an opportunity to develop a sense of pride and feeling of belonging through territorial appropriation (Armstrong, 2000; Brunson et al., 2001; Allen et al., 2008; Teig et al., 2009; Bradley et al., 2013). Furthermore, such cultivated spaces provide an opportunity of versatile open spaces that are close-to-home (von der Haide, 2014).

Aesthetic improvement

With urban agriculture, urban dwellers are increasingly shaping the urban landscape and it is therefore often associated with the improvement of physical space (von der Haide, 2014). Community gardens or greenery, in general, aesthetically meliorate neighbourhoods by bringing natural beauty to places that may be lacking it. Along with community involvement, this embellishment of space leads to less graffiti and trash. Urban growers are proud of the beauty they have brought into being and others seem to notice as well as appreciate it as well (Simon et al., 2013). Furthermore, the increased attachment to space results in safe spaces that were not only less likely to be vandalised but also featured a reduction in crime (Brunson et al., 2001; Allen et al., 2008; Teig et al., 2009; Bradley et al., 2013). Thus, urban agriculture projects are places to build trust, create a sense of community as well as concern for others in the neighbourhood (Armstrong, 2000; Teig et al., 2009).

An experiment has revealed that tree-lined streets were perceived to be safer - both in urban and suburban settings. Furthermore, individual driving speeds were significantly reduced in the suburban conditions with trees (Rosenblatt Naderi et al., 2008).

Sense of security

With reference to greenery and safety, it is noteworthy to cite the study of Kuo et al. (2001a), who compared crime rates for 98 apartment buildings with varying levels of nearby vegetation in Chicago. The results revealed, that "buildings with high levels of vegetation had 52% fewer total crimes, 48% fewer property crimes, and 56% fewer violent crimes than buildings with low levels of vegetation" (Kuo et al., 2001a; p. 355). Green spaces receive greater use, which fosters "eyes upon the street" (Jacobs, 1961, p. 35) and, thus, increase the informal surveillance and provide an increased sense of security (Kuo et al., 2001a).

To sum up, urban agriculture's impacts on the society are manifold. The co-creation of an inclusive city takes place on various levels - from an urban grower's sense of pride and increased community cohesion to beautified, functional, well-maintained and safer

neighbourhoods (see figure 13). Thus, it recognises the individual human being and provides equal participation across age, abilities, gender or ethnicity. In collaboration with others, the environment - bet it an entire neighbourhood or a front garden in a multiple family dwelling - can be shaped according to their needs. Furthermore, such spaces often display social and cultural rituals as well as symbols that have a meaning for all residents. This, in turn, creates social cohesion and support community development (Inclusive City, 2007).

HEALTH // CO-CREATING A HEALTHY CITY

Urban agriculture can have a positive impact on city dwellers' health. There are some benefits that directly address urban growers while others contribute to the well-being of all urban citizens. The latter strongly refers to the presence of a natural environment within the built structure. Urban growers themselves reap the benefits of urban agriculture in a variety of ways, in particular due to physical activity and an improved relationship with food.

Physical activities

When people come together around urban agriculture, physical activity levels are often boosted (Waterford, 2015). Urban agriculture activities include many forms of exercises, "ranging from fine motor to gross motor activities" (Mattson, 1992, p. 166). While physically disabled or elderly urban growers take care of fine motor tasks, such as transplanting or cutting flowers, people with more physical abilities carry out gross motor activities such

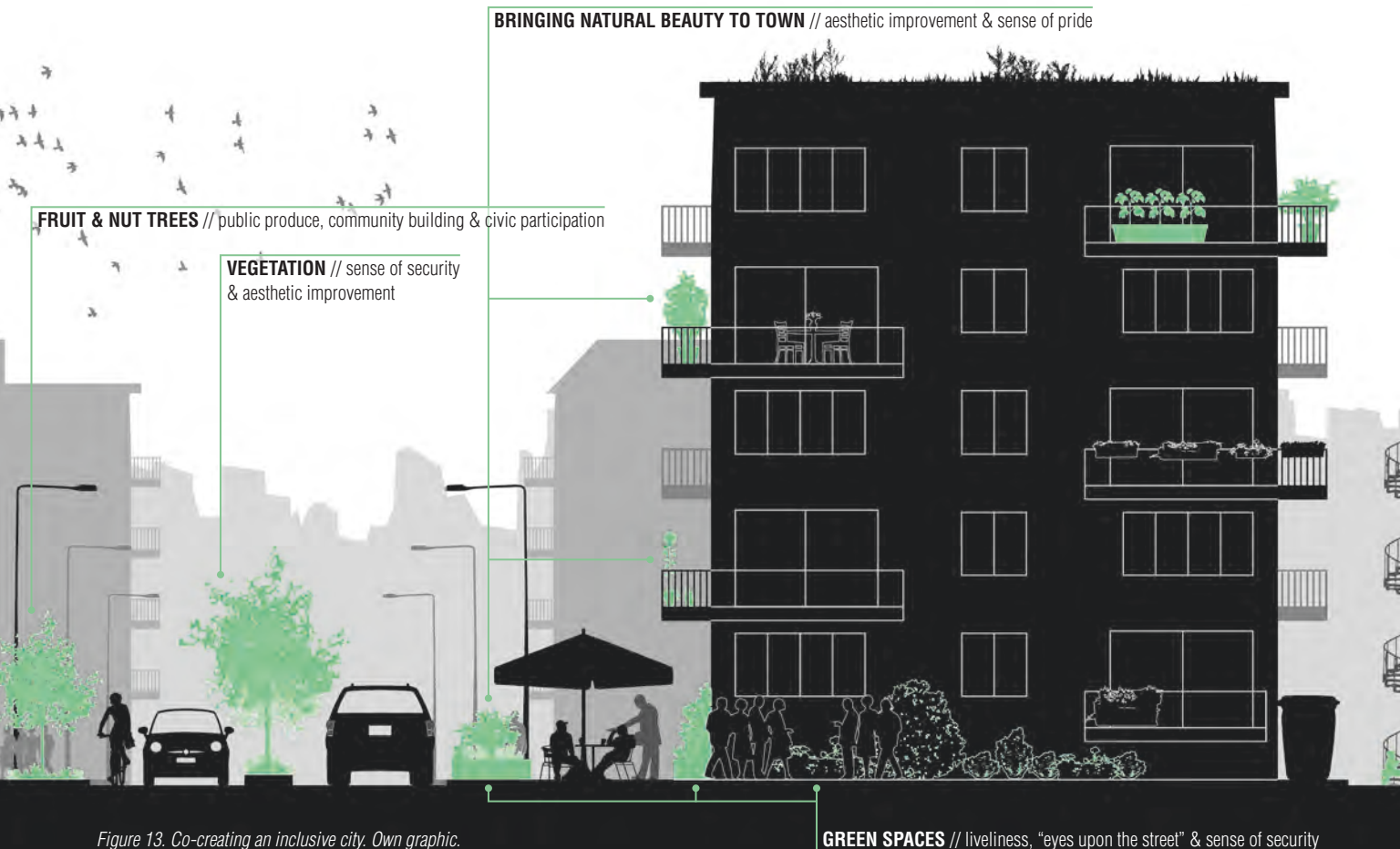


Figure 13. Co-creating an inclusive city. Own graphic.

as pulling weeds, raking leaves or digging up flower beds (Mattson, 1992). Generally, gardening is considered to be a "satisfying labour" (Hanna et al., 2000, p. 210). Furthermore, many urban growers state that working in urban agriculture is a lot more interesting than going to the fitness studio and, furthermore, that in this way they have "fun" doing exercise (Waterford, 2015, p. 4). We assume, that urban growers feel - unconsciously - that way, because of gardenings "aerobic, noncompetitive nature" (Mattson, 1992, p. 166).

Thanks to the fact, that gardening can be adapted to anyone's needs and physical abilities, it is not only known as a recommended form of physical activity but has evolved to be one of the most frequently practised types of exercise "across age, gender, and ethnicity" (Bellows et al., 2004, p. 7; Hanna et al., 2000; Armstrong, 2000).

Gardening activities - along with comparable exercise such as swimming, bicycling at < 15km/h or moderate walking - can significantly ameliorate practitioners' physical fitness and is, therefore, beneficial for their health (Hanna et al., 2000; Hynes et al., 2004). Since gardening involves numerous tasks and is, therefore, feasible "for a range of age and ability levels" (Sommerfeld et al., 2010, p. 709), research often unravels its holistic advantages (Bellows et al., 2004). Nonetheless, there are numerous studies that focused on particular benefits, for instance lowering the risk of chronic diseases from overweight, sedentary lifestyles and physical inactivity for both adult and children (Blair et al., 2002; Hynes et al., 2004; Castro et al., 2013). While latter addresses both adult and children, many

The cited health benefits are taken from these studies: Ekblom-Bak et al., 2014; Bellows et al., 2004; Beitz et al., 2004; Chau et al., 2004; Reynolds et al., 2004; Park et al., 2009.

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studies approach a specific age group or population strata. Among other things, gardening has been associated with reducing risks of coronary heart diseases (notably elderly males and menopausal women) and occupational injuries (railway workers). Furthermore, it can improve glycemic control as well as weight loss (obese diabetes sufferers) and beneficially support hand strength and pinch force (elderly people).

In addition, there are numerous research works that focus on leisure-time gardening programmes for children. It could be proven, that gardening increased the physical movement and herewith the energy expenditure (Kien et al., 2003; Herman et al., 2006; Phelps et al., 2010; Castro et al., 2013). A remarkable advantage of gardening as a form of physical activity is that it does not necessitate athletic skills. Thus, children that are normally sitting on the sidelines during school-sponsored sporting activities can easily be involved in this non-competitive alternative (Kien et al., 2003).

Mental well-being

Stephen Kaplan once stated: "Nature is not just 'nice'... it is a vital ingredient in healthy human functioning" (quoted in Malakoff, 1995). On this view, studies from an array of disciplines - ranging from sociology and psychology to medicine and economics - have explored the people-plant interactions (Malakoff, 1995).

In the urban landscape, gardens, as well as other close-to-nature vegetation, can create a retreat from the noise and restlessness of city life (Brown et al., 2000). In accordance to this, numerous studies document that city dwellers can reduce stress, fear and anger as well as blood pressure and muscle tensions by "simply looking at a plant" (Brown et al. 2000, p. 28; Kaplan, 2001; Kuo et al., 2001b; Moore et al., 2007; Catanzaro et al., 2004). Thus, views on nature can have a restorative effect because they evoke a feeling of release or escape from daily life (Kaplan, 1992; Hynes et al., 2004). Based on these findings, gardens have been successfully implemented in patient care and prison environment (Ulrich, 1984; Moore, 1982).

Several studies of more recent date have carried out specific investigations on the effect of immersion in a natural scene - be it a park or another urban green space (Schmutz et al., 2014). According to Bjerke et al. (2006), scenes with a moderate degree of vegetation are preferred in comparison to open or even thickly overgrown. Interestingly enough, the effects of socio-demographic and attitudinal variables have revealed, that well educated, middle-aged, wildlife interested and so-called "ecocentric" (Bjerke et al., 2006, p. 42) people have a higher preference for dense vegetation than other population strata. Another study has shown, that the urban green spaces' psychological benefits increase with the species richness, whereas visible static components of biodiversity (plant species richness) are more accurately perceived. More cryptic components of the urban ecosystems with regard to behaviour and simpleness of species distinction, namely bird and butterfly richness, turned out to be less relevant (Fuller et al., 2007).

Even if many gardeners state that the sheer presence of plants helps to reduce stress and simultaneously improves overall well-being, working with plants evokes both illness prevention and healing responses (Armstrong, 2000; Brown et al., 2000; Patel, 1991; Teig et al., 2009; Golden, 2013). Therefore, health professionals make use of plants and cultivation

Figure 14. Glimpses of Andernach (Germany) and Todmorden (United Kingdom), where typical ornamental plants have been replaced with edible ones. Thus, runner beans and chard naturally belong to the urban landscape and are regularly harvested by the residents.

activities to support patients of different age groups with mental illnesses to improve self-esteem, social skills and use of spare time (Brown et al., 2000; Bellows et al., 2004).

Particularly with regard to the anticipated ageing of the world population and the increased incidence of dementia with advancing age, research on risk factors for dementia has gained international priority (Simons et al., 2006; WHO, 2015a). Based on a long-term study that followed nearly 3'000 older adults for 16 years, gardening activity has proven "to offer substantial protection against the onset of dementia" (Simons et al., 2006, p. 70). Thus, including gardening and many of its critical functions - endurance, dexterity, sensory awareness, learning as well as problem-solving - in senior citizens daily life might reduce the incidence of dementia in future years (Simons et al., 2006).

According to the World Health Organisation, the total number of people with dementia is projected to 75.6 million in 2030 and almost triple by 2050 to 135.5 million (2015).

Interaction with natural spaces has also turned out to have a positive impact on children. Thanks to various studies, there is emerging evidence that contact to nature during childhood - be it growing up next to natural elements, visiting parks or even gardening - might influence attitudes towards nature in later life (Lohr et al., 2005). Even if this is not a benefit per se, "there is much interest from a sustainability perspective in how attitudes and behaviours that are positive toward nature develop" (Keniger et al., 2003, p. 921). The study authors state that the strongest influence comes from active gardening activities, such as picking flowers or piecing together bird house. Thus, in order to benefit the most from this discovery, horticultural programmes should be offered to children raised in urban surroundings with few or no plants (Lohr et al., 2005).

Basically, the beneficial impacts on mental health have its source in various degrees of interaction: the simple view on green spaces or (semi-) natural scenes; the immersion in a natural scene and lastly the active engagement in a natural setting (Schmutz et al., 2014). Thus, for human health it is essential to maintain green spaces in urban settings, because "less green nature means reduced mental well-being, or at least less opportunity to recover from mental stress" (Pretty et al., 2005, p. 2). Nonetheless, it is not enough to simply provide green space, the active involvement - be it from children or elderly people -

is a crucial component for prosperousness on human health (Fuller et al., 2007).

Nutrition

Throughout the world, food accessibility and food security are among the main reasons why people are engaged in urban agriculture. Especially in developing countries, urban agriculture can make an important contribution to household food security (see excursus #5 // Urban agriculture in the Global South). In the Global North, urban agriculture has been practised for food safety especially during times of crisis or food shortages (FAO, 2015). Nowadays, especially low-income families benefit from an easier access to fresh produce and greater choice (Cohen et al., 2012; von der Haide, 2014).

Since urban agriculture is influenced by manifold variables - growing techniques, cultivated crops and environmental factors (soil, water, sunlight, ...) - it is difficult to estimate its potential yields and the correlated benefit for food safety (Ackerman, 2012). It should be pointed out, that urban growers describe the production of food as one of the many facets of urban agriculture. Thus, maximising yield is not their main objective - especially if doing so could impair or even undermine other intentions (Ackerman, 2012).

However, the fresh produce is not only consumed by urban growers, who are willing to participate and invest time, but also the remaining city dwellers can benefit from it (Patel, 1991; Armstrong, 2000; Teig et al., 2009; Golden, 2013). On the one hand, there are community garden programmes that grow beyond the personal consumption and donate

Figure 15. Co-creating a healthy city. Own graphic.

excess vegetables and fruits to local food banks or with the direct neighbourhood (Balmer et al., 2005; Corrigan, 2011). On the other hand, there are initiatives that grow produce on the urban public ground and let it harvest by the (interested) city dwellers. However, the latter is - at least in some cases - still in the fledgeling stage. People are ashamed to pick public produce, because it could seem like they are in need of free goods (F. Berger, personal communication, October 26, 2015; Diening, 2013). Or, as Darrin Nordahl after many years of promoting and managing public produce states: "people are reluctant to harvest public edibles because they perceive them as private" (Nordahl, 2014, p. 115). The simplest solution to bypass this situation would be a sign, which encourages folks to harvest ripe produce (Nordahl, 2014).

Todmorden (United Kingdom) and Andernach (Germany) are two examples, where public produce is implemented all over the town's open spaces (see figure 14). Ornamental plants are progressively replaced with edible ones, which can be harvested by the townsfolk. The effects are far-reaching, including community-building, municipal savings or reduced vandalism.

Another beneficial impact on human being's health is the evidence that urban agriculture increases the fruit and vegetable consumption among participants (Brown et al., 2000; Alaimo et al., 2008; Allen et al., 2008; McCormack et al., 2010). According to a study by Alaimo et al. (2008), "adults with a household member who participated in a community garden consumed fruits and vegetables 1.4 more times per day than those who did not participate, and they were 3.5 times more likely to consume fruits and vegetables at least 5 times daily" (p. 94). These results are comparable to and supported through other studies (Teig et al., 2009; Corrigan, 2011).

In addition to the increased fruit and vegetable uptake, urban agriculture also has the potential to make city dweller's diet more diversified. Surveys from Toronto revealed, that

urban growers were not only cultivating typical local vegetables (cabbage, eggplant or tomatoes) but planted an addition 16 vegetable crops to supply the local community with foods non-purchasable in local supermarkets. Thus, the residents benefit from the garden's vegetative diversity and can savour locally grown bok choy, long bean, hairy gourd as well as edible chrysanthemums (Baker, 2004; Lin et al., 2015).

Food literacy

Garden-based education can prove to be beneficial for the nutrition supply of children. In-school gardens - either used for after-school programmes or directly embedded in school lessons along with food preparation, nutrition classes and physical activity - turned out to be good for children's as well as adolescents' eating habits. On the one hand, their vegetable and fruit uptake is increased, on the other hand their attitudes towards vegetables and fruits significantly changes to the better (Lineberger et al., 2000; Morris et al., 2002; Herman et al., 2006; McAleese et al., 2007; Allen et al., 2008). Furthermore, such gardens provide opportunities to engage teachers, parents as well as local gardeners (Herman et al., 2006).

The direct engagement and practical experience with fresh food - cultivation, harvesting, cooking, preserving as well as understanding seasonality - positively impacts food literacy and simultaneously raises awareness about local and regional cultivation conditions (Bellows et al., 2004; Cohen et al., 2012). An anecdote illustrates this benefit quite well: Andernach, an edible city in Germany, designates each growing season with a different motto. Apparently, the "Year of the Onion" was not crowned with success, because people confused the onions with chives and harvested them way to early. Thus, the city's master gardener Eberlein advises pickers as follows: "Only harvest the vegetables, when they look like in the supermarket" (Diening, 2013).

On the whole and regardless of age, gender, ethnicity as well as personal skills, a good many of studies have proven the favourable effect of urban agriculture on urban grower's sense of well-being (see figure 15). Furthermore, they are not solely a result of the direct engagement, but also to the benefit for innocent bystanders. Urban agriculture contributes to a healthy city, because it creates a health-supportive environment and, thus, enhances city dwellers quality of life (WHO, 2015b).

ECOLOGY // CO-CREATING AN ECO-FRIENDLY CITY

Throughout the world, urbanisation is a principal driver for extensive changes in land use and, thus, influences the socio-economic and biophysical and landscape (Grimm et al., 2008; Lin et al., 2015). Typically, urban landscapes are intensively developed and feature large part of sealed surfaces. This results in an array of issues, inter alia urban heat island effect, air pollution or overstrained sewerage systems. Urban agriculture can play an integral role as productive green infrastructure and features significant potential to provide critical environmental services to cities and its inhabitants. These benefits influence a range of umbrella terms, such as stormwater management and climate regulation, and simultaneously entail further co-developmental effects (Dubbeling, 2014).

Stormwater management & urban hydrology

Urban agriculture and its various components - be it fruit-bearing street trees, raised beds

on impermeable surfaces or sidewalk gardens - has numerous beneficial impacts on the urban water infrastructure, both on fresh water as well as on wastewater. With the aid of different strategies, urban agriculture - especially with regard to container-based and ground-based urban agriculture - can reduce its use of potable water for irrigation. On the one hand, alternative sources of water rather than potable water are promoted, such as rainwater or treated wastewater (Ackerman et al., 2012; Freshwater Society, 2013; Dubbeling, 2014; Dhakal et al., 2015). On the other hand, efficient drip irrigation systems are often implemented and in order to save additional water, often used only at night (Freshwater Society, 2013; Dubbeling, 2014; Dhakal et al., 2015).

With regard to wastewater, urban agriculture can play a crucial role in complementing existing sewerage systems by significantly reducing stormwater run-off. Firstly, urban agriculture can be implemented in decentralised stormwater management features - infiltration trenches, street tree pits or rain gardens - and allows stormwater to infiltrate rather than to drain into the sewer system (Grant, 2012; Dubbeling, 2014). A beneficial ancillary effect of such infrastructures lies therein that they are capable of providing multiple functions (Kimmel et al., 2013). For example, they can be integrated into traffic calming schemes other traffic control installations or to beautify are heavily paved neighbourhoods (Hoyer et al., 2011; Grant, 2012).

Secondly, green roofs store significant amounts of rainwater - depending on the system and depth of growing medium - and reduce the immediate water run-off by 50-90%. Most of this water returns directly into the natural water cycle through the processes of evaporation via soil and evapotranspiration via plants. (Ackerman et al., 2012; IGRA, 2015). The excess water is filtered and then discharged into sewerage system with temporal delay. This leads to significantly reduced stress of wastewater systems - throughout the year as well as at peak flow periods (IGRA, 2015). As far as detention is pertained, rooftop agriculture could have an advantage over conventional green roofs, because they require a deeper growing medium. Since most crops need to be irrigated on a regular basis, this benefit could be partially rescinded by the fact that partially saturated soil is less capable of absorbing additional stormwater (Ackerman et al., 2012).

In New York, the percentage of impervious area is 64%. In districts like Mid-Manhattan west it can reach as high as 94% (Rosenzweig et al., 2006).

The third benefit on stormwater management lies in the presence of trees and their ability to reduce stormwater run-off in numerous ways (McPherson et al., 2010):

- Leaves and branch surfaces intercept and store rainfall and thereby reduce run-off volumes and delay the onset of peak flow.
- Roots create channels and hereby increase the rate at which the rainfall infiltrates soil. This is also beneficial for groundwater recharge.
- Evapotranspiration through tree leaves reduces soil moisture, which increases the soil's capacity to store rainfall. However, this benefit is minimal during winter.
- Tree canopies lower soil erosion by decreasing the impacts of raindrops on meagre surfaces.

Furthermore, the numerous elements of decentralised stormwater management have the capability to significantly lower run-off's pollution load, because the roots take up nutrients

and other pollutants from soils and water (Bedan & Clausen, 2009; McPherson et al., 2010; Hoyer et al., 2011). Additionally, thanks to the local infiltration as well as evaporation, the city's hydrologic cycle can be improved and reactivated (McPherson et al., 2010; Hoyer et al., 2011).

Organic waste & nutrient recycling

Much what ends up in a city's waste stream consists of valuable organic material that ends up in landfills or incineration plants. Mostly, these facilities are located outside the city and require Not to mention that landfills are a limited commodity and, furthermore, emit significant amounts of methane (Ackerman et al., 2012; Dubbeling, 2014).

Thus, instead of squandering biowaste - originating from households, gardens, parks as well as food processing activities - it could be utilised in biogas and/or composting plants. In order to make composting a viable activity right in the city, there has to be a constant demand. Apparently, urban agriculture provides an excellent possibility to use this resource right where it is produced. By integrating composting, urban agriculture can help to "create an ideal small-scale closed-loop system wherein nutrients from food waste are recycled back into the soil (Ackerman et al., 2012, p. 71). For numerous reasons, compositing is well-suited for urban agriculture: 1) it provides soil, which is often a rare good in cities, 2) it enhances and maintains urban soils that are often nutrient poor or even contaminated; 3) it reduces the application of chemical fertilisers; 4) it enriches soil's with organic matter and hereby improves its water holding capacity, and 5) it leads to higher carbon sequestration due to higher amounts of organic matter in soils (Ackerman et al., 2012; Freshwater Society, 2013; Dubbeling, 2014).

Further co-developmental effects lie therein that urban composting reduces energy use due to lower waste volumes and related transport and, furthermore, it lowers the depletion of certain minerals - such as phosphorus - by making productive use of organic waste (Dubbeling et al., 2011; Dubbeling, 2014).

With regard to a possible implementation, various approaches are feasible and range from small-scale individual bins to city-wide programmes. Distributed approaches included in-vessel composting, in which organic waste is collected from single households - either from apartment buildings or even neighbourhoods - and composted in bins outside a dwelling or in a nearby garden. Centralised approaches include source-separated composting, in which citizens separate organic waste into designated bins, which are collected and then brought to a large-scale biogas and/ or composting plant (Ackerman et al., 2012). Both approaches have advantages and disadvantages - while distributed systems provide ready-to-use and cost-effective compost to urban growers, t the opportunity to produce biogas is bypassed. Centralised systems, in turn, can make use of biogas, but often involve a means of transport to plant outside the city. For financial and quantitative reasons, it is difficult for urban growers to have access to this compost (F. Berger, personal communication, October 26, 2015).

Biodiversity

In many parts of the world, human development is extending rapidly on the verge of urban areas, resulting in a loss of natural and rural habitats due to agricultural intensification

(Benton et al., 2003; Brown et al., 2005). Thus, green spaces within the urban landscape suddenly become essential places of refuge for native biodiversity (Goddard et al., 2010). Urban agriculture and its varying features - fruit-bearing trees, pollinator-friendly flowers or even compost heaps - contribute greatly to such spaces' vegetative diversity and hereby create habitats for a variety of animal species (Lin et al., 2013; Lin et al., 2015).

The manifold facets of urban agriculture facilitate a considerable variation in vegetative complexity and structural diversity. Various studies have researched on species richness of domestic gardens. For example, a survey from five cities across the United Kingdom has recorded a total of 1'056 plant species 267 gardens. The authors revealed, that such gardens' flora is more species-rich than neglected urban habitats as well as semi-natural habitats. Considering the fact that domestic gardens represent a respectable portion of city areas, it is presumed that collectively, domestic gardens are the "foremost species resource" (Loram et al., 2007; Loram et al., 2008, p. 329). Also community and allotment gardens show considerable levels of vegetative biodiversity. According to a study, Stockholm's allotment gardens often feature sumptuous flower-filled areas that contribute to an extremely rich plant diversity - in a single allotment garden of 400m2, 447 different species were found (as quoted in Colding et al., 2006, p. 240).

According to Taylor-Lovell (2010), urban agriculture definitely has the potential to contribute to biodiversity conservation, particularly if native species are integrated.

A further reason, why urban agriculture contributes to biodiversity lies therein that urban growers often cultivate a variety of vegetables and fruits, which are no longer commercially available. These heirloom crops, which are often beautifully coloured and patterned, might otherwise cease to exist (Garnett, 1996). Urban growers obtained the seeds of the old cultivars either by passing down from generation to generation or from seed banks and project, which are focused on heirloom varieties (see fig. 16).

Plant diversity is an essential base for insect diversity. Furthermore, plant diversity, as well as small-scale structural complexity, are important for arthropods, grasshoppers, web spiders and ground-dwelling beetles (Lin et al., 2015). A study from Pennsylvania figured out that native plants within suburban gardens increased butterfly diversity (Burghardt

Figure 16. Heirloom tomatoes come in many shapes and colours.

et al., 2009). Another study from New York demonstrated that community gardens provide habitat to 54 bee species, including species that nest in hives, pith, cavities and wood (Matteson et al., 2008). Similarly, across Vancouver's different garden types a mean richness of 23 bee species were sampled (Tommasi et al., 2004). Bees, bumblebees and other pollinators are crucial for the development fruits, vegetables and seeds (TEEB, 2011). In habitats with greater bee diversity, the crops experience higher or more stabilised fruit settings (Winfree et al., 2009).

Urban agriculture provides an array of wildlife-friendly features - fruit and nut trees, berry bushes or compost heaps - can increase bird and vertebrate abundance and diversity (Goddard et al., 2013). Additional elements, such as bird tables, pollinator hotel or a pile of logs, support this effect (Good, 2000). Furthermore, native vegetation can encourage large populations of native as well as exotic bird species at the local level (Daniels et al., 2006). At the landscape level, garden heterogeneity can enhance the diversity of insectivorous birds (Andersson et al., 2007).

Additionally, urban agriculture is applicable on an abundance of different open spaces and, thus, provides many opportunities for (re)vegetating the urban landscape at the local scale. Scattered all over the city, these diversely vegetated spots can improve the connectivity of native populations that are momentarily restricted to remnants (Doody et al., 2010).

Urban climate, air quality & energy consumption

On of the most serious environmental challenges of our time is the increasing global demand for energy. A majority of the world's energy is derived from non-renewable fossil fuel sources. On the one hand, this entails ecological ruination and instability in many resource-rich nations, on the other hand the fossil-fuel consumption is constantly adding greenhouse gases to the atmosphere (IPCC, 2015; Ackerman, 2012). This causes air pollution and is the main contributor to globally rising temperatures since the 19th century - also known under the term climate change (IPCC, 2015; Brown et al., 2015). These processes have the potential to affect drastically and destabilise the earth's environment as well as provoke "widespread social upheaval" (Ackerman, 2012, p. 136).

Although an ingenious combination of far-reaching strategies is required to pre-empt the expected implications, urban agriculture could have a small, but relevant role to play. Urban agriculture could contribute its share in various ways: 1) ameliorate the urban microclimate by helping to mitigate the urban heat island effect (UHI) and simultaneously improve the air quality, 2) reducing building energy use through rooftop agriculture, and 3) lowering energy use associated with food transportation and storage.

According to Schueler (2000), the impervious coverage varies as follows: "In rural areas, impervious coverage may only be one or two percent. In residential areas, coverage increases from about 10 percent in low-density suburban areas to over 50 percent in multi-family communities. In industrial and commercial areas, coverage rises above 70 percent. In dense metropolises it is over 90 percent (as quoted in Hoyer et al., 2011).

Various physical characteristics - predominance of hard and sealed surfaces, thermally conductive materials, anthropogenic heat sources, lack of shade and reduced evapotranspirative cooling - contribute to the occurrence of the so-called urban heat island effect, because incident radiation is absorbed, stored and reradiated at night (Grant, 2012; Brown et al., 2015). As climate models continue to indicate increased likeliness of heat waves in urban areas, there is a growing interest into the relationship of green infrastructure and the mitigation of the urban heat island effect (Alexandri et al., 2008; Lin et al., 2015). Increasing the urban landscape's proportion of green spaces - for example through the

implementation of urban agriculture's various components - can reduce surface as well as air temperatures (Gill et al., 2007; Lin et al., 2015). At the ground level, planting can influence the energy loads on individual buildings and, therefore, create a cooling effect. With regard to urban agriculture crops - to this day, there is no study that examined their impact on the UHI effect compared to more conventional forms of ground-level plantings, such as lawn or different grasses. Although many food crops provide tighter cover and are equipped with wider foliage, the effect of a cultivated piece of land might be offset because of paths between planted rows (Ackerman et al., 2012).

The cooling effect of on-the-ground planting can be amplified by including trees. They can further reduce temperatures by shading larger areas of built surfaces (McPherson et al., 2010; Ackerman et al., 2012; Lin et al., 2015). In the case of fruit trees, this effect might be slightly reduced due to frequent pruning (Ackerman et al., 2012). Furthermore, an additional cooling effect of the air lies in the effect of evapotranspiration - plants convert liquid water into vapour with the aid of solar energy that would otherwise result in heating of the air (Federer, 1976; McPherson et al., 2010).

Both evaporative cooling and a reduced UHI effect entail further co-developmental effects. For example, downsized utilisation of air conditioning lowers the energy use and as a final result decreases the emission of pollutants from power plants (Heisler, 1986; Yang et al., 2008).

Urban green spaces of more than one hectare have significant impact upon the level of temperature reduction. Thus, the cooling effect of such larger spaces has been termed the *park cool island* as opposed the urban heat island effect (Woolley, 2003). However, all these effects are dependent on plant species, vegetation density and structure, plant maturity, local climates as well as architecture, and thus, the impact on air temperatures across the wider urban environment is still unclear (Spronken-Smith et al., 1998; Stewart, 2011).

In addition to its beneficial impact on the urban heat island effect, urban agriculture can improve air quality. City air often contains high levels of pollutants - originating from motor vehicles, power plants or space heating - that are harmful to human health (Mayer, 1999). Conventional air pollution management strategies focus on controlling the source of air pollutants and, therefore, are fairly efficient in reducing the emissions of new air pollutants (Schnelle et al., 2002; Yang et al., 2008). In order to address pollutants already in the air, urban agriculture can be called into action. Its vegetation can reduce air pollutants through a dry deposition process. Because of the high surface area and roughness provided by the stems, branches, twigs and foliage, vegetation constitutes an effective sink for air pollutants (Beckett, Freer-Smith & Taylor, 1998). Trees, for example, remove gaseous air pollutants primarily by uptake via leaf stomata, whereby some gases are removed by the plant surface. Moreover, pollution is removed by intercepting airborne particles by leaf and bark surfaces (Nowak, 1994; Nowak, Crane & Stevens, 2006). The average percent air quality improvement due to trees is relatively low (< 1 %). But since the improvement relates to multiple pollutants, the actual magnitude of pollution removal can be significant. According to Nowak et al. (2006, p. 121) - whose percent air quality improvement estimates are likely conservative - trees still remove "hundreds to thousands of metric tons of pollutants per city per year".

Nonetheless, in densely populated cities with high percentages of impervious areas it can be difficult to plant trees. Since rooftops constitute a large portion of a city's impervious area, green roofs can be an answer to this "dilemma" (Yang et al., 2008, p. 7'267). Compared to Nowak's studies about air pollution removal by trees (1994), "a medium size tree can

remove the same amount of air pollutants as a 19 m^2 extensive green roof (Yang et al., 2008).

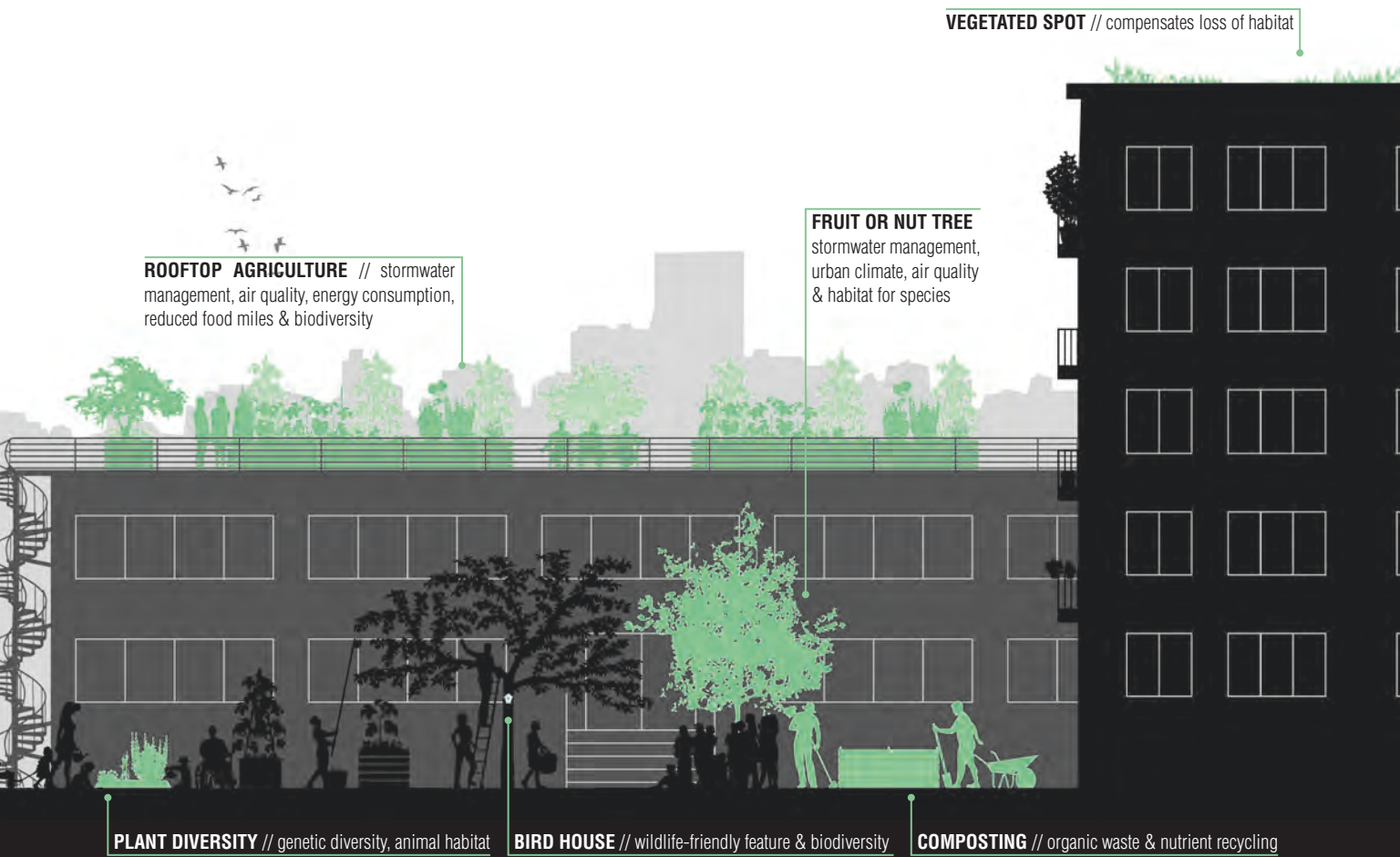
Green roofs provide further beneficial impacts in cities. Vegetation, growing media as well as water absorbed by the soil add considerable mass and heat capacity to the roof. This results in greater heat retention and, thus, reducing the need for space cooling and heating (Lazzarin, Castellotti & Busato, 2005; Yeung & Li, 2014; Gagliano, Detommaso, Nocera & Evola, 2015). Furthermore, vegetation can play an important role in lowering temperatures because it combines shading, evapotranspiration, and increased albedo (Solecki, Rosenzweig, Cox, Parshall, Rosenthal & Hodges, 2006; Scherba, Sailor, Rosenstiel, & Wamser, 2011; Lamnatou & Chemisana, 2014).

According to Ackerman et al. (2012), it is likely that rooftop agriculture might perform better than other types of intensive roofs and might be more effective in cooling buildings than a standard extensive roof. This assumptions are based on a number of reasons: 1) food crops have to be intensively watered, which increases the green roof's cooling capacity, 2) standard green roof vegetation, such as sedum, are adapted to harsh climates and open their stomata only at night to limit water loss through evapotranspiration, 3) food crops require a deeper growing medium, which adds thermal mass, and, 4) compared to standard green roof vegetation, food crops are taller plant communities and cast more shade (Solecki et al., 2006).

Figure 17. Co-Creating an eco-friendly city. Own graphic.

A further ecological benefit of urban agriculture is associated with the fact that food is produced close to or within the city and, thus, with reduced food miles (Dubbeling et al., 2011). Furthermore, less energy is used for refrigeration, storage, processing as well as packaging. Especially in the case of rooftop greenhouses, synergistic and cyclical processes between domestic and industrial sector and agriculture could be used - such as use of cooling water, excess heat or CO_2 from industry. Urban agriculture, thus, by the provision of local and fresh produce, can lower the carbon footprint of our edibles (Dubbeling et al., 2011).

All in all, urban agriculture has significant ecological impacts on the urban landscape (see figure 17). With its contribution, the natural environment is (re)incorporated into the city and, thus, it has an impact on a city's metabolic system. It regards urban outputs as crucial inputs and brings them back into the city's metabolism - be it organic waste in form of compost or stormwater run-off by means of evaporation (Deelstra et al., 2000). With reference to an often discussed topic, namely climate change, it becomes clear that urban agriculture combines mitigation (energy used, UHI or landfill volume) as well as adaptation strategies (locally produced food, biodiversity or stormwater infiltration). Although these benefits depend on an array of factors, it would be worth to examine as well as monitor them in order to obtain more specific findings (Dubbeling, 2014).



ECONOMY // CO-CREATING A PRODUCTIVE CITY

The available systematic literature on urban agriculture's economic impacts is very limited. Thus, most of the subsequent information is derived from project reports from both government and non-profit organisations, books, expert interviews and personal experience. Nonetheless, the benefits are manifold and range from reduced public land-maintenance costs to increased local employment opportunities and raised property values.

Tourism

An economic impact of urban agriculture includes its effect on tourism. Throughout the world, urban agriculture projects are "a must" on traveller's itinerary. To this day, we have not encountered any study that deals with the subject. Nonetheless, successful projects report on visitor rushes and the possibilities to expand their fields of activity. For instance, "Tokyo Local Fruit" is exploring where, how and by whom fruit and vegetables are being non-commercially cultivated and consumed in the sprawling Japanese city and shares its findings in the form of so-called "fruit paths" (Berthelsen et al., 2013). Despite its image of an asphalt jungle, Tokyo's citizens not only grow a wide variety of vegetables and fruits on intentional and accidental plots, but also possess a substantial knowledge of food preparation and local consumption practices. According to the project co-ordinators, tracing paths "sparks the imagination and adds a sense of living history to routine neighbourhood walks" (Berthelsen et al., 2013, p. 99).

A few years ago, when the renowned project "Incredible Edible Todmorden" started to smuggling vegetable plants into public spaces, they did not expect to attract global attentiveness. But the intention to grow food for everyone to share disseminated in no time at all and without further ado, visitors from all over the world arrived in Todmorden. Out of hand, the initiators invented the so-called "vegetable tourism" - along with guided tours and various thematics paths tourists can learn more about the flourishing local food movement (Incredible Vegetable Tourism, 2010). The project seems to be highly inspiring - the idea spread across the globe and nowadays stretches from Canada to New Zealand (Incredible Edible Network, 2015).

The High Line in New York City: this regenerated former railway line is planted in compliance with Piet Oudolf's "New Perennial Movement". This means that the (mostly native) plant's entire life cycle is celebrated. Thus, throughout the year the park is endowed in a dynamic, seasonally changing landscape - from mellow tints after the burst of buds to sumptuous summer growth and the many shades of evergreen in winter. In combination with paths, viewpoints and gathering spaces, the park is designed as a coherent urban landscape and attracts nearly 5 million annual visitors (Geiger, 2014; Viljoen et al., 2014). Although the High Line does not produce food, it is a representative of a landscape, that visibly expresses the processes of "growth, blossoming, die-back and germination" (Viljoen et al., 2014, p.37). Thus, it contrasts public parks that comply with familiar and well-groomed ornamental aesthetics and simultaneously introduces a form of landscaping, which is fairly akin to urban agriculture (Viljoen et al., 2014).

Employment opportunities & entrepreneurial endeavours

Although we are solely focusing on the non-commercial section of urban agriculture, it still provides several opportunities for local job creations. As it seems, especially fruit trees

are predestined to create new - innovative - ways of employment. In Seattle, landowners (including the municipality of Seattle) simply list their fruit trees in the register of "City Fruit". As soon as the fruits are ripe, the organisation emits a harvesting crew that picks the trees' fruit surpluses for free. While tree owners are released from disposing of unwanted fruit, the community benefits as well - City Fruit donates a major part of the harvest to local meal programmes as well as food banks and sells the rest to restaurants (Nordahl, 2014).

In 2013, City Fruit gleaned 3'850kg of fruit from 135 sites. Thereof, it donated 3'200 and sold the rest to restaurants with eco-conscious chefs (Nordahl, 2014)

Also a Germany-based project gleans surplus fruits from privately as well as publicly owned trees and meadow orchards. A supervised group of handicapped people harvests ripe apples and pears, which are then processed into direct, naturally cloudy juice. This high-quality product is sold to companies, private clients as well as local stores. Afterwards, the total proceeds flow back into the project (Lokal, sozial, nachhaltig, n.d.). By analogy, the project is called "The Money is on Trees".

Another business derived from the greenery at the University of California: circa 1'500 olive trees - scattered all around the campus - created not only a maintenance nightmare, but also a real safety problem (squished, oily fruits). To make a virtue out of necessity, it was decided to pick the olives on time and produce "UC Davis Olive Oil". Since the project is a great success, it is meanwhile possible to purchase many more products, such table olives or body butter (Nordahl, 2014).

Various urban agriculture projects generate a small income by holding a variety of events - be it nutritional classes, seedling markets or harvest festivals. Furthermore, many projects place their sites at disposal - be it for photo shootings or film sets, team building events (to enhance social relations and define roles within teams) or even weddings.

A further economic impact of urban agriculture includes the market expansion for farmers. Nowadays, some farmers consider the city as a chance for progression. With the aid of various imaginative operating models they can benefit from urban agriculture. For instance, they are involved in landscape maintenance or offer classes about cultivation techniques (B. Pölling, personal communication, June 09, 2015).

Increased property values

In conjunction with urban agriculture's economic impacts, there are a few studies that correlate community gardens as well as street trees to increasing home values and household income (Whitmire, 2008; Voicu et al., 2008; Donovan et al., 2010). According to Voicu et al. (2008), high-quality gardens have the greatest impact and - within five years of a garden's opening - raised the property values by as much as 9.4%. Another study used a hedonic model to estimate the value of street trees and found that not only the number of trees facing a property but also the trees' crown areas "positively influence sales price" (Donovan et al., 2010, p. 82). Authors from both studies state, that green spaces - be it a street tree or a garden - significantly outweigh their initial investments as well as maintenance costs. Furthermore, such investments result in sizeable payoff for the adjacent community as well as for the city itself, because it achieves additional property tax revenues from the neighbourhood (Voicu et al., 2008; Donovan et al., 2010). Thus, these findings should support local governments to take "sounder decisions about whether (and

The results of these studies are all from the USA, in particular from Saint Louis City (Whitmire, 2008), New York (Voicu et al., 2008) and Portland (Donovan et al., 2009), and refer to specific site conditions. Thus, generalising and extrapolating these findings to other sites shall only be done with caution.

how much) to invest in (or to encourage private investment in) community gardens and other green spaces" (Voicu et al., 2008, p. 277).

However, this benefit is not only seen benevolently. McClintock (2013), for instance, approaches such findings with scepticism, because they might attract younger and wealthier citizens. This, in turn, can often lead to gentrification, culturally changing neighbourhoods and estranging - if not suppressing - long-time residents. Nonetheless, according to Whitmire (2008), the trend to an increasing diversity of residents should not be generalised too much, because amongst renters it is often considered as a strength for a neighbourhood.

A further economic impact might be of interest for many inner-city business districts. A national survey has evaluated public perceptions, patronage behaviour intentions and product willingness to pay in relationship to varied presence of streetscape greening (Wolf, 2003). The findings suggest that street trees and sidewalk gardens positively correlate to consumer behaviour and result in 12% higher willingness to pay for goods and services (Wolf, 2003). Thus, the integration of streetscape greening could be of major importance for the revitalisation of commercial quarters.

Savings for municipal agencies

An utterly underestimated economic impact of urban agriculture includes the potential savings for municipal budgets. Essentially, these cost savings can be achieved in two ways - firstly, by converting vacant as well as underutilised land into an asset and secondly, by encouraging food gardens in public space. The first strategy reduces financial expenses, because the costs to maintain a vacant lot cease to exist - mowing, clearing up after illegal dumping or even responding to policy calls involving malefaction and violence at the sites (Balmer et al., 2005; Hodgson, 2012; SPUR; 2012; Hagey et al., 2012). According to SPUR (2012), San Francisco's Department of Public Works estimates to save annually $4'100 (~ €3'850) per site.

The second strategy suggests to replace some ornamental plants with edible ones - be it herbs, vegetables, certain eatable flowers, berries, shrubs as well as fruit and nut trees. Many decision-makers are opposed to this idea, because they worry about an additional financial burden, mainly because of increased maintenance. Nonetheless, there are progress reports from various cities that have successfully allowed, encouraged as well as included crop plants in public spaces - altogether in a fiscally responsible manner. The (edible) city of Andernach has published some data to highlight edible crops' marketability. As shown

Table 5. In Andernach, ordinary flower beds are significantly more expensive than the ones planted with mixed perennials and vegetables.

TYPE OF PLANTING	COST PER M² AND YEAR // IN EURO
ORNAMENTAL FLOWERS tuplips // tagetes // geranium // ...	58
MIXED PERENNIALS catnip // calendula // lavender // ...	9-11
VEGETABLES cale // chard // tomatoes // beans // ...	15

Source: based on Machkowski (2014) & Wengel (2014). Own graphic.

in table 5, beds with vegetables or mixed perennials are comparatively inexpensive to classical flower beds that have to be replanted up to four times a year (Machkowski, 2014). Vegetables and mixed perennials have also been planted around the town's landmark (see figure 14) and resulted in significant municipal savings for maintenance activities - annually €500 instead of €5'000 (Wengel, 2014).

In addition to vegetables and mixed perennials, a Northern Californian study revealed that trees can entail substantial financial savings (see table 6). Planting, pruning and tree removal account for a tree's greatest costs and, furthermore, maintenance expenditures tend to accumulate with mature tree size, because increased labour and equipment costs (McPhearson et al., 2010). As it is recognisable from table 6, private trees create higher net benefits. This is due to the fact that standard care for street and park trees is often higher because municipalities have to manage risks, maintain required clearances for vehicles and pedestrians and, moreover, repair damage to sidewalks and curbing caused by tree roots (McPhearson et al., 2010). Nonetheless, calculated over a 40-year period, a tree's annual as well as its total net benefits are remarkable. Benefits assigned with energy savings and increased property values generate the largest fraction of the total benefits. Nonetheless, the environmental benefits alone - including energy savings, reduced stormwater run-off and atmospheric CO_2 as well as lower levels of air pollutants - are greater than the tree care costs (McPhearson et al., 2010). Although the study does not explicitly refer to trees that bear fruits and nuts, we assume that they entail financial savings within the same range.

With reference to the growing popularity of urban agriculture, the publication of such numbers is essential in order to have basis for discussion with sceptical - or hesitating - government officials.

Ornamental grasses, for instance, are often praised for their drought tolerance and feathery, wild look. Fennel, by the way, provides similar aesthetics and is equally drought-tolerant. Another drought-tolerant, nearly maintenance-free substitute for grasses are Mediterranean herbs. Furthermore, they are edible, decoratively looking, pollinator-friendly and fragrant (Nordahl, 2014).

Economic savings on food

A last economic benefit of urban agriculture relates to cost savings on food. According to numerous studies, urban growers save money thanks to offsetting produce expenditures (Blair et al., 1991; Patel, 1991; Hagey et al., 2012). According to Hynes (1996), "every $1 invested in a community garden plot yields approximately $6 worth of vegetables" (quoted in Bellows et al., 2004, p. 4). This positive outcome is apparently due to the fact, that labour is not considered a factor in investment. Furthermore, urban growers usually have to pay little or even nothing for plots and often get access to tools and utilities (Bellows et al., 2004). Also public produce is pleasantly contributing to people's household budgets. Mary Clear, chair of "Incredible Edible Todmorden", refers to her fellow citizens and states that

TREE	COSTS in $		NET BENEFITS in $		NET BENEFITS in $	
	ANNUAL		ANNUAL		TOTAL OVER 40 YEARS	
small	yard: 10	public: 17	yard: 41	public: 29	yard: 1'640	public: 1'179
medium	yard: 11	public: 24	yard: 60	public: 42	yard: 2'392	public: 1'679
large	yard: 13	public: 28	yard: 122	public: 101	yard: 4'868	public: 4'034
conifer	yard: 15	public: 33	yard: 146	public: 142	yard: 5'855	public: 5'685

Source: based on McPherson et al., 2010, p. v .Own graphic.

Table 6. Average annual costs of trees in comparison with the net benefits (annual and total) over 40 years.

"[...] nearly 50% said it had had a positive impact on their income" (quoted in Waterford, 2015, p. 118).

All in all, the urban agriculture's contribution to a productive city stretch to various directions and are often for the benefit of all city dwellers (see figure 18). It has the ability to improve the financial efficiency of urban authorities and simultaneously provides opportunities to adequately invest into infrastructure that has a beneficial impact on the city as well as on its inhabitants (UN-Habitat, 2015). Furthermore, it offers the possibility for co-developmental endeavours- either for the urban growers themselves or for entrepreneurs that consider its presence as well as its products as a trigger for a business idea. Nonetheless, these favourable effects are highly underestimated and are typically not associated with urban agriculture. This could be based on the fact, that they are upstaged by other benefits - most probably by health and societal points of view. Furthermore, good data is extremely scarce. Although there are various success stories from municipalities across the globe that have implemented urban agriculture in their agenda, findings are just touched upon or roughly estimated (Facteau et al., 2011). Furthermore, monitoring and evaluation of processes and the subsequent publication of findings seem to be largely non-existent.

CONCLUSION

With the aid of the four categories - society, health, ecology and economy - urban

Figure 18. Co-creating a productive city. Own graphic.

agriculture's benefits were highlighted from various perspectives. As it is shown in figure 19, there are numerous benefits in each of the four areas of examination. These findings not only highlight its diversity, but also underpin its - still mostly informal - *raison d'être* in the urban fabric.

During the analysis of urban agriculture's benefits, two paramount characteristics became apparent. Firstly, urban agriculture's benefits are not limited to individual human beings or a group of like-minded people. They go clearly beyond and have a positive effect on varying scales: from butterflies and heirloom vegetables to neighbourhoods and an entire city's metabolic system - and even further, if the co-developmental impacts are taken into account. Secondly, thanks to its various cultivation typologies and their respective components, urban agriculture can be widely integrated across the urban landscape. Its diversity endows it with a remarkable adaptive capacity and lets it well-embed as well as interact with its surroundings.

In the next chapter, the analysed layers of urban agriculture are going to be merged. Thereby, its benefits can be portrayed in a holistic way and, additionally, its full potential can demonstrated at a glance. Furthermore, the summarised benefits are going to be linked with the various open space typologies across the urban landscape. Lastly, the reciprocal relations between urban agriculture and the requirements on urban open spaces as well as the city - and reverse - are going to be worked out.

Figure 19. A comprehensive view on urban agriculture's manifold benefits. Own graphic.

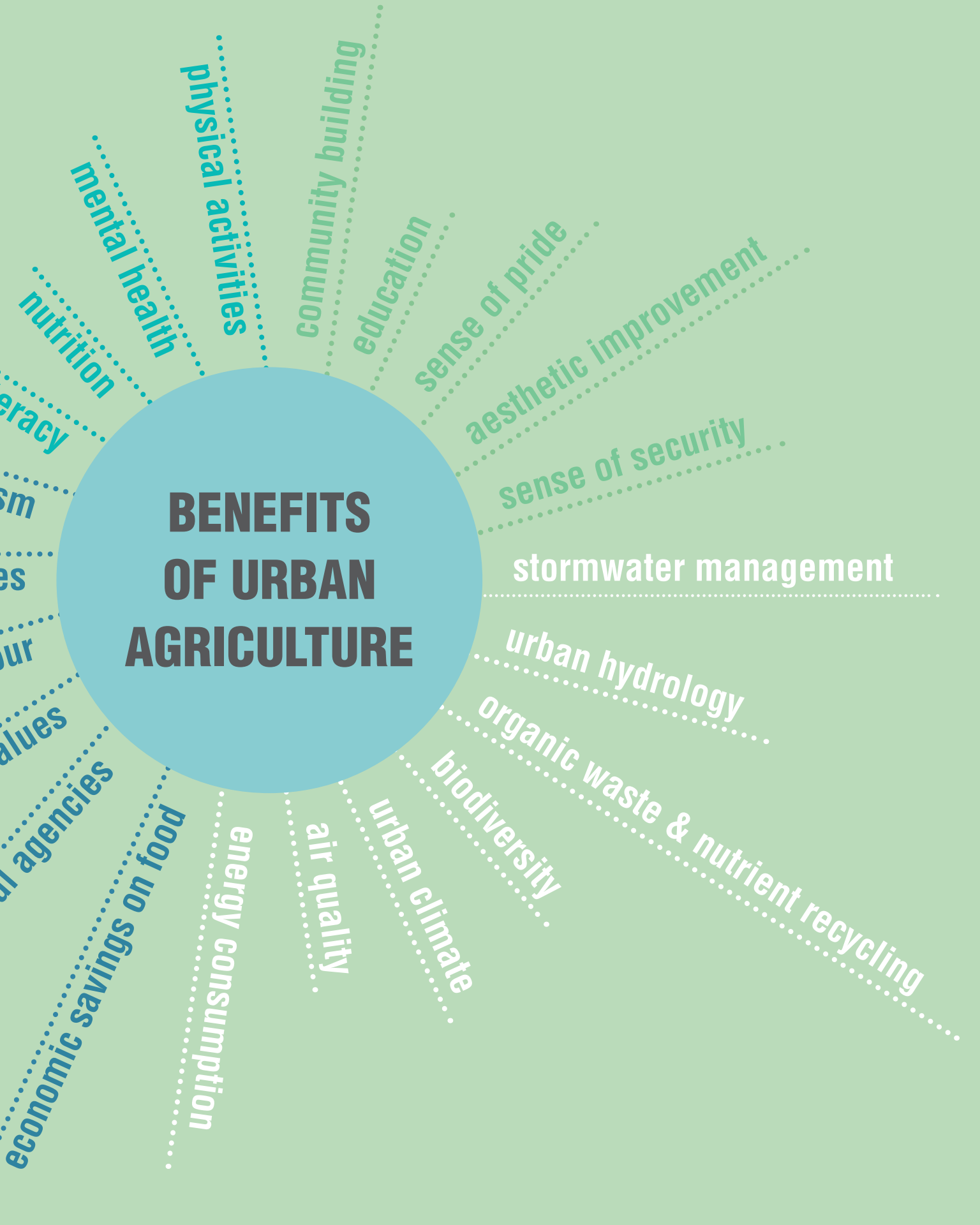

BENEFITS OF URBAN AGRICULTURE
physical activities
mental health
nutrition
eracy
sm
es
ur
alues
l agencies
economic savings on food
energy consumption
air quality
urban climate
biodiversity
organic waste & nutrient recycling
urban hydrology
stormwater management
sense of security
aesthetic improvement
sense of pride
education
community building

Figure 20. Another perspective.

EXCURSUS

1 // HAMBURG AS SELF-RELIANT CITY IN FOOD?

While doing the research in the wide field of urban agriculture, we asked ourselves, if the urban perimeter of Hamburg would be big enough to satisfy its inhabitant's food demand. According to recent statistics, Hamburg covers an area of 75'522 hectares and has about 1.72 million inhabitants (SABL, 2014). About 14'560 ha are agricultural land and used for horticulture, grazing land or arable farm land. About 900 farms - most of them covering an area less than 5 ha - produce a vast range of goods: vegetables, fruits, meat and dairy products, ornamental plants as well as Christmas trees (SAHSH, 2011).

The report done by Wakmiya (2011) gives a good overview on how much land an average German indirectly needs for following a typical German diet.

The results of recent studies about the average German's eating habits, show that by following the "German diet", which is rich of meat and diary products (see figure 22), an area as big as 2'523 m^2 is annualy required to produce the food of one single German (Wakamiya, 2011). By multiplying this area by the number of Hamburg's inhabitants, it is possible to have a rough estimation of the agricultural land that Hamburg would need in order to provide food to everyone. That corresponds to about 440'000 ha, about 5.9 times Hamburg's area (figure 23), and 30 times more the area currently used as agricultural land. Even if it is just a rough estimation, it shows already that Hamburg needs an area much bigger than itself for being self-sufficient in term of food.

Anyway, a short reconsideration can be done: as it is possible to see in figure 21 (area needed for the production of food) the space requirement for the production of eatables varies drastically: for planting and collecting 1 kg vegetables, 0.40 m^2 are needed, whereas an area 60 times bigger is needed for producing 1 kg beef.

The studio "Tonnen für die Tonne" was conducted for WWF Germany and gives many tips on how our diet could be healthier and more sustainable

This leads to the assumption, that a change of diet - less meat, more vegetables - would reduce the city's dependence on food imports. Therefore, in scenario B we recalculated the space requirement for Hamburg's production by adapting the nutrition as it is suggested in WWF Germany's publication "Tonnen für die Tonne" (Noleppa & Witzker, 2012). As shown in figure 23, this dietary change - more vegetables, less meat - the area of the required spaces decreases to 4.7 times Hamburg's area - instead of the 5.9 of the Scenario A.

Going a bit more into the details of the food production chain, one issue that often remains hidden is food waste. Several studies revealed, that in Europe we waste - only at the consumer level - about 30% of vegetables and fruits, 15% of meat and 8% of diary products (Gustavsson et al., 2011). Without getting into ethical questions, we recalculated scenarios A and B and assumed, that food waste could be eliminated (see figure 23, scenarios A1 and B1). It is possible to observe that either by following the "German diet" (Scenario A) or by following a healthier one (Scenario B) if all the produced food would be consumed, the area needed for the production would decrease by about half of Hamburg's area.

Even though Hamburg can not become self-sufficient in terms of food, it is important to underline that our eating habits directly influence the space - as well as all the other resources - we require for producing the food we eat.

1kg

The space required for the production of **1kg** food varies from **0.4 m²** (vegetables) to more than **30 m²** (beef)

Figure 21. Area needed for the production of different foods. Sources: Wakamiya (2011). Own graphic.

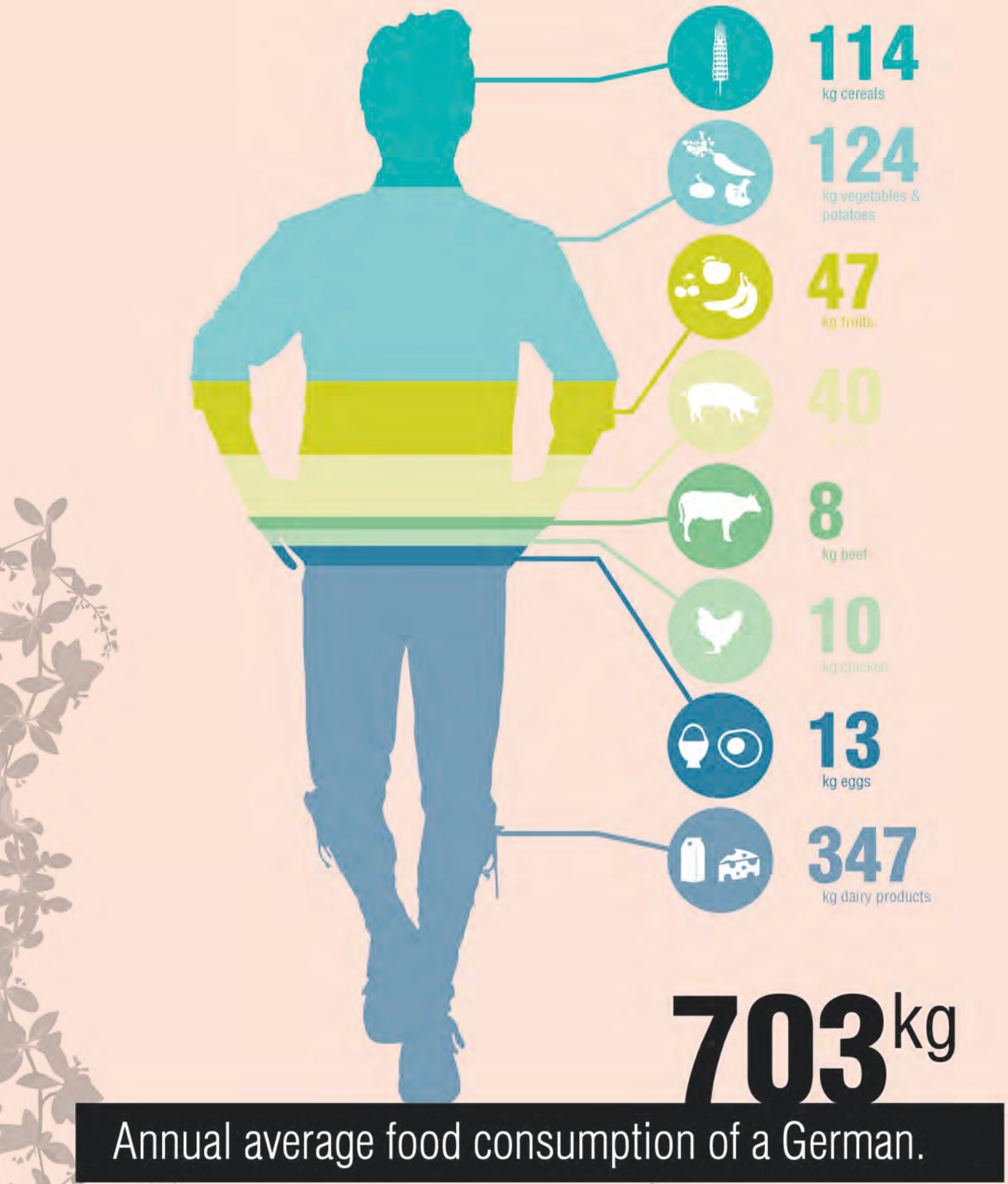
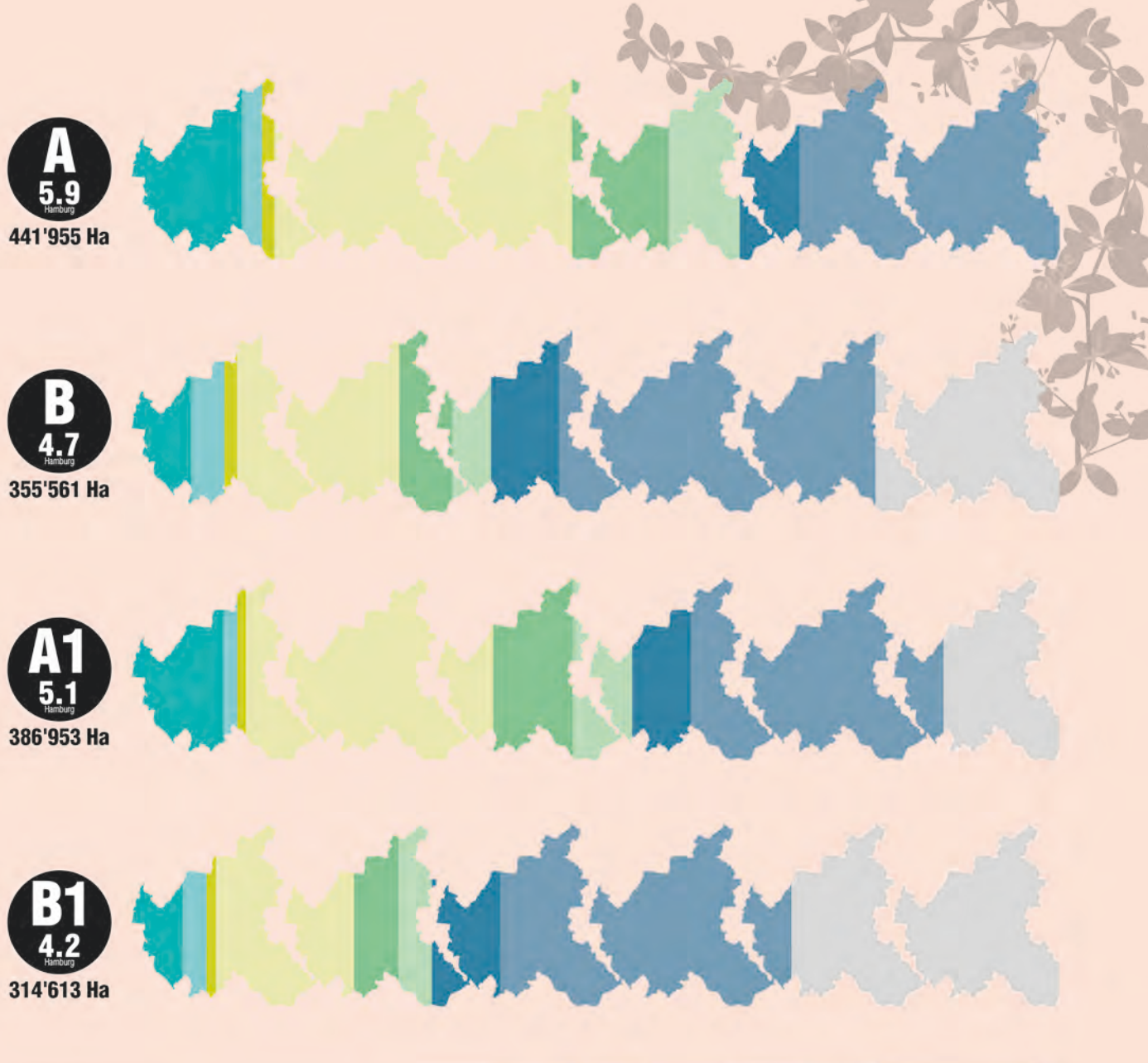
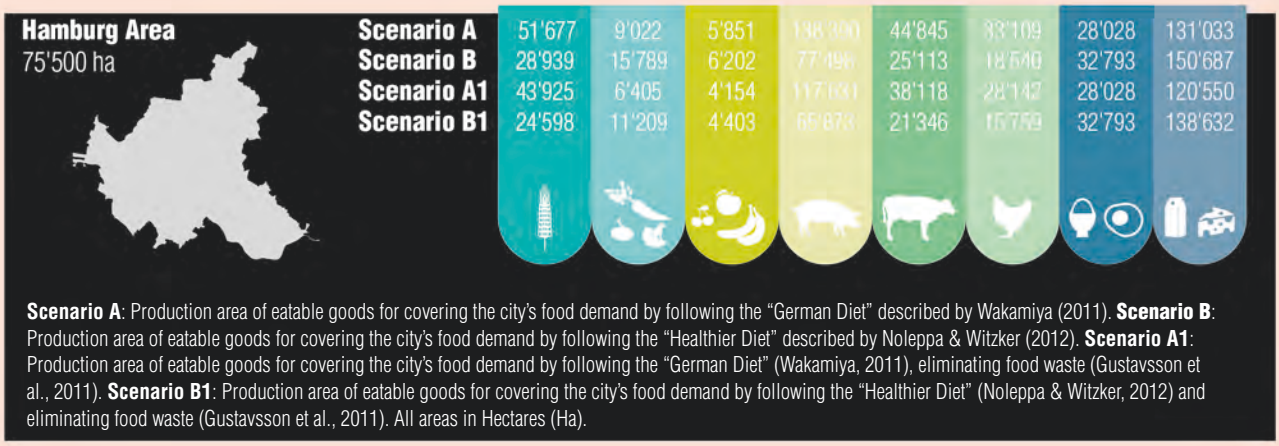


Figure 22. Annual average food consumption of a German. Source: Wakamiya, 2011. Own graphic.





Scenario A: Production area of eatable goods for covering the city's food demand by following the "German Diet" described by Wakamiya (2011). **Scenario B**: Production area of eatable goods for covering the city's food demand by following the "Healthier Diet" described by Noleppa & Witzker (2012). **Scenario A1**: Production area of eatable goods for covering the city's food demand by following the "German Diet" (Wakamiya, 2011), eliminating food waste (Gustavsson et al., 2011). **Scenario B1**: Production area of eatable goods for covering the city's food demand by following the "Healthier Diet" (Noleppa & Witzker, 2012) and eliminating food waste (Gustavsson et al., 2011). All areas in Hectares (Ha).

Figure 23. Different scenarios showing the amount of hectares needed for producing food by following different habits. Own graphic.

2 // FOREST GARDENING

The original form of forest gardening includes seven layers and requires - besides patience - a thorough understanding of natural processes, interactions and cycles.

Nonetheless, some initiatives decided to put forest gardening into practice, but in a simplified way and therefore work with less layers.

Subsequently some glimpses into two projects from San Francisco and London:

Figure 1:
:: The Urban Orchard Project // London
:: heralds of spring

Figure 2:
:: Friends of the Urban Forest // San Francisco
:: preparing the ground for planting street trees and sidewalk gardens

Figure 3:
:: The Urban Orchard Project // London
:: an primarily underused interspace in a residential area has been transformed into an urban orchard

Figure 4:
:: Friends of the Urban Forest // San Francisco
:: even the smallest ones are actively supporting the tree-planting campaign & simultaneously get closer to nature

Figure 5a:
:: Friends of the Urban Forest // San Francisco
:: an ordinary street in San Francisco

Figure 5b:
:: Friends of the Urban Forest // San Francisco
:: a former ordinary street in San Francisco has been equipped with various sidewalk gardens

Figure 6:
:: Friends of the Urban Forest // San Francisco
:: work in progress

Figure 7:
:: The Urban Orchard Project // London
:: all layers of the population are volunteering & create one urban orchard after another


FIGURE 1

FIGURE 3

FIGURE 6

FIGURE 2

FIGURE 4

FIGURE 5A

FIGURE 5B

FIGURE 7

#3 // GROUND-BASED CULTIVATION

Throughout the world, there are many ground-based urban agriculture projects - be it on the ground or on rooftops. Subsequently some impressions from Germany, Netherlands, Japan, US and Australia.

Figure 1:
:: Intercultural Garden // Hamburg
:: the garden's workshop in the midst of sumptuous vegetation

Figure 2:
:: Intercultural Garden // Hamburg
:: with a view to the centre of the garden

Figure 3:
:: Noppongi Rouen // Tokyo
:: the restaurant from the outside

Figure 4:
:: Noppongi Rouen // Tokyo
:: the restaurant's interior space is equipped with little kitchen gardens

Figure 5:
:: AUTh university farm // Greece
:: drip irrigation on the organically grown kitchen gardens

Figure 6:
:: AUTh university farm // Greece
:: supervised by the students, the citizens grow a diverse variety of vegetables and herbs

Figure 7:
:: Rosemary's // New York
:: the restaurant's rooftop garden, surrounded by NewYork's urban landscape

Figure 8:
:: Rosemary's // New York
:: the yield is part of the menu

Figure 9:
:: Bankastraat // Amsterdam
:: lush vegetation along one of the sidewalks

Figure 10:
:: Bankastraat // Amsterdam
:: even on the smallest spaces the vegetation is flourishing

Figure 11:
:: Reclaim the Curb // Melbourne
:: one of the reclaimed curbs, planted with vegetables to take away


FIGURE 1


FIGURE 2


FIGURE 3

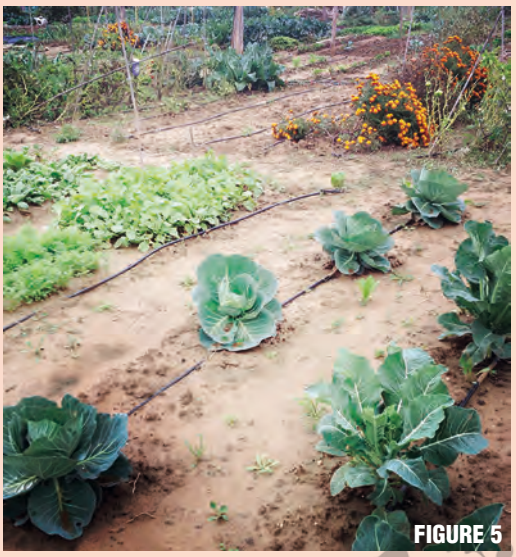


FIGURE 5


FIGURE 6

FIGURE 7

FIGURE 10

FIGURE 4

FIGURE 8

FIGURE 11

FIGURE 9

#4 // CONTAINER-BASED CULTIVATION

Container-based agriculture is probably the one, which fits most peoples image of urban agriculture.

Due to the nearly limitless options for planters, it is very flexible and fits to nearly every location. Furthermore, it can be applied on contaminated or temporarily limited sites.

Subsequently some glimpses into four different, but very successful projects from Europe:

Figure 1:
:: Allmende Kontor // Berlin
:: a diverse mix of containers

Figure 2:
:: Gartendeck // Hamburg
:: also accessible for wheelchair users & physically impaired gardeners

Figure 3:
:: Prinzessinnengarten // Berlin
:: drip irrigation

Figure 4:
:: Prinzessinnengarten // Berlin
:: blackboard with a list of harvestable vegetables & herbs

Figure 5:
:: Trädgård På Spåret // Stockholm
:: thriving community garden on a former railway area

Figure 6:
:: Trädgård På Spåret // Stockholm
:: workshop for interested people

Figure 7a:
:: Prinzessinnengarten // Berlin
:: aerial perspective on the site in 2006

Figure 7b:
:: Prinzessinnengarten // Berlin
:: aerial perspective on the site in 2014

Figure 8:
:: Allmende Kontor // Berlin
:: companion planting of flowers, herbs and vegetables


FIGURE 1

FIGURE 2

FIGURE 3


FIGURE 5

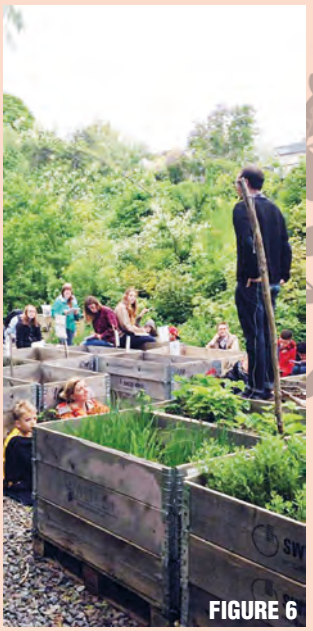


FIGURE 6

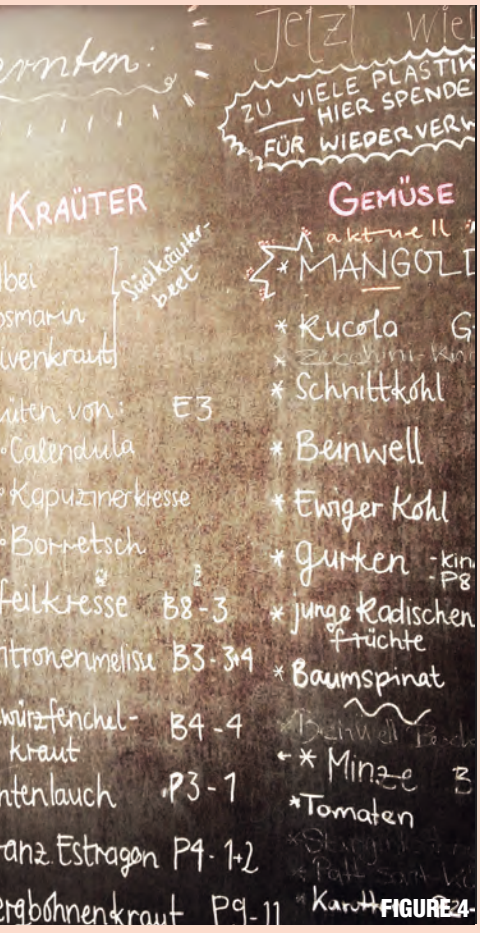


FIGURE 4


FIGURE 7A


FIGURE 7B


FIGURE 8

#5 // URBAN AGRICULTURE IN THE GLOBAL SOUTH

In the Global South, urban agriculture has long been practiced and plays a crucial role in enhancing urban food security. According to the RUAF Foundation, Resource Centre on Urban Agriculture & Food Security, this is mainly due to the fact that the costs for urban area's food supply - based on rural production and imports - are steadily increasing (n.d.).

Next to the nutritional security, especially for the underprivileged population, urban agriculture contributes to the development of local economies, poverty eradication, productive reuse of urban wastes as well as social inclusion (RUAF, n.d.).

Therefore, in many developing cities, urban agriculture is a well-established and effective strategy to make the city liveable while simultaneously earning a living (de Graaf, 2013).

Figure 1:
:: Agricultura Urbana // Brazil

Figure 2:
:: Agricultura Urbana // Brazil

Figure 3:
:: Urban Leaves // Mumbai, India

Figure 4:
:: Urban Leaves // Mumbai, India

Figure 5:
:: Urban Leaves // Mumbai, India

Figure 6:
:: Urban Leaves // Mumbai, India

Figure 7:
:: Abalimi // Cape Town, S. Africa

Figure 8:
:: Abalimi // Cape Town, S. Africa

Figure 9:
:: Abalimi // Cape Town, S. Africa

Figure 10:
:: Abalimi // Cape Town, S. Africa


FIGURE 1

PROGRAMA DE AGRICULTURA URBANA // Rio de Janeiro, Brazil:

The programme, initiated in 1999 by AS-PTA, a non-governmental organisation, provide both technical assistance on organic urban gardening and space - about 1'000 m^2 for each garden - on what once were empty lots in the peri-urban areas of Rio de Janeiro.

Started as a project to boost the economies of poor families, has now 650 active gardeners - mostly women - that, having learned how to grow organic food, no longer have to spend money on vegetables.


FIGURE 3


FIGU


FIGURE 2


FIGURE 7


FIGURE 4

URBAN LEAVES // Mumbai, India

What started in 2001 as an urban experiment on a 280 m2 terrace, became one of the most respectable urban farming movement of the Indian metropoly.

Thanks to the tenacity of her initiator, and her interests on the various cycles linked to agriculture - waste, pollination, water - , in 2009 Urban Leaves has become a Volunteer Driven Movement, and a programme under the Vidva Vaaridhi Trust.

After many workshops held in different terrace gardens, a first community garden situated within the Maharashtra Nature Park opened, and in the last couple of years, Urban Leaves has been expanding creating five other community farms and different school garden projects.


FIGURE 8

ABALIMI // Cape Town, South Africa

Abalimi - that in Xhosa means “the Planters” - & Harvest of Hope are projects that as main target want to alleviate the poverty of the low- (or no-) income families of Cape Town, that live in the informal settlements also known as “townships”.

The farmers learn how to grow organic food “for sale and for eating at home, while conserving indigenous flora and promoting alternative technologies”.

More than 3’000 urban farmers are part of the network both by farming in micro scale or in community gardens.

The food which is not for personal consumption is sold in 15 different distribution points of the city.


FIGURE 9


RE 5


FIGURE 6


FIGURE 10

#6 // EXPECTED FUTURE DEVELOPMENTS

Throughout the world, the number of urban agriculture projects is steadily extending and an astounding variety of initiatives can be found.

Nonetheless, some urban farmers are widening their product palette and field of action. While some of the project are related to flora, many others involve animals.

Figure 1:
:: Eco-Grazing // Paris
:: the *moutons tondeuses* ...

Figure 2:
:: Urban Farm // Dublin
:: chicken on the rooftop of an old chocolate factory in the north of Dublin

Figure 3:
:: GroCycle // Devon
:: oyster mushrooms growing on the city cafés' waste coffee grounds

Figure 4:
:: GroCycle // Devon
:: the kit for growing mushrooms at home

Figure 5:
:: Vulkan Bigård // Oslo
:: the bee houses, designed by Snøhetta

Figure 6:
:: Urban Physic Garden // London
:: the plants are grouped according to their medicinal properties - in this picture, the "dermatology ward" is shown

Figure 7:
:: Guerilla Grafters // San Francisco
:: a freshly grafted tree, tagged monitored by its "adoptive parent"

Figure 8:
:: Guerilla Grafters // San Francisco
:: an apricot branch, which was once grafted to an ornamental plum

Figure 9:
:: Growing Power // Milwaukee
:: on-the-ground demonstration about vermicompost by Will Allen


FIGURE 1


FIGURE 3

FIGUR

FIGURE 2

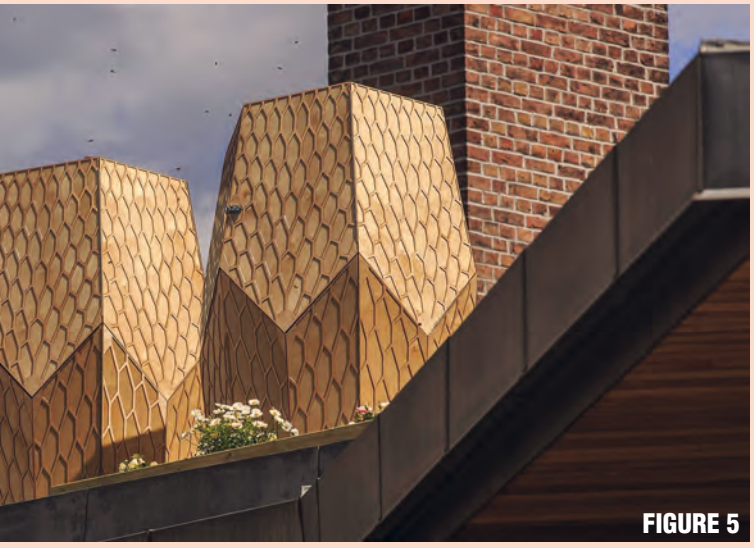


FIGURE 5

FIGURE 7

FIGURE 8

FIGURE 6

FIGURE 9

Figure 24. Greening the grey

SECTION THREE

THE LINK BETWEEN URBAN OPEN SPACES & URBAN AGRICULTURE

MERGING URBAN AGRICULTURE & URBAN OPEN SPACES

IN A DENSIFYING CITY, URBAN OPEN SPACES ARE FACING VARIOUS CHALLENGES. ONE THE ONE HAND, OPEN SPACES SHOULD MEET THE REQUIREMENTS OF ITS GROWING NUMBER OF USERS, ON THE OTHER HAND, THEY HAVE TO FULFIL EXPECTATIONS REGARDING CLIMATE ADAPTATION AND OPERATING EFFICIENCY.

URBAN AGRICULTURE, IN TURN, HAS AN ARRAY OF BENEFITS THAT OFTEN REMAIN HIDDEN - EITHER, BECAUSE THEY ARE OVERSHADOWED BY COMMONLY KNOWN FACTS OR BECAUSE THEY ARE NOT PRIMARILY ASSOCIATED WITH THE SUBJECT ITSELF.

THANKS TO ITS VERSATILITY, URBAN AGRICULTURE HAS THE POTENTIAL TO PLAY A KEY ROLE IN REMOVING SOME OF THE PRESSURE ON URBAN OPEN SPACES:

FIRSTLY, IT CAN BE COMBINED WITH WIDE-RANGING TYPES OF URBAN OPEN SPACES - BE IT A GRASS VERGE

ALONG A SIDEWALK, A NEIGHBOURHOOD PLAZA OR A FLAT ROOFTOP; SECONDLY, IT ENTAILS AN ARRAY OF BENEFITS THAT CORRESPOND TO THE REQUIREMENTS OF URBAN OPEN SPACES.

THUS, IT MOBILISES OFTEN OVERLOOKED AS WELL AS RATHER MONO-FUNCTIONALLY USED SPACES OF THE URBAN TERRITORY, AND, SIMULTANEOUSLY EQUIPS THEM WITH A MULTI-FUNCTIONALITY.

JUXTAPOSING URBAN AGRICULTURE, URBAN OPEN SPACES AND THE URBAN ENVIRONMENT DEMONSTRATES THAT AN ARRAY OF RECIPROCAL RELATIONSHIPS CAN BE CREATED - THE CITY FULFILS SOME OF URBAN AGRICULTURE'S NEEDS, WHICH IN TURN, FULFILS THE DEMANDS OF THE URBAN ENVIRONMENT AS WELL AS THE REQUIREMENTS OF URBAN OPEN SPACES.

SOCIO-NATURAL & PRODUCTIVE LANDSCAPES

PRELIMINARY STEPS

Socio-natural and productive urban landscapes aim to link concerns about the increasing pressure on urban open spaces by considering urban agriculture as a means for mobilising residual as well as mono-functional spatial fragments of the urban territory and their subsequent transformation into multi-functional spaces. The reciprocal relationships between agriculture and the city provide an opportunity to create a sustainable urban future.

Instead of expanding at the edge towards the rural hinterlands, numerous cities are focusing on densification of the existing built structure. Although this - provisionally - preserves empty areas, it implies quantitative and qualitative consequences for inner-city open spaces. As already highlighted in section 1 of this study, densification is accompanied by an increasing pressure on the remaining open spaces. While they have to fulfil expectations regarding climate adaptation and operating efficiency, the growing population demands adequate open space utilisations (BSU, 2014). This means in effect that open spaces have to be created in such a way that they correspond to as many requirements as possible. Thus, by incorporating socio-natural and productive urban landscapes, this aspiration could be reached. Two preliminary steps are necessary to initiate this process - widen the current understanding of open space typologies and allowing multiple use open spaces to avoid competing land uses.

1st step // widen the current understanding of open space typologies

In order to mobilise new spatial potentials in a densifying city, the current understanding of open space typologies has to be widened. Firstly, awareness should be raised to consider so-called residual spaces. Such spaces are frequently overlooked and, therefore, tend to be unproductive and dysfunctional. This, in turn, leads to the fact that they often do not meet expectations regarding aesthetics, function and economic (Shukla, 2013). Such spaces exist across the urban landscape, and, for example, include: anonymous green spaces in between multilevel buildings, grass verges along streets and sidewalks, road space including street medians and curbs, sparsely used parking lots and sometimes even street corners.

This indicates that they constitute not only an inherent part of the urban territory but also represent a constant companion of a city dweller's field of vision. Thus, relooking and rethinking such spaces would be for the benefit of many - not only for the spaces themselves but also for the city and its inhabitants (Shukla, 2013).

However, additional open spaces are related to buildings - windowsills, balconies, terraces as well as rooftops. As a matter of principle, such building-integrated spaces are scattered across the built environment and represent a substantial part of the urbanised area. Thus, it would be natural to integrate them in the widened understanding of urban open space typologies.

Altogether, in addition to the familiar urban open spaces - plazas, playgrounds or pedestrian zones - there is an array of additional typologies that are worth to be included - especially in densifying cities, where open spaces are a rare commodity.

2nd step // multiple use open space

The second step to fulfil the numerous requirements on urban open spaces implies multifunctional usages of open spaces. By allowing - and regulating - various usages, the available open space can be used effectively.

In particular, this is important for these spaces that are normally characterised as urban

open spaces - parks, plazas or sports grounds. Many of these traditional typologies are programmed and have been created "to be used in a certain way, at specific times, by certain types of people, for a limited set of purposes " (Shukla, 2013, p. 5). Thus, by enriching their repertoire with additional usages, also these spaces correspond to a greater number of requirements.

Altogether, emphasising on multi-coded urban open spaces - be it *traditional* or *new* ones - is a promising way to relieve the pressure on urban open spaces. Not only, because it is an efficient use of space, but simultaneously creates synergies and, thus, reduces competing land uses.

MERGING THE FINDINGS

Merging urban agriculture's benefits

In section 2 of this study, the benefits of urban agriculture have been presented. During the analysis, it became clear, that these benefits are neither restricted to a single component nor to only one of the analysed dimensions (see fig. 19). But, in turn, a single component has multiple as well as wide-ranging benefits.

By overlaying the various analysed layers - society, health, ecology and economy - to one holistic picture, it is possible to recognise urban agriculture's full potential. As shown in figure 25, each of urban agriculture's components - such as a fruit-bearing tree or a street planter with herbaceous perennials and vegetables - is having multiple benefits on the city and its inhabitants. For instance, a plum tree that is planted in the midst of a residential area can be a trigger for an array of effects (extract):

- **SOCIETY** // The tree, its blossom and leaf canopy bring nature to town and aesthetically improve the neighbourhood. This, in turn, can positively influence the community's sense of security. Furthermore, the tree is a gathering place, where neighbours meet and chat while picking the ripe plums.
- **HEALTH** // The plums enrich the consumer's diet and simultaneously contribute to food literacy. Furthermore, for adjacent neighbours it provides visual contact to nature and therefore beneficially affects their overall well-being.
- **ECOLOGY** // The tree provides shade and improves the air quality. It supports the local biodiversity by offering habitats for animal species and, furthermore, its blossom provides a food source for many pollinators. Thus, it is a productive green infrastructure.
- **ECONOMY** // In the long term, trees are financially rewarding and, therefore, lead to municipal savings. Furthermore, thanks to its fruits, consumers reduce their food expenditures and benefits from for fresh and local food.

Merging urban agriculture and urban open spaces

Urban agriculture's various cultivation typologies - forest gardening, ground-based and container-based - as well as their respective components, enable the integration across the

SOCIETY public produce // civic participation // environmental education
HEALTH food literacy // access to healthy food
ECOLOGY stormwater management // urban hydrology
ECONOMY business opportunities // municipal savings

SOCIETY community building // liveliness
HEALTH physical activities // mental well-being
ECOLOGY stormwater management // urban hydrology
ECONOMY increased property values // municipal savings

SOCIETY aesthetic improvement // sense of security
HEALTH mental health // visual contact with nature
ECOLOGY biodiversity // urban climate // air quality
ECONOMY increased property values // market expansion

SOCIETY community building // sense of pride
HEALTH food literacy // access to healthy food
ECOLOGY reduced food miles // biodiversity
ECONOMY economic savings on food

SOCIETY liveliness // "eyes upon the street"
HEALTH mental health // visual contact with nature
ECOLOGY urban climate // air quality // biodiversity
ECONOMY municipal savings // entrepreneurial endeavours

PUBLIC
STREET MEDIAN
GROUND-BASED // FOREST
nut trees, melliferous trees, herbaceous perennials, ground-cover

PUBLIC
SIDEWALK // STREET CORNERS
CONTAINER-BASED
dwarf nut & fruit trees, berry bushes, herbaceous perennials, vegetables, ground-cover

PUBLIC // COMMUNITY // PRIVATE
ANONYMOUS GREEN // NICHE SPACES // GRASS VERGES
CONTAINER-BASED // GROUND-BASED
dwarf nut, melliferous & fruit trees, berry bushes, herbaceous perennials, vegetables, ground-cover

PUBLIC
STREET MEDIAN
GROUND-BASED // FOREST
nut trees, melliferous trees, herbaceous perennials, climbers, ground-cover

PRIVATE
BALCONIES // TERRACES
CONTAINER-BASED
herbaceous perennials, vegetables, culinary herbs, ground-cover

PUBLIC // COMMUNITY // PRIVATE
NICHE SPACES
PHYSICAL COMPONENTS
tool shed, rainwater harvesting, water connection, storage area

Figure 25. Merge of numerous open space typologies, urban agriculture and its benefits. Own graphic.

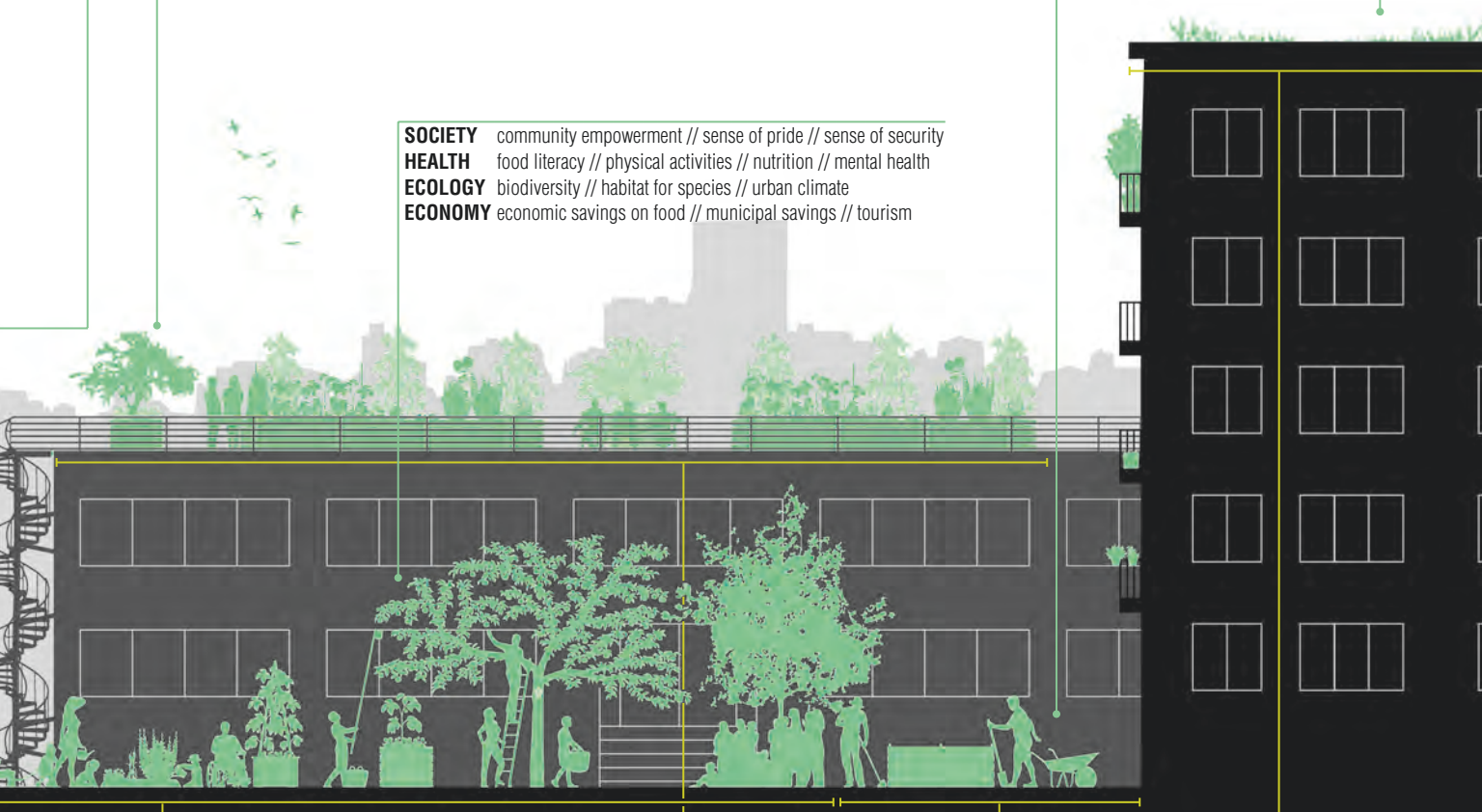
SOCIETY environmental education
HEALTH food literacy
ECOLOGY stormwater management
ECONOMY municipal savings

SOCIETY aesthetic improvement
HEALTH mental health // visual contact with nature
ECOLOGY biodiversity // energy consumption // air quality
ECONOMY increased property value

SOCIETY community empowerment // education // sense of pride
HEALTH food literacy // physical activities // nutrition
ECOLOGY biodiversity // energy consumption // urban climate
ECONOMY tourism // economic savings on food

SOCIETY education // community-building
HEALTH food literacy // physical activities
ECOLOGY organic waste & nutrient recycling
ECONOMY municipal savings

SOCIETY community empowerment // sense of pride // sense of security
HEALTH food literacy // physical activities // nutrition // mental health
ECOLOGY biodiversity // habitat for species // urban climate
ECONOMY economic savings on food // municipal savings // tourism



PUBLIC // COMMUNITY

VACANT & UNDERUTILISED LOTS // AMENITY & ANONYMOUS GREEN

FOREST GARDENING // GROUND-BASED // CONTAINER-BASED

fruit, nut and melliferous trees // dwarf fruit, nut & melliferous trees, berry bushes, herbaceous perennials, vegetables, ground-cover, climbers, wildlife-friendly features

PUBLIC // COMMUNITY // PRIVATE

NICHE SPACES // BACKYARD

PHYSICAL COMPONENTS

composting heaps, tool sheds, rainwater harvesting

COMMUNITY // PRIVATE

ROOFTOP AGRICULTURE

CONTAINER-BASED // GROUND-BASED

dwarf trees, berry bushes, herbaceous perennials, vegetables, climbers, ground-cover

PRIVATE

GREEN ROOF

GROUND-BASED

drought-tolerant planting, melliferous planting

urban landscape. Its diversity endows it with a remarkable adaptive capacity that reacts on the given context. With reference to the requirements on urban open spaces and the two suggested preliminary steps, urban agriculture has the potential to play a key role.

Thanks to its versatility, to put it bluntly, it kills two birds with one stone: firstly, it can be combined with wide-ranging types of urban open spaces - be it a grass verge along a sidewalk, a neighbourhood plaza or a flat rooftop; secondly, it entails an array of benefits that correspond to the requirements of urban open spaces. Thus, it mobilises often overlooked as well as rather mono-functionally used spaces of the urban territory, and simultaneously equips them with a multi-functionality.

In figure 25, urban agriculture has been merged with various open spaces typologies. While the benefits of its components are written "above-ground", its cultivation typologies including a selection of plants are assigned to different urban open spaces. This compilation - although it represents only selected examples - demonstrates that urban agriculture has the potential to transform cities into *socio-natural and productive urban landscapes*.

Reciprocal relationships

Applying urban agriculture across the cityscape is a way to fulfil the requirements open spaces are facing in a densifying environment. In table 7, these requirements have been juxtaposed with the benefits of urban agriculture. Indeed, the positive effect is clearly recognisable - both on the level of open spaces as well as on the level of the urban environment.

However, not only the city but also urban agriculture has certain demands. Thus, the lower part of table 7 shows, in what ways the city can supply urban agriculture. For example, city dwellers are consuming the produce and herewith supplying urban agriculture's need that someone harvests and enjoys its delicacies.

This overview demonstrates that the implementation of urban agriculture across the urban landscape leads to reciprocal relationships. While urban agriculture's needs are fulfilled by the city, it supports pressured open spaces and fulfils certain needs of the city (de Graaf, 2013). Thus, a win-win situation is created.

Of course, such relationships are highly context-sensitive and have to be developed according to given circumstances. By planting plum trees all over the cityscape, the target will be missed: "The question is not how many plum trees can you plant [...]. Rather, the question is how many plums should you plant?" (Nordahl, 2014, p. 115). Thus, for each context the most appropriate components of urban agriculture have to be selected in order create balanced reciprocal relationships that benefit the city and its inhabitants.

URBAN // DEMAND	URBAN AGRICULTURE // SUPPLY
URBAN OPEN SPACES	
PLACES FOR MEETING, RECREATION & INCLUSION	SOCIAL INTERACTION & COMMUNITY COHESION CROSS-GENERATIONAL & CROSS-CULTURAL INTEGRATION
SENSE OF PLACE & IDENTITY	SENSE OF PRIDE & FEELING OF BELONGING
COMMUNITY DEVELOPMENT	COMMUNITY INVOLVEMENT
EDUCATION // nature, food literacy & life skills	SPACES FOR LEARNING EXPERIENCES, EDUCATIONAL PROGRAMMES & YOUTH DEVELOPMENT OPPORTUNITIES
AESTHETIC CONTRIBUTION	NATURAL BEAUTY
SENSE OF SECURITY	INFORMAL SURVEILLANCE
ACTIVE RECREATION	FINE & GROSS MOTOR ACTIVITIES
PASSIVE RECREATION	PLACES TO RETREAT FROM THE URBAN EVERYDAY LIFE MENTAL WELL-BEING
CONNECTING WITH NATURE	NATURAL ENVIRONMENT & HEALTHY NUTRITION
GREEN INFRASTRUCTURE	PRODUCTIVE GREEN INFRASTRUCTURE
PRESERVE BIODIVERSITY	SPECIES HABITAT, PLANT AND ANIMAL DIVERSITY,
PRESERVE DIVERSITY IN WILDLIFE	WILDLIFE-FRIENDLY FEATURES
JUSTIFIED ECONOMIC VIABILITY	EMPLOYMENT OPPORTUNITIES ENTREPRENEURIAL ENDEAVOURS
MAINTENANCE & PRESERVATION IN THE LONG TERM	INCREASED TOURISM & PROPERTY VALUES SAVINGS ON FOOD (URBAN GROWERS) LOWER MAINTENANCE COSTS UTILISING VACANT LOTS & NEGLECTED SPACES
URBAN ENVIRONMENT	
WASTE TREATMENT & MANAGEMENT	COMPOSTING & NUTRIENT RECYCLING
AIR POLLUTION CONTROL	IMPROVED AIR QUALITY
CLIMATE CONTROL // BUILDING & CITY-WIDE SCALE	SHADE, HEAT ABSORPTION & EVAPORATIVE COOLING THERMAL INSULATION // roof LOCAL FOOD
STORMWATER MANAGEMENT & HYDROLOGY CYCLE	RAINWATER HARVESTING INFILTRATION, RETENTION & EVAPOTRANSPIRATION

URBAN AGRICULTURE // DEMAND	URBAN // SUPPLY
DAYLIGHT	SUN-EXPOSED SPACES
SOIL, NUTRITION & FERTILIZER	COMPOST
IRRIGATION	RAINWATER HARVESTING
SPACE	VACANT LOTS, INTERSTICES, TEMPORARY & NICHE SPACES
LOADING CAPACITY	UNDERUSED CONSTRUCTIVE CAPACITY // buildings
LABOUR	URBAN GROWERS, ENTREPRENEURS
CONSUMPTION OF PRODUCE	URBAN GROWERS & CITY DWELLERS

Table 7. Matrices of supply and demand of agriculture and the city and its urban open spaces. Based on De Graaf, 2013, p. 39. Own graphic.

Figure 26. Bridging the gaps.

SECTION FOUR

BARRIERS & STRATEGIES TO TAP URBAN AGRICULTURE'S POTENTIAL

BARRIERS & STRATEGIES TO TAP URBAN AGRICULTURE'S POTENTIAL

EVEN THOUGH URBAN AGRICULTURE HAS MANY BENEFITS, THIS PRACTICE IS RESTRICTED BY NUMEROUS OBSTACLES AND "NEGATIVE ATTITUDES" (SMIT ET AL., 2001C, P. 1.).

THESE SIGNIFICANT BARRIERS - IN WHICH MANY STAKEHOLDERS PLAY A ROLE - DISALLOW URBAN AGRICULTURE TO OBTAIN THE NECESSARY ACCEPTANCE TO BECOME AN ACKNOWLEDGED STRATEGY FOR ADVANCING SUSTAINABLE DEVELOPMENT.

THE CHALLENGES CAN BE DIVIDED INTO THE FOLLOWING CATEGORIES:

1 :: SCEPTICISM, SOCIOCULTURAL BIASES & INSTITUTIONAL CONSTRAINTS

2 :: CONSTRAINED ACCESS TO RESOURCES, INPUTS & FINANCIAL MEANS

3 :: SPECIAL RISKS OF CULTIVATING IN THE CITY

4 :: ORGANISATIONAL CONSTRAINTS

THESE FOUR CATEGORIES ARE EXPLAINED IN DETAIL, AND THE BARRIERS ARE OUTLINED. TO UNDERSTAND WHICH BARRIERS ARE MOST TO LIKELY BE A THREAT FOR THE IMPLEMENTATION OF URBAN AGRICULTURE, A RISK ANALYSIS WAS CARRIED OUT.

DEPENDING ON PROBABILITY AND IMPACT LEVEL OF THE BARRIER, IT WAS POSSIBLE TO CREATE A LISTING THAT SHOWS, WHICH BARRIERS HAVE A LOW RISK, A MANAGEABLE RISK OR A HIGH RISK.

FOLLOWING THIS, STRATEGIES AND RECOMMENDATIONS HAVE BEEN DISCUSSED, AND EVEN THOUGH BY NO MEANS THE LIST OF STRATEGIES IS COMPLETE, A FIRST BASIS FOR DISCUSSION IS GIVEN, IN ORDER TO ADDRESS THE BARRIERS.

URBAN AGRICULTURE BARRIERS

The previous chapters have shown, that urban agriculture is not only equipped with multifaceted benefits but is also highly adaptable to an urban context's various open space typologies. Furthermore, it could be demonstrated, that urban agriculture's and a city's needs and supplies complement each other very well, and a symbiotic relationship could be established without further ado.

The titles of the four categories are partially borrowed from the book "Urban Agriculture - Food, Jobs and Sustainable Cities" (Smit et al., 2001c), whereas the challenges come from various sources.

Nonetheless, urban agriculture is restricted by numerous obstacles and "negative attitudes" (Smit et al., 2001c, p. 1.). These significant barriers disallow urban agriculture to obtain the necessary acceptance to become an acknowledged strategy for advancing sustainable development. Many expert reports and literature reviews debate the occurring constraints (see Pearson et al., 2010; Cohen et al., 2012; Hagey et al., 2012; Hendrickson et al., 2012; Bohn et al., 2014a). Based on a review of these documents, urban agriculture's challenges can be divided into four broad types:

- scepticism, sociocultural biases & institutional constraints
- constrained access to resources, inputs & financial means
- special risks of cultivating in the city
- organisational constraints

In the subsequent paragraphs, the challenges will be addressed and backed up with explanations. It is essential to know urban agriculture's constraints, in order to formulate target-oriented recommendations for action in a subsequent step.

SCEPTICISM, SOCIOCULTURAL BIASES & INSTITUTIONAL CONSTRAINTS

The scepticism and sociocultural biases against urban agriculture are often deeply enrooted in local cultures as well as in particular population strata. Most of them are related to attitudes about aesthetics, its legitimacy as an urban land use and urban agriculture's usefulness as such (Smit et al., 2001c; Bohn et al., 2014a). While some of them originate from "outdated, European views" (Smit et al., 2001c, p. 1) on the modern city, others are based on urban agriculture's versatile nature.

In the 19th century, the European concept of the city as a "planned, civilized space" (Smit et al., 2001c; p. 2) took root and with it some misconceptions about agriculture as such. Thus, in many cultures it is considered to be rural, outdated and with low economic returns. Practiced in urban areas, it is labelled as temporary, unsophisticated or even misplaced and is a contrast to the clean, neat and efficient ideal of the modern city (Smit et al., 2001c). Even if these times seem to belong to the past, they are still anchored in the opinion of many planners, economists and policymakers. There is still a long way to go, in order to grant urban agriculture's reason for existence as part of the urban landscape.

Not only bygone understandings of how a city ideally looks like account for sceptical attitudes towards urban agriculture, but the practice itself is partially at fault. First of all, urban agriculture is - as the definitions have revealed - encompassing a wide range of

activities and, therefore, appears fairly complex. Even within one city, there are different organisational structures and cultivation methods for urban agriculture operations. Secondly, it is continuously - and rapidly - changing, in order to be adaptable to given settings and legislations (Bohn et al., 2014c). Because of the ongoing emergence of new projects and the modification of existing projects, even for long-time observers, it is difficult to keep track on the urban agriculture movement (Cohen et al., 2012). Thirdly, urban agriculture appears all around the world. Thus, depending on the local context - country, regions and individual sites - it is handled differently (Bohn et al., 2014c).

With reference to sociocultural biases, one reason has its source from a "traditional" prejudice: urban agriculture is seen as some kind of "outcast industry" (Smit et al., 2001c, p. 2). While in the developing world this manifests itself in the form of gender bias (often practiced by women), in the Global North it continues to be recognised as a trend - created and lived out solely by hip and bohemian citizens (Smit et al., 2001c; Wissmann, 2014). What is often left behind with this fairly one-sided statement is the fact, that quite a lot of urban agriculture projects arise from community-conscious guiding principles. Thus, such projects are often located in "underserved neighborhoods, including many low-income communities and communities of color" (Cohen et al., 2012, p. 81). To maintain social equity in the urban agriculture movement, significant race- and class-based disparities have to be overcome. To put it plainly, access to grants, in-kind assistance as well as to information about such opportunities have to be accessible for everybody (Cohen et al., 2012).

Additionally to scepticism and sociocultural biases, institutional constraints are challenging the spreading of urban agriculture. Usually, urban agriculture is not a firm component of planning and policy-making processes (Smit et al., 2001c; Cohen et al., 2012). As a consequence, urban agriculture projects are either completely excluded from policy-making or included only nominally in decisions that affect their neighbourhoods. At the same time, government officials often take a decision based on citywide criteria and are therefore negligent of critical concerns, which occur at the neighbourhood level (Cohen et al., 2012). Since planners and policymakers typically have not a focus on the production activities of agriculture, they tend to overlook problems as well as opportunities within the entire food system (Cassidy et al., 2008). Instead of identifying opportunities to preserve circumjacent agricultural areas or integrating new production functions into the urban environment, peripheral or even rural landscapes are often considered as areas for future development (Taylor Lovell, 2010). As a consequence, urban sprawl is advancing and according to Taylor Lovell (2010, p. 2502) "we see a growing disconnect between urban residents and the agricultural landscapes that sustain them".

Generally, successful co-operations among municipalities and citizen-triggered projects are rare. This could be based on the fact, that grassroots activities are still a rather new phenomenon for many cities and the process of gaining experience is still going on. As a consequence, certain concerns or even disinterest are expressed by involved authorities to make use of this - yet unconventional - format of open space usage (von der Haide, 2014). This leads to the fact that many urban growers ask for an increased response capacity on the part of municipal authorities - especially concerning site maintenance, safety and sanitation (Cohen et al., 2012). Another reason for the improvable collaboration of bottom-up governance of community gardens with formal planning practice might derive

from urban growers themselves. Since they are committed to urban agriculture on a volunteer basis, available resources - especially time and expert knowledge - are scarce. Thus, the collaboration with decision-makers can arise from wilful or compelling reasons.

CONSTRAINED ACCESS TO RESOURCES, INPUTS & FINANCIAL MEANS

As the previous chapters highlighted (see table COMPONENTS), urban agriculture projects require certain physical and non-physical components to be fully operative in the long run. The lack of growing space is one of the most crucial factors that limit the growth of urban agriculture (Smit et al., 2011c; Cohen et al., 2012; Golden, 2013; Bohn et al., 2014a). This is not only confining the projects' capacities to produce food, but also prevents their capability to extend goal-orientated programs for specific target groups (Cohen et al., 2012).

This constraint has various dimensions - it is not only the lack of space per se, but also its size, suitability and appertaining permits. Depending on land tenure and zoning regulations, the access to water as well as the possibility to set up required infrastructure - be it a tool shed or a system for rainwater harvesting - are of major importance for the practicability or urban agriculture projects (Smit et al., 2001c; Adamchak, 2011; Hendrickson et al., 2012).

Furthermore, especially in densely developed cities with high property values, urban agriculture is competing with other land uses, in particular with commercial developers (Pearson et al., 2010; Bohn et al., 2014c). This often leads to the result, that urban agriculture is often tolerated on an interim, but not on a long-term or even permanent basis (Cohen et al., 2012). An additional competitive situation is created by the fact, that many residents prefer open space uses that are oriented toward cultural functions, such as "nature parks or sports fields" (Taylor Lovell, 2010, p. 2512). Despite urban agriculture's multifunctional nature, people assume that it offers a greater benefit to individuals (urban growers) than it does to the general public.

Another constraint, which urban agriculture is encountering, is the access to necessary inputs such as growing media, fertiliser and nutrients as well as equipment and tools. Particularly the first mentioned input, growing media, is very important but simultaneously expensive to purchase and transport (Smit et al., 2001c; Cohen et al., 2012). Not only soil in sufficient quality is required, but also other components such as compost and other soil amendments (see figure CBA). Generally, fertilisers, as well as equipment and tools, are related to financial expenditures, which often burden the projects'budgets.

Another component, which is of significant importance is the availability of sufficient operating funds. Albeit urban agriculture projects obtain their finances from various sources - philanthropic dollars, government grants, individual donations or fees from services and tourist groups - limited financial resources are a big obstacle for projects to grow additional food, offer programmes or make general improvements to their sites (Cohen et al., 2012).

SPECIAL RISKS OF CULTIVATING IN THE CITY

The urban environment implicates various special risks for cultivating crops. First of all,

urban grown plants - be it vegetables, fruits, berries or nuts - are exposed to a higher pollution load compared to rural growing regions (see table 8). The three main causes for higher concentration of noxious substances are: 1) cultivating on contaminated soils (Alloway, 2004; Ackerman, 2012; Saeumel, 2013), 2) utilisation of contaminated water for irrigation purposes (Arora et al., 2008) and 3) the air introduction of emissions caused by traffic and industry (Chaney et al., 1984). Thanks to the launch of lead-free petrol and paint, the re-accumulation of contaminants has been substantially reduced (Saeumel, 2013).

Nonetheless, heavy metals remain in the soil and can be re-mobilised by chemical or physical modifications. Studies have shown, that the accumulation of heavy metals is varying among different types of crops. There is evidence, that leafy vegetables and herbs absorb high quantities, whereas root vegetables and legumes are moderate respectively low accumulators of heavy metals (Alexander et al., 2006). Furthermore, studies have revealed, that soft fruits take in higher amounts of heavy metals, while stone fruits and nuts absorb lower quantities (Saeumel et al., 2012; Saemuel, 2013). In general, in urban residues from heavy metals are more likely to be detected in urban grown vegetables than fruits (Saemuel, 2013). Nonetheless, depending on the noxious substance, the primary risk is often not the consumption of food cultivated in contaminated soil but rather dermal exposure or direct ingestion of soil, which is actually the most serious type of exposition (Rosen, 2002; Shayler et al., 2009; Ackerman, 2012).

However, pollution is not only caused by the urban environment but might also originate from urban agriculture practices. Normally, manure and compost are enough to grow healthy and flourishing plants. Nonetheless, some urban growers apply chemical fertilisers, which mainly consists of nitrogen, phosphorous and potassium. Although this type of fertiliser is widely available, ready-made and often less expensive than manufactured organic fertiliser, still many experts and practitioners advise against it (Simon et al., 2013). The excessive use of chemical fertilisers can contaminate stormwater runoff, which then in turn pollutes surface water and groundwater (Davies et al., 2001; Spetzman et al., 2004). Furthermore, as it is nicely put in the book "Urban Gardening for Dummies" (Simon et al., 2013): "Chemical fertilizers don't add organic matter or feed to the soil's microorganisms. Chemical fertilizers are like taking vitamin pill, while organic fertilizers are like eating a good meal."

ELEMENT	SOIL total concentration in mg / kg		PRECIPITATION deposition n in kg / km² / year	
	TOWN	COUNTRYSIDE	TOWN	COUNTRYSIDE
Zn	100 - 424	44 - 97	30 - 300	3 - 30
Pb	100 - 654	25 - 74	7.5 - 15	0.5 - 7.5
Cu	32 - 151	13 - 29	4 - 20	0.2 - 4
Ni	11 - 36	5 - 41	1.5 - 7.5	0.4 - 1.5
Cr	8 - 59	11 - 13	2 - 4	0.4 - 2
Cd	0.3 - 8.4	0.1 - 0.9	0.1 - 0.4	0.01 - 0.2

Source: adapted from Wie gesund ist die "Essbare Stadt"?, p. 21, by I. Saeumel, 2013, Forum Geoökologie, 24 (2), 20-24.

Table 8. Comparison of the median values of heavy metal contents in soils and precipitation between urban and rural areas.

Another type of special risks of cultivating in the city comes from the city dwellers - theft and vandalism (Adamchak, 2011). Especially in neighbourhoods, where urban agriculture is practiced for food security, theft of produce is commonly occurring (Smit et al., 2001c). Furthermore, stealing also causes troubles in projects, which are run by individuals or a community for the purpose of self-consumption. Most often, such projects label their beds with "forbidden to pick flowers / vegetables / fruits" (see figure 27).

However, depending on the type of project, the take-away of products can also be seen as welcome gesture and citizens even have to be explicitly requested to harvest the products (Diening, 2013; F. Berger, personal communication, October 26, 2015). On the basis of various projects - for example from edible cities such as Andernach (Germany) and Todmorden (United Kingdom) - it could be revealed, that vandalism is a minor issue (Mueller, 2013; Diening, 2013). Pam Warhurst, founder of "Incredible Edible Todmorden", explains it like this: "If you take a grass verge that was used as a litter bin and a dog toilet and turn it into a place full of herbs and fruit trees, people won't vandalise it. I think we are hard-wired not to damage food" (Graff, 2011).

In terms of special risk of cultivating in the city, the lack of proper insurance is brought up in a few papers (Smit et al. 2001c; Hagey et al., 2012; Wang et al., 2013). Only a small percentage urban growers have access to so-called special insurances, such as the federal crop insurance. According to Wang et al. (2013), they are reliant on ordinary types of insurance "in order to manage the loss and damage covered by extreme weather events" (p. 325). However, these types do often not specifically represent the needs of urban growers, because many types of damages occurring from weather and traditional farm risks are excluded. Nonetheless, insurance premiums are often high and contribute to the financial challenges - including start-up and operating costs - of many urban agriculture projects. Although there are some strategies, such as sharing insurance expenses with other farmers, it remains regularly challenging to overcome these obstacles (Hagey et al., 2012; Wang et al., 2013).

According to Hackworth (2007), gentrification is a "process central to carving out new urban spaces for capitalist accumulation" (McClintock, 2013).

Another special risk of cultivating in the city is the fact, that urban agriculture is sometimes claimed to be a driver of gentrification. According to Bohn et al. (2014c), speculators appear on the scene, as soon as people have achieved significant success in improving their neighbourhood. Also National Geographic article has reported, that "land in cities is often expensive, especially since gardens tend to contribute to gentrification and rising rents" (Howard, n.d.). Nonetheless, there are numerous causes of gentrification, and further investigations are necessary to not only depict urban agriculture's role, but also to find suggestions for improvement.

ORGANISATIONAL CONSTRAINTS

A final constraint to tap urban agriculture's full potential is the lack of organisation among urban growers themselves. According to Smit et al. (2001c), this originates from the facts that there is a wide spreading as well as a shortage of cohesion among the individual projects. Although there are numerous coordinated networking opportunities - for example, the "International Network for Urban Agriculture" (INUAG) - still many projects do not take part in these offers. Whatever is the reason for this non-participation, it entails many lost opportunities for learning from other urban growers.

An additional constraint, which directly originates from the urban growers, is the lack of know-how. On the one hand, urban agriculture is generally practiced by people, without agricultural background (Berges et al., 2014; von der Haide, 2014; Bohn et al., 2010). Thus, the yields might suffer from "inferior or insufficient inputs, use of poorly adapted varieties, poor water management, and lack of farming knowledge" (FAO, 1997). Apart from maintaining adequate yields, managing pests and weeds poses an additional moderate risk to the long-term success of urban agriculture projects (Oberholtzer et al., 2014). On the other hand, setting-up a project is a complex undertaking and includes an array of numerous intermediate stages and a significant amount preparatory work. Although there exist various helpful guides, it is difficult to obtain strategic advice on how to establish, plan, run and reflect on urban agriculture projects (Bohn et al., 2014c). This might lead to a further constraint, which is concerned with ongoing community engagement. Even if projects are embedded in the neighbourhood and supported by the community - be it volunteering or attending public events - keeping up this neighbourhood linkage and the consisting support can be challenging (Cohen et al., 2012).

Nonetheless, by far the major constraint to tap urban agriculture's full potential, are gaps in the availability of good quality and comparable data (FAO, 1997; FAO, 2010). So far, existing quantitative and qualitative data is "inexistent, or scattered and inconsistent" (FAO, 2008, p.55). Firstly, this might be caused by the absence of long-term experience with urban agriculture projects, which do not belong to allotment and community gardens (Bohn et al., 2014c). Secondly, although there exist case study data, "a more comprehensive set of basic data is needed" (FAO, 1997) in order to investigate urban agriculture's priority needs, such as environmental impact analysis, volume and type of food produced or used methods and inputs. As soon as those data are available, specific research and analysis would investigate further details, such as intensified sustainable cropping systems, land use changes due to future demographic shifts or small-plot agronomic requirements (FAO, 1997). Thirdly, little evaluation is done on comparable projects, and there is an "inconsistent dissemination of transferable knowledge" (Bohn et al., 2014c, p. 156). Fourthly, there is a deficiency in "institutional knowledge around how to 'scale-up' the findings UA case studies" (Pearson et al., 2010, 12). Lastly, available studies refer to a wide range of definitions and,

Figure 27. A "picking-prohibited-sign" in one of Berlin's community gardens.

Figure 28. A "food-to-share-sign" in Todmorden (United Kingdom), where a group of volunteer grows edibles round the town.

therefore, are based on various evidence bases. Consequently, the ability to interpret the results is limited and it is impossible to assign causal connections (Warren et al., 2015).

Without good quality data and strong study designs, it is difficult to understand how and to what extent urban agriculture contributes to a wide range of outcomes - be it ecological, social or even economic aspects (Cohen et al. 2012; Warren et al., 2015). As a consequence, it remains ambiguous, whether urban agriculture's beneficial effects arise evenly from the wide array projects - no matter the scale of type of cultivation - or if there are considerable differences.

Furthermore, even if a lot is written about urban agriculture, many topics are only superficially addressed within the literature and reliable data is rare (Pearson et al., 2010). The causes for this situation might be enrooted in the fact, that the investment and research in urban farming practices as well as techniques are fairly low (Smit et al., 2001c). Furthermore, most of the outcomes are complex to measure and research is "potentially costly" (Malakoff, 1995).

Despite all these challenges, urban agriculture is spreading across cities and the number of projects is steadily increasing (Cohen et al., 2012). In many respects, it can be assumed that practice is often outstripping policy and other urban developing tools (Bohn et al., 2014c). However, sceptical - or even negative - attitudes from critical actors are particularly restricting for urban agriculture's further development. As long as planners, economists and decision-makers consider it as a secondary activity, a good many of the biases continue to exist. This results not only in a lasting insufficient support, but also in a continuation or creation of policies and legislation that are unfavourable for urban agriculture (Smit et al., 2001c).

Already in 1995, Roger S. Ulrich and Russ Parsons - at that time both employees at the Texas A&M University - called up for reliable data to furnish proof for gardening activities.

It is precisely for this reason that urban agriculture has to be documented better. Reliable as well as comprehensive quantitative and qualitative data is necessary to tap - and make use of - urban agriculture's full potential. Although Socrates once enunciated: "A good decision is based on knowledge and not on numbers" (The Socratic Dialogue: Laches by Plato), numbers are important in our environment, which is shaped by hard facts. According to Russ Parsons and Roger S. Ulrich, the lack of hard data "can create the impression among decision-makers that there is an absence of tangible, credible evidence regarding the benefits" (seen in Malakoff, 1995).

Since urban agriculture is such a far-reaching subject, the data acquisition should be acquired on various scales - not only within the scope of scientific projects, but also by the contribution of urban gardeners themselves. In this way, measures can be developed to demonstrate urban agriculture's benefits at a neighbourhood scale as well as at a city-wide level.

STRATEGIES & RECOMMENDATIONS TO TAP URBAN AGRICULTURE'S POTENTIAL AS A TOOL FOR SUSTAINABLE DEVELOPMENT

In the previous chapters, we have seen how the incorporation of urban agriculture could meet the requirements of urban open spaces and, additionally could supply cities that strive for sustainable urban development as a solution to enhance the quality of life of its inhabitants. The excursus has given an overview on different projects that display the versatility of urban agriculture practices - both in the North and in the South. In the latest chapter, urban agriculture's barriers have been illustrated.

In this chapter, possible strategies to tap the potential of urban agriculture will be illustrated, and even if by now means the list of strategies is complete, it outlines a first basis for discussion.

RISK ANALYSIS

In order to comprehend better the barriers discussed in the previous chapter, and to find possible solution strategies, a risk analysis has been carried out. That should simplify the process to understand, which barriers are likely to happen and, depending on probability and impact level, if they can be a threat for the implementation of urban agriculture as an instrument for sustainable development.

The "risk analysis is a technique used to identify and assess factors that may jeopardize the success of a project or achieving a goal" (Allen & Derr, 2016, p. 26; see also Vose, 2008, pp. 14-17).

In order to fill the risk matrix we have taken the barriers summarised in the table 9, and, embedded them based on our knowledge and on what we have found out during this research (see fig. 29). After having filled the matrix, we identified the barriers with low risks, manageable risks or high risks by adding the probability number to the impact number. The lowest risks are for the barriers "UA originates pollution" and "vandalism, theft or exuberance of edibles" (2 total points) and the highest risk is for "lack of data"

A. SCEPTICISM, SOCIOCULTURAL BIASES, INSTITUTIONAL CONSTRAINTS	B. CONSTRAINED ACCESS TO RESOURCES, INPUTS AND FINANCIAL MEANS	C. SPECIAL RISKS OF CULTIVATING IN THE CITY	D. ORGANISATIONAL CONSTRAINTS (FARMERS)
A1. Urban agriculture's complex nature	B1. Lack of suitable growing spaces	C1. Exposure to pollution	D1. Lack of coordinated organisation // networking
A2. Too dynamic system for legislation times	B2. Constrained access to water	C2. Ua originates pollution / harmful practices	D2. Lack of know-how // gardening
A3. Gender // race // class based disparities	B3. Competition with other land uses	C3. Vandalism, theft or exuberance of edibles	D3. Lack of know-how // project management
A4. Just a trend?	B4. Constrained access to growing media, fertiliser and nutrients as well as equipment and tools.	C4. Driver of gentrification	D4. Lack of data
A5. Authorities are unexperienced in working with citizen triggered activities	B5. Limited financial resources		
A6. Low visibility on decision-makers agenda			

Table 9. Urban agriculture's four typologies of challenges, with respective barriers

Source: Own graphic.

Figure 29. Risk analysis. Own graphic.

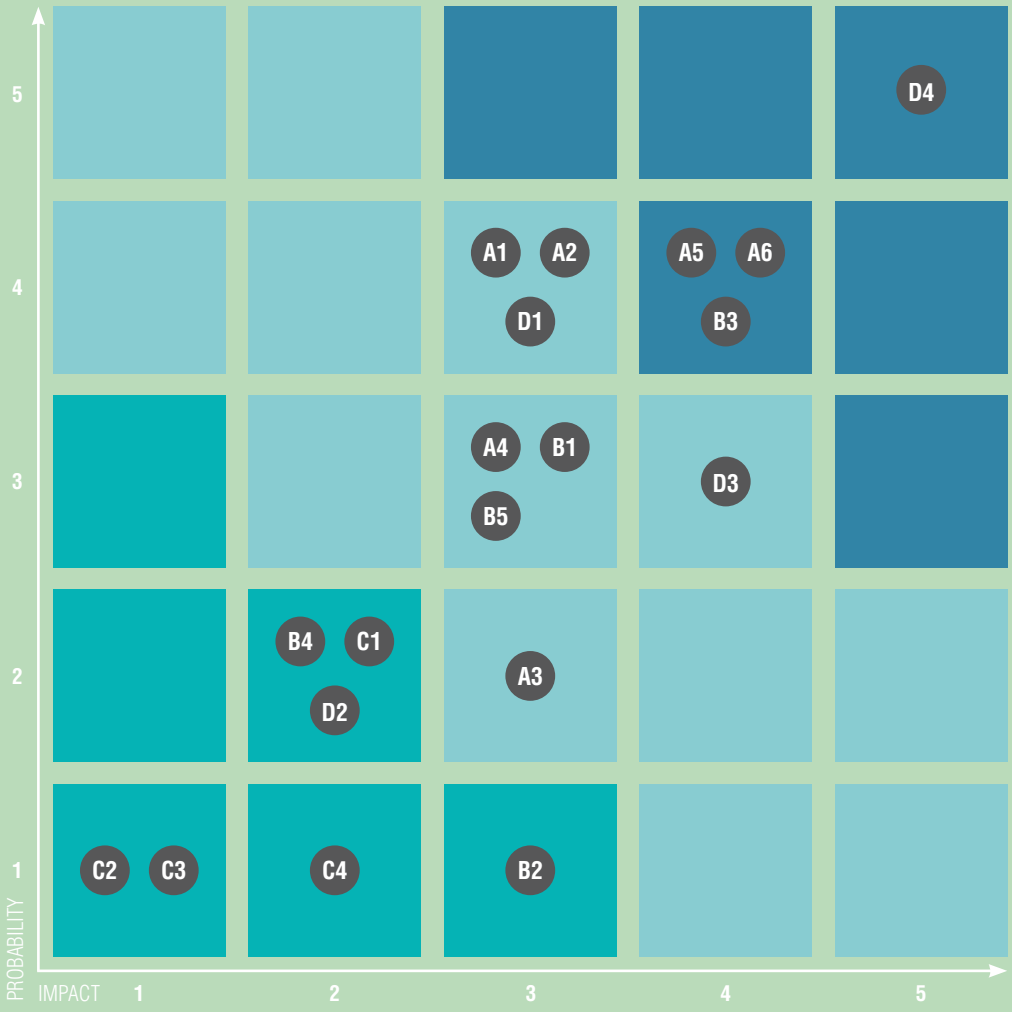


Figure 30. Hierarchy of risks. Own graphic.

LOW RISK

- B4. CONSTRAINED ACCESS TO GROWING MEDIA, FERTILISER AND NUTRIENTS AS WELL AS EQUIPMENT AND TOOLS
- C1. EXPOSURE TO POLLUTION
- D2. LACK OF KNOW-HOW / GARDENING
- B2. CONSTRAINED ACCESS TO WATER
- C4. DRIVER OF GENTRIFICATION
- C2. UA ORIGINATES POLLUTION / HARMFUL PRACTICES
- C3. VANDALISM, THEFT OR EXUBERANCE OF EDIBLES

MANAGEABLE RISK

- A1. URBAN AGRICULTURE'S COMPLEX NATURE
- A2. TOO DYNAMIC SYSTEM FOR LEGISLATION TIMES
- D1. LACK OF COORDINATED ORGANISATION / NETWORKING
- D3. LACK OF KNOW-HOW / PROJECT MANAGEMENT
- A4. JUST A TREND?
- B1. LACK OF SUITABLE GROWING SPACES
- B5. LIMITED FINANCIAL RESOURCES
- A3. GENDER / RACE / CLASS BASED DISPARITIES

HIGH RISK

- D4. LACK OF DATA
- A5. AUTHORITIES ARE INEXPERIENCED IN WORKING WITH CITIZEN TRIGGERED ACTIVITIES
- A6. LOW VISIBILITY ON DECISION-MAKERS AGENDA
- B3. COMPETITION WITH OTHER LAND USES

(10 total points). In the next part of the chapter strategies and recommendations will be pointed out.

LOW RISKS // STRATEGIES AND RECOMMENDATIONS

Constrained access to growing media, fertiliser and nutrients as well as equipment and tools

By collecting organic waste, compost can be produced which is an excellent growing media with an abundant amount of nutrients. Furthermore, it significantly reduces the need for chemical fertilisers. Composting pits can be set up in the backyard, in the community garden or even in the neighbourhood - simply there, where it will be used. In order to get access to equipment or tools, it would be worth to look at second hand markets, or to organise events to collect money.

Exposure to pollution

Get to know the site, on which urban agriculture is going to be practiced. Testing for contaminants could be a first step, but is quite expensive. Thus, it is easier to use planter boxes and raised beds in order to protect the crops from soil contamination. Planting protecting hedges around the crops could be solution to protect the crops from air pollution, for example from heavily trafficked streets. Furthermore, fruit trees, root vegetables and legumes tend to accumulate less heavy metals than leafy greens (Alexander et al., 2006; Saeumel, 2013).

Lack of know-how // gardening

As many other practices, urban agriculture requires knowledge, time and dedication. There are plenty of books that can help to set up a project in any context. Gardening associations, as well as different support organisations, can help to acquire the necessary know-how.

Constrained access to water

Having a rainwater harvesting system or access to treated wastewater system would be the best solution for not depending on municipal water (Ackerman et al., 2012; Freshwater Society, 2013; Dubbeling, 2014, Dhakal et al., 2015). Using a drip irrigation system is an efficient form of water use (Freshwater Society, 2013; Dubbeling, 2014; Dhakal et al., 2015). And, it goes without saying, that plants should not be overwatered, but they should receive water according to their needs.

Driver of gentrification

Since there are numerous causes and factors that lead to gentrification, it would be superficial to depict urban agriculture as a single driver for gentrification (Whitmire 2008). In places where this seems to happen, precise investigations should be carried out, evaluating and weighing the positive aspects as well.

Urban agriculture originates pollution // harmful practices

One of the causes of pollution due to urban agriculture comes from the use of ready-made and cheap fertiliser. Preferring organic fertiliser (compost, manure, mulch) would be much better - it does not originate pollution, it offers what the plants need (Simon et al., 2013). Also cheap soils or certain green roof substrates may cause polluted stormwater run-off, but this issue is yet to be fully understood (Wittinghill et al., 2011).

Vandalism, theft or exuberance of edibles

Even though vandalism and theft could be an issue - especially in places where urban agriculture is practiced for food security - experiences from different projects show that it is considered a minor problem (Smit et al., 2001c; Mueller, 2013; Diening, 2013). Sometimes it is enough to label the produce accordingly to the project's purpose - either "picking forbidden" or "food to share".

Exuberance of edibles happens, when food supply and consumer demand do not match. By knowing the "carrying capacity" (Nordahl, 2014, p. 115) of cultivated crops, it could be possible to minimize waste.

MANAGEABLE RISK // STRATEGIES AND RECOMMENDATIONS

Urban agriculture - complexity of the topic

Urban agriculture covers a wide range of topics, which are sometimes overlapping and, thus not clearly distinguishable. Furthermore, various stakeholders from all over the world with varying moving causes are involved and create a meshwork of differing fields of activities, practices and goals.

This results in a bizarre situation - on the one hand, it is possible to obtain documentations, texts and books on specific topics, and on the other hand, it is still difficult to communicate urban agriculture's basic idea. Thus, the benefits and effects of such projects should be monitored, evaluated, visualised and published. This can not only contribute to a better understanding but also to raise public awareness (Bohn et al., 2014a).

Too dynamic system for legislation times

Urban agriculture is a dynamic concept that includes a wide range of livelihood systems that can be practiced in different locations and under varying policy regimes and socio-political conditions (Dubbeling & de Zeeuw, 2007). Although there are various cities that formally acknowledged urban agriculture in their legislation, another idea suggests itself: Is urban agriculture too dynamic or are legislations too rigid?

Lack of coordinated organisation // networking

The lack of a coordinated organisation or networking are lost opportunities to demonstrate urban agriculture's potential as well as to create synergies. Fortunately, there are many active organisations and networks (global and locals, real and virtual) that support and show what urban agriculture is capable of (see appendix: "cited projects"). However, better networking among these groups, combined operations and concerted actions are crucial to gain more visibility in order to reach a wider public and leave an imprint on decision-makers.

Lack of know-how // project management

As for any other kind of activities, a good project management can play an essential role in the success of a project. As stated by Bauer and Fletcher (Design Trust of Public Space in New York City), "like any good gardening practice, a little bit of extra effort at the beginning can help your garden or farm grown stronger over time" (2015).

Just a trend?

Literally, urban agriculture is being practiced since ages and it is nothing new. And even

it has seen its "high season" during times of crisis, it has not forfeited its raison d'être. Nowadays it is practiced for a multifaceted spectrum of moving causes and, thus, has become an essential facet of a movement, which is based on environmentally and socially sustainable motives, (re)connection with nature as well as community building (Follett 2009; Press et al., 2011; Mok et al., 2014). It may happen that one or two inducements might change over time, but it will certainly not disappear from the scene.

Lack of suitable growing spaces

Thanks to the adaptability of urban agriculture it is not restricted to certain open space typology. Especially, if additional spaces - be it a windowsill, street medians or vacant lot - are included, a whole range of growing spaces are at disposal.

Moreover, to respond to local opportunities, an inventory of capacity can be done both on the micro and on the macro scale This can help to not only find suitable open spaces, but also to locate resources, stakeholders, and managerial capacities (Bohn et al., 2014a).

Limited financial resources

As already written for the point "project management", it is important that urban gardeners (but also municipalities) improve their communication skills and project management. This, in order to learn how to access philanthropic money or money from support organisations. Other opportunities for fundraising include, for example, word to mouth propaganda, the setup of dedicated events done in situ, or, also depending on the innovation of the proposed ideas, internet crowd funding. However, collecting evidence and findings of the work achieved are crucial to obtaining external financial support.

Gender // race // class-based disparities

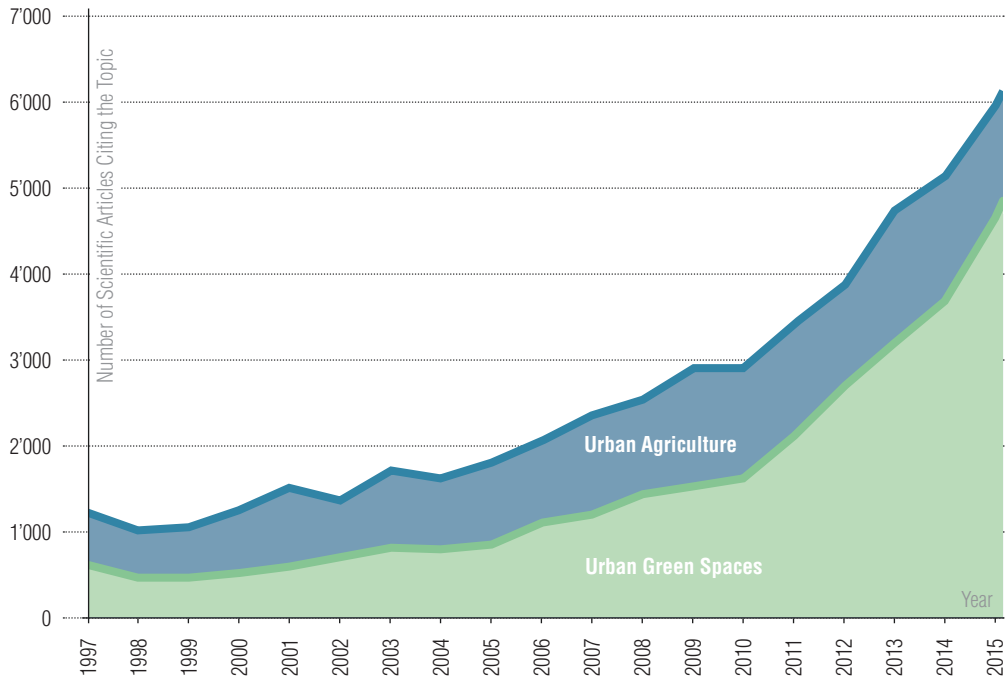


Figure 31. Research done in sciencedirect.com, showing the number of articles that include the terms "urban agriculture"and "urban green spaces". Source: Science Direct, retrieved 17.11.2015. Own graphic.

Since urban agriculture often involves education, it could be a mechanism for social and political change to reduce such disparities. Inequities could be addressed by supporting capacity building - especially among underprivileged groups (Cohen et al., 2012).

HIGH RISK // STRATEGIES AND RECOMMENDATIONS

Lack of data

As already discussed in the chapter "Barriers", the lack of data is the biggest issue related to proof urban agriculture's benefits and opportunities the urban environment. The Design Trust of Public space in New York City, actively addressed to this issue. In 2015, the initiators have published a manual named "Data collection kit: Methods for measuring the outcomes and impacts of community gardens and urban farms". In this manual, which is freely accessible, the different steps for collecting data all on food production (crop and harvest count), environment (landfill waste diversion, compost production and rainwater harvesting), social aspects (participation by geography, task and project, skills and knowledge in the garden and in sharing with other gardens), health (eating, good moods, change in attitude, beauty of the garden), and economy (market sales and donation of food) are comprehensively explained. The data collection functions also with the smartphone, and is then downloadable for researchers, policymakers, funders, and, of course, the urban growers themselves (Bauer & Fletcher, 2015).

Even though it will take some time to gather some relevant amounts data as well as to compare and analyse them, the project is a good start, that, if replicated elsewhere, can help to prove the benefits of urban agriculture.

On the other hand, it is remarkable the fact that in the last years - especially from 2010, namely, the International Year of Biodiversity - the number of published researches connected with urban agriculture and urban green spaces have seen a rapid growth (see figure GROWTH). Thus, the current situation is significantly improved compared to a handful of years ago.

Authorities are inexperienced in working with citizen triggered activities

Grassroots movements are still considered a rather new phenomenon, therefore, the process of gaining experience is still going on (von der Haide, 2014). For planners and municipalities, the benefits of working together and collaborate with active citizens are manifold. The following are some of the benefits related to a collaborative process between planners and citizens as described by Godschalk & Mills in 1966:

> "With collaborative planning [...] the planner [...] demonstrates that he considers the citizens of his community to be intelligent able to think, decide, and grow. Counter to the trend toward quantification abstraction, he sees his community, not through a computer, but across a table. Second, with a systematic public consultation process, the planner is able to stay abreast of social change. Finally, and perhaps most important, the planner gains a vital understanding of the people and groups for whom he works, with their specific limitations and potentials. If planning is to be judged in terms of the effectiveness of plan implementation rather than solely the efficiency of plan preparation, these will be important gains."

Clearly, what is stated here is that through public consultation process - today we would refer to public participation process - the citizen is valued, the social changes can be tracked, and the planning can, therefore, mirror the needs of the community.

Low visibility on decision-makers agenda

As long as planners, economists and decision-makers consider urban agriculture as a secondary activity, a good many of the biases will continue to exist (Smit et al., 2001c). To scale up urban agriculture, a collaboration between grassroots movements and govern entities is necessary.

However, before urban agriculture will be visible on decision-maker's agenda, it might have to gain visibility at the community level. Creating events, or meeting occasions directly on the site where urban agriculture is practiced will increase its visibility. Showing the results of the hard work and telling the stories that happen on the "urban fields" can also gain visibility on local and regional newspapers, magazines, or television programs. These steps do not replace the urgent need for data, but can be a way to provide a glimpse behind the scene and herewith to underpin its significance.

Nonetheless, for decision-makers and municipalities it would also be worthy to have a look at cities that have already integrated urban agriculture in their policies and land planning. To varying extents, these cities officially support urban agriculture: Montreal, Edmonton, Lisbon, Delft, Paris, Vancouver, London, Stockholm or Berlin to cite just a few. Thus, these cities surely have gained substantial experiences and an exchange of information could by inspiring for other municipalities.

Nonetheless, it would be desirable if urban-agriculture-friendly cities would monitor their strategies, and, subsequently evaluate and publish the findings. These data can serve as best practice examples and pave the ground for others.

Competition with other land uses

Because of the high land prices and an array of competing land uses in cities, urban agriculture may not seem like a wise choice for urban space utilisation in the first instance (Taylor, 2010). This risk could be reduced by compiling an overview on its various components. In combination with a holistic presentation of its benefits, its adaptive capacity and multi-functionality could be communicated and could become clear, that urban agriculture is much more than "just" growing vegetables on a vacant lot.

Figure 32. Pioneering.

SECTION FIVE

CONCLUSION

URBAN AGRICULTURE HAS ALWAYS BEEN PART OF THE URBAN REALM, AND IT IS NOT A NEW PHENOMENON.

NEVERTHELESS, MOST OF THE RESEARCHES AND PUBLICATIONS FOCUS ON THE MISSING LINK BETWEEN URBAN PLANNING AND FOOD, AND MADE IT CLEAR THAT PLANNING AUTHORITIES, POLICY-MAKERS AND DECISION-MAKERS, UNDERRATE AND OVERLOOK THE BENEFITS THAT URBAN AGRICULTURE HAS (DEELSTRA ET AL., 2000; MCCLINTOCK, 2010; MOUGEOT, 2000 & 2006; TAYLOR, 2010; QUON, 1999; VAN LEEUWEN ET AL., 2010).

THIS RESEARCH, ON THE OTHER HAND, LOOKS AT THE OPPORTUNITIES GIVEN BY URBAN OPEN SPACE AND PROVIDES A COMPREHENSIVE UNDERSTANDING OF URBAN AGRICULTURE PRACTICES.

SO, “WHY SHOULD URBAN AGRICULTURE BE USED AS A TOOL FOR SUSTAINABLE DEVELOPMENT?”

BY MERGING THESE TWO TOPICS, IT APPEARS EVIDENT THAT THE DEMAND THAT URBAN OPEN SPACES HAVE CAN

BE MET BY URBAN AGRICULTURE'S BENEFITS AND VICE VERSA.

MOREOVER, DUE TO ITS CROSS-CUTTING AND MULTI-DIMENSIONAL NATURE, THE EFFECTS OF URBAN AGRICULTURE OFFER INDISPENSABLE OPPORTUNITIES TO DEAL WITH URBAN CHALLENGES REGARDING SUSTAINABILITY, HEALTH, ECONOMY, SOCIETY, URBAN DESIGN AND LOCAL FOOD SUPPLY.

INDEED, IN ORDER TO TAP THIS POTENTIAL AND SCALE UP ITS BENEFITS, THE OPPORTUNITIES RELATED TO URBAN AGRICULTURE HAVE TO BE COMMUNICATED IN A WAY THAT SHOULD BE EASILY UNDERSTANDABLE.

CITIZENS, GRASSROOTS MOVEMENTS, AND COMMUNITIES ARE SHOWING ACTIVELY HOW IT IS POSSIBLE TO TAP SOME OF URBAN AGRICULTURE'S POTENTIAL, BUT STILL NEED A FRAMEWORK THAT PROTECTS AND VALUES THEIR WORK.

MUNICIPALITIES, ON THE OTHER HAND, NEED DATA

AND EVIDENCE FOR INTEGRATING URBAN AGRICULTURE PRACTICES INTO LONG-TERM OPEN SPACE STRATEGIES; THEY NEED IT IN ORDER TO MEASURE, EVALUATE AND MONITOR THE EFFECTS THAT URBAN AGRICULTURE HAS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT.

CITIES AROUND THE GLOBE THAT HAVE ALREADY INTEGRATED URBAN AGRICULTURE IN THEIR OPEN SPACE STRATEGIES - BOTH IN A FORMAL OR INFORMAL WAY - CAN ALREADY REAP THE BENEFITS OF IT.

AS WRITTEN BY MARCO CLAUSEN, ONE OF THE INITIATORS OF THE *PRINZESSINNENGARTEN* IN BERLIN, THESE CITIES, AS WELL AS THE URBAN GROWERS THAT CONSTANTLY WORK THE URBAN LAND, CAN BE CONSIDERED LIKE PIONEER PLANTS (2015). PIONEER PLANTS ARE “PLANTS WHICH INITIALLY COLONIZES AN UNFAVO[U]RABLE SITE IN TERMS OF SOIL AND MICROCLIMATE, AND, BY IMPROVING THE SOIL ENABLES THE SUBSEQUENT GROWTH OF MORE DEMANDING PLANTS” (IFLA, 2010).

AFTER THIS RESEARCH, WE OBTAINED THE CERTAINTY, THAT IN MANY PLACES THE FIELD IS PREPARED AND READY FOR THESE PIONEERS TO CONTINUE THEIR WORK, AND FOR MORE DEMANDING PLANTS TO BE PLANTED.

SHAPING OUR CITIES TOWARDS A PRODUCTIVE AND SOCIO-NATURAL URBAN LANDSCAPE WILL SURELY TAKE SOME MORE TIME.

NEVERTHELESS, TAPPING URBAN AGRICULTURE'S POTENTIAL AND USING IT AS A TOOL FOR SUSTAINABLE DEVELOPMENT TODAY, WILL SURELY BRING ITS FRUITS IN THE LONG-TERM WHILE MAKING URBAN OPEN SPACES A BETTER PLACE FOR US, FOR THE GENERATIONS TO COME, AND FOR THE ENVIRONMENT.

"PERHAPS IT MIGHT HELP TO CONSIDER THE CITY ITSELF AS A GARDEN, WITH ITS RESIDENTS AS THE GARDENERS. IT IS A PLACE COMBINING ORDER AND UNPREDICTABILITY, WHICH REQUIRES DILIGENT AND LONG-TERM PLANNING, AND PATIENT CARE. IF WE SOW THE SEEDS TODAY, THEN WITH A BIT OF LUCK, TOMORROW THE CITY WILL FLOURISH AS A GARDEN." (CLAUSEN, 2015)

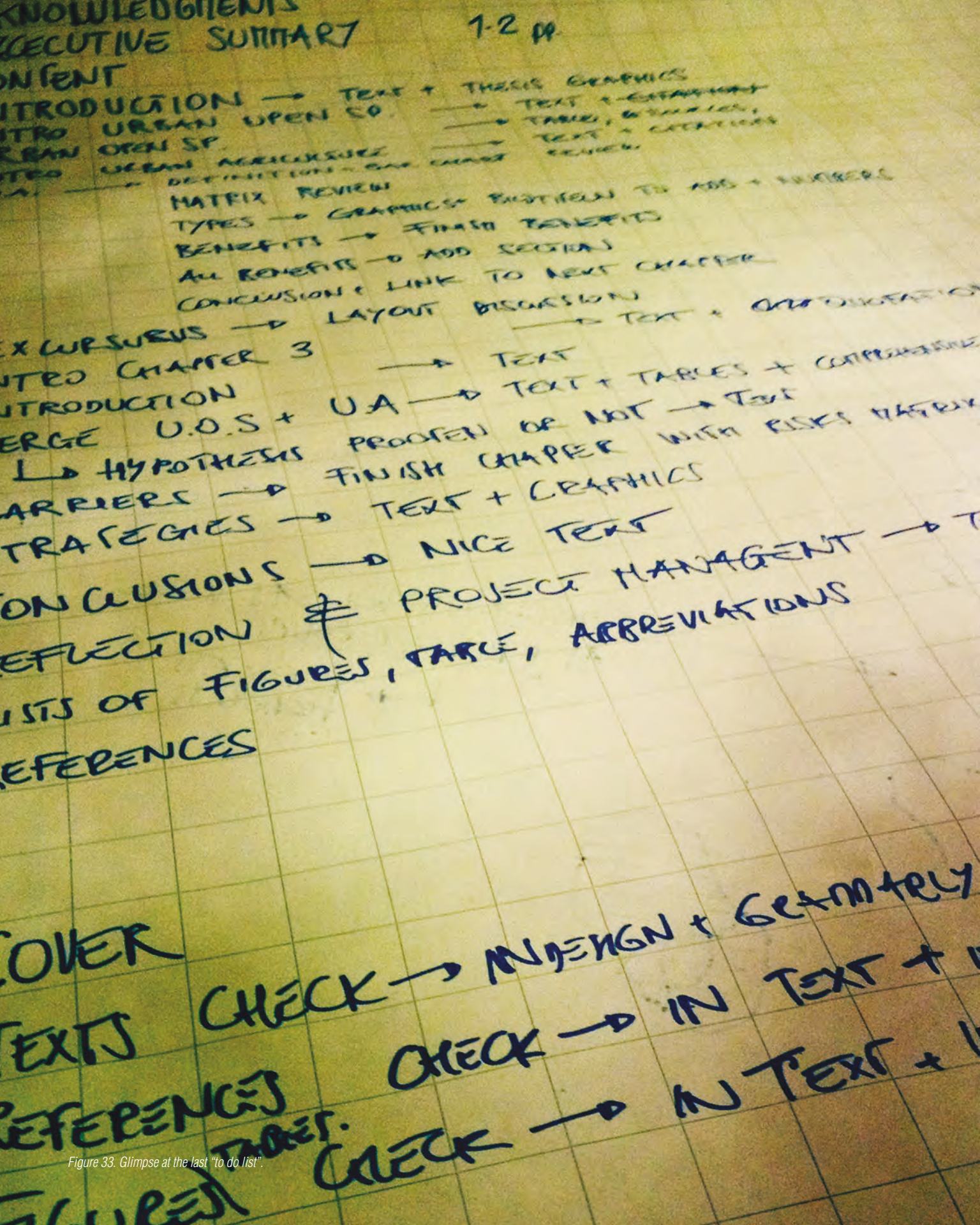


Figure 33. Glimpse at the last "to do list".

SECTION SIX

PERSONAL REFLECTION

PERSONAL REFLECTION

> "The Master of Science Degree Programme REAP – "Resource Efficiency in Architecture and Planning" is an international and interdisciplinary programme at HafenCity University Hamburg that is concerned with sustainable planning on different scales. It aims to enable participants to promote sustainable architecture and urban development in different geographical and cultural settings." (HCU, 2015).

Both of us have a background in architecture, and one of the reasons why we joined this Master course was the possibility to look at the urban environment as a complex system, to study sustainable urban development and to become acquainted with many of its different facets.

Before choosing the topic for this five months long research, we were looking at different options. Since we are often asked, what we actually learn in our Master studies, we planned to point up our gained knowledge with the aid of this Thesis. With the research question "Why should urban agriculture be used as a tool for sustainable development?" we implied the fact that we had to think holistically from the start on. From the one hand, we aimed at filling the knowledge gap related to the central topic, and on the other hand, we wanted to link the contents of this work with an array of topics we have been studying during REAP.

Urban agriculture, with its complexity and interconnections to many other fields of knowledge, is surely a subject that can help understanding sustainable urban development (see figure 36). Even though this research has challenged our minds to think logically as well as constructively, we are satisfied with the learning effects achieved: We looked at present issues related to densification; we delved into the basics of urban planning to have an understanding of the utilisation, planning and regulations of the spaces between buildings; we explored the manifold effects of urban agriculture, relating it to the social, environmental and economical requirements that cities, and their open spaces, are striving for; and finally, we looked for ways to tackle the current barriers and, therewith, underpinning urban agriculture's raison d'être and support it on its way to becoming a tool for sustainable development.

As shown in figure 35, the research and discussing as well as writing constitute the two significant parts of this thesis. While research and discussing were our guiding thread and permanently on our side, writing came along in wave-like portions. Visualising and editing, in particular, took place towards the end.

Since we are both engaged in various urban agriculture projects (see fig. 34), we enjoyed visiting other projects, talking to their participants as well as (digitally) getting to know other wonderful initiatives across the globe (see fig. 37). Thus, writing this Thesis was also some kind a matter of the heart and endowed us with plenty of inspiring and enriching moments.

Figure 34. At work.

THE HOURS SPENT FOR THIS RESEARCH

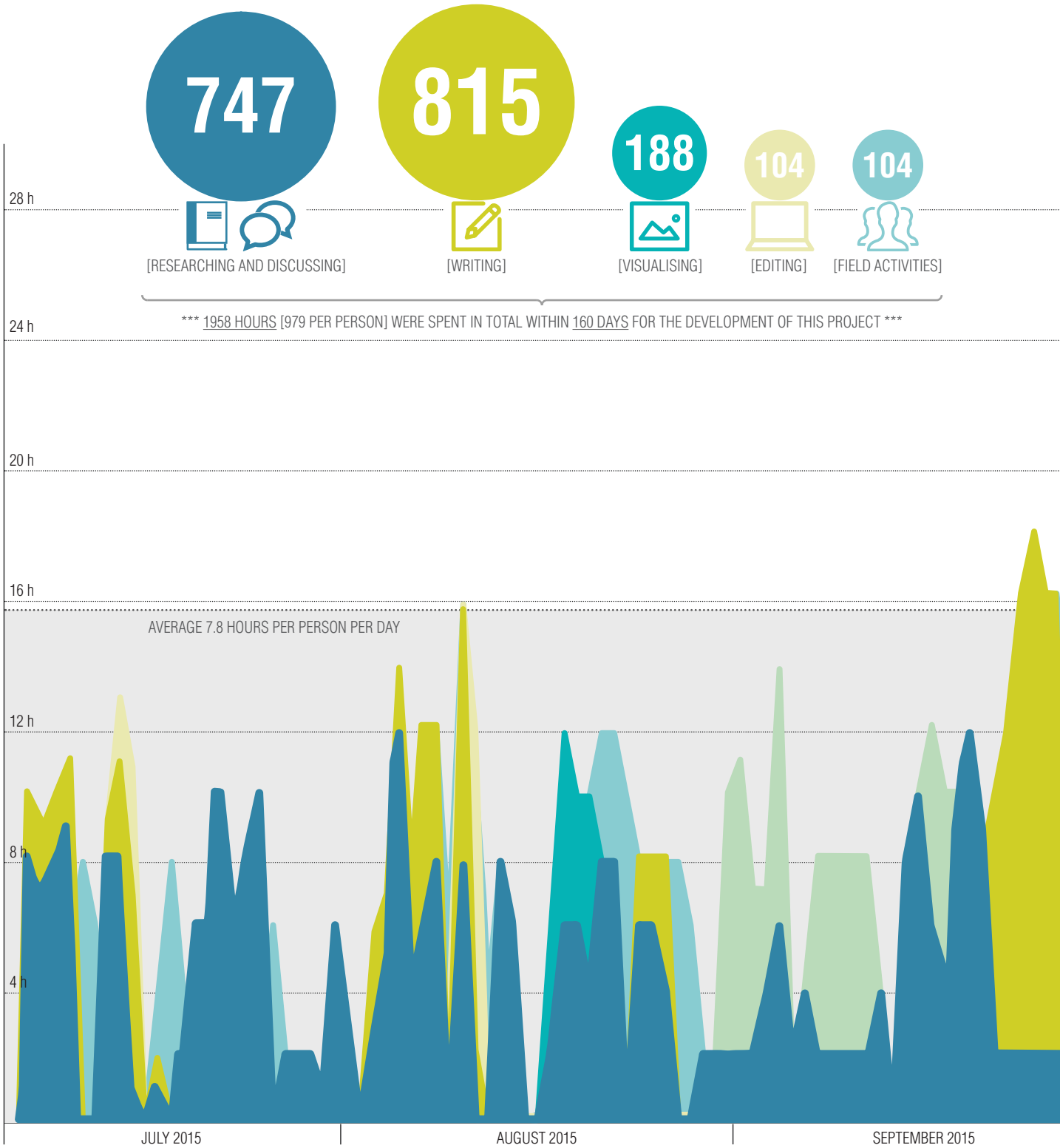
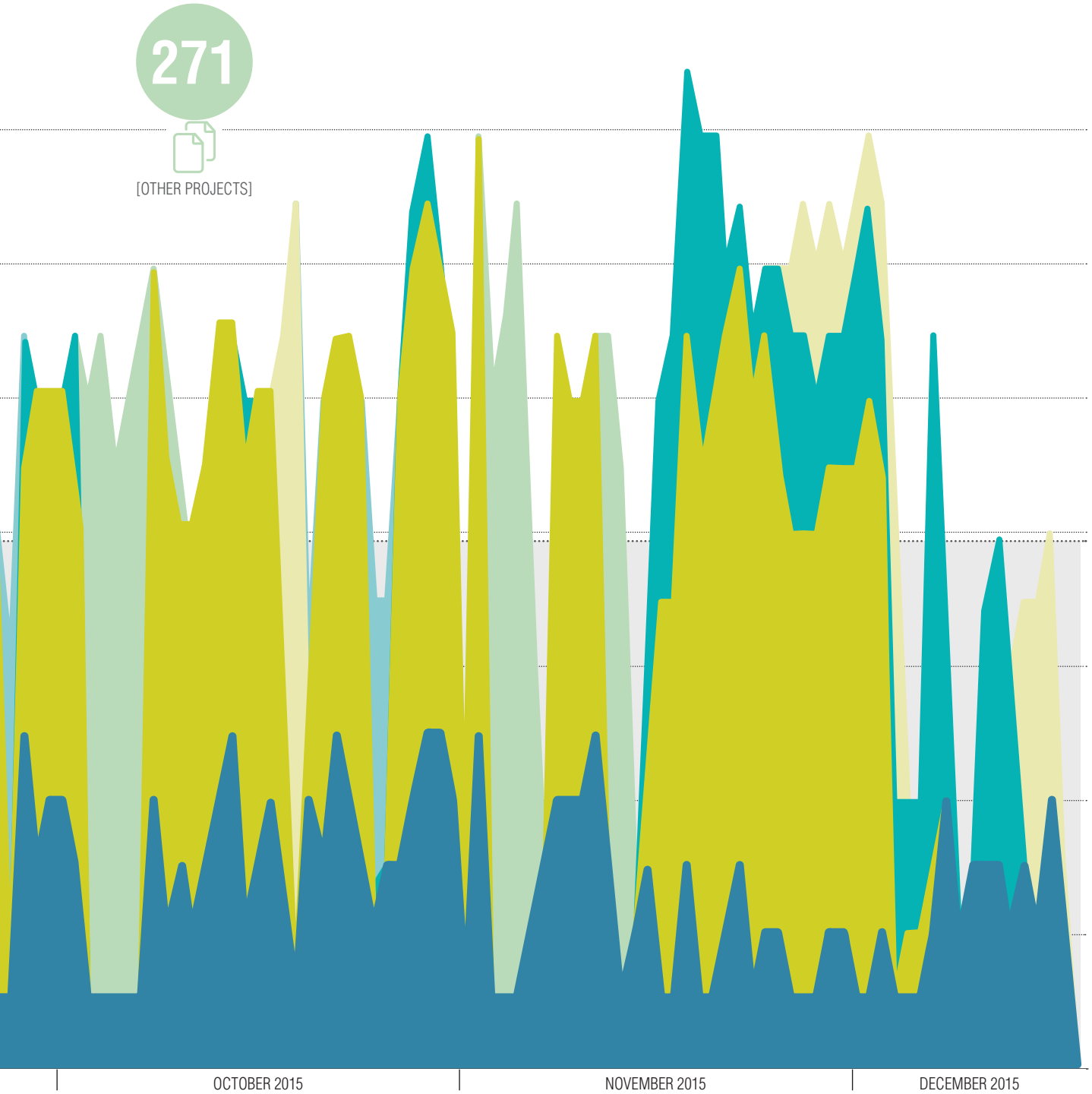


Figure 35. Additive hours spent per day for working on this project; total of two persons. Above: total of hours divided per topic. Own graphic.


271
[OTHER PROJECTS]
OCTOBER 2015
NOVEMBER 2015
DECEMBER 2015

KEYWORDS WE HAVE FOUND DURING THIS RESEARCH

Keyword	Number of publications
urban agriculture	11
urban ecology	8
urban planning	8
community gardens	7
ecosystem services	6
open space	4
green space	4
food security	4
urban green space	4
biodiversity	4

Table 10. Keywords found in publications. In the 80 papers with keywords we have researched on, 348 keywords were found. The "top five" of used keywords include: 1) urban agriculture, 2) urban ecology, 3) urban planning, 4) community gardens, 5) ecosystem services. Source: Own graphic. [thanks to wordle.net]

Figure 36. Word-cloud showing the keywords of the scientific papers that have been used for this research. Own graphic. [thanks to wordle.net]

URBAN AGRICULTURE // CITED PROJECTS

EUROPE

Allmende Kontor
Berlin, Germany
www.allmende-kontor.de

AUTh University Farm
Thessaloniki, Greece
www.auth.gr/en/access/8366

Bankastreet
Amsterdam, Netherlands
www.redscape.nl/portfolio/geveltuinen

Chocolate Factory // Urban Farm
Dublin, Ireland
www.urbanfarm.ie

Das Geld hängt an den Bäumen
Hamburg, Germany
www.dasgeldhaengtandenbaeumen.de

Eco-Grazing
Paris, France

Edible City
Andernach, Germany
www.andernach.de

Gartendeck
Hamburg, Germany
www.gartendeck.de

GroCycle
Exeter, United Kingdom
www.grocycle.com

Prinzessinnengarten
Berlin, Germany
www.prinzessinnengarten.net

Incredible Edible Todmorden
Todmorden, United Kingdom
www.incredible-edible-todmorden.co.uk

Intercultural Garden
Hamburg, Germany
www.interkgarten.de

Pollinator Passasjen
Oslo, Norway
www.pollinatorpassasjen.no

The Urban Orchard Project
London, United Kingdom
www.theurbanorchardproject.org

Trädgård På Spåret
Stockholm, Sweden
www.pasparet.org

Transition Town Totnes
Totnes, United Kingdom
www.transitiontowntotnes.org

Urban Physic Garden
London, United Kingdom
www.physicgarden.org.uk/

NORTH AMERICA

City Fruit
Seattle, USA
www.cityfruit.org

Friends of the Urban Forest
San Francisco, USA
www.fuf.net

Growing Power
Milwaukee, USA
www.growingpower.org

Guerilla Grafters
San Francisco, USA
www.guerrillagrafters.org

High Line
New York, USA
www.thehighline.org

Just Food
New York, USA
www.justfood.org

Rosemary's
New York, USA
www.rosemarysnyc.com

UC Davis Olive Center
Davis, USA
www.olivecenter.ucdavis.edu

ASIA

Roppongi Nouen
Tokyo, Japan
www.roppongi-nouen.jp

Tokyo Local Fruit
Tokyo, Japan
www.tokyogreenspace.com

Urban Leaves
Mumba, India
purvita10.wix.com/urbanleaves

AFRICA

Abalimi
Cape Town, South Africa
www.abalimi.org.za

SOUTH AMERICA

Programa de Agricultura Urbana
Rio de Janeiro, Brazil
aspta.org.br/programas/programa-de-agricultura-urbana/

OCEANIA

KIWI bees
Hastings, New Zealand
www.kiwibees.co.nz

Reclaim the Curb
Melbourne, Australia
www.reclaimthecurb.org

WORLDWIDE

Boskoi // www.boskoi.org
Fallen Fruit // www.fallenfruit.org
Mundraub // www.mundraub.org

Figure 37. Locations, names and websites of cited projects. Own graphic.

Figure 38: Inspiration.

SECTION SEVEN

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#2 // Forest-gardening // pp. 90-91

Figure 1. www.theurbanorchardproject.org/about-us/gallery

Figure 2. www.flickr.com/photos/friendsoftheurbanforest

Figure 3. www.flickr.com/photos/thelondonorchardproject

Figure 4. www.flickr.com/photos/friendsoftheurbanforest

Figure 5. www.flickr.com/photos/friendsoftheurbanforest

Figure 6. www.flickr.com/photos/friendsoftheurbanforest

Figure 7. www.flickr.com/photos/thelondonorchardproject/

#3 // ground-based cultivation // pp. 92-93

Figure 1. Own photograph.

Figure 2. Own photograph.

Figure 3. www.becoming-a-designer.blogspot.de/2012/11/roppongi-nouen-tokyo.html

Figure 4. www.openhousebcn.files.wordpress.com/2012/05/openhouse-barcelona-roppongi-nouen-farm-architecture-on-design-partnership-japan

Figure 5. Own photograph.

Figure 6. Own photograph.

Figure 7. www.rosemarysnyc.com/gallery

Figure 8. www.rosemarysnyc.com/gallery

Figure 9. www.rainproof.nl/toolbox/maatregelen/geveltuintje

Figure 10. www.rainproof.nl/toolbox/maatregelen/geveltuintje

Figure 11. www.treadinglightlyblog.files.wordpress.com/2013/09/img_1108.jpg

#4 // container-based cultivation // pp. 94-95

Figure 1. Own photograph.

Figure 2. Own photograph.

Figure 3. Own photograph.

Figure 4. Own photograph.

Figure 5. www.facebook.com/TRADGARDPASPARET

Figure 6. www.facebook.com/TRADGARDPASPARET

Figure 7. Google Earth // 2006 & 2014

Figure 8. Own photograph.

#5 // Urban agriculture in the global south // pp. 96-97

Figure 1. http://www.ipsnews.net/2012/05/urban-farming-takes-root-in-brazilrsquos-favelas/

Figure 2. https://aueufmg.files.wordpress.com/2013/04/programa-de-agricultura-urbana-as-pta.jpg

Figure 3. Own photograph.

Figure 4. Own photograph.

Figure 5. Own photograph.

Figure 6. Own photograph.

Figure 7. http://awsassets.wwf.org.za/img/original/_j2t8122.jpg

Figure 8. http://abalimi.org.za/key-activities/

Figure 9. https://www.globalgiving.org/

Figure 10. http://episcopaldigitalnetwork.com/ens/files/2012/02/elo_020312_SAfricafarm.jpg

#6 // FUTURE TRENDS IN URBAN AGRICULTURE // pp. 98-99

Figure 1. www.popupcity.net/wp-content/uploads/2013/05/Paris-sheep.jpg

Figure 2. www.thecitydublin.files.wordpress.com/2012/12/urban-farm-nine.jpg

Figure 3. www.ksr-ugc.imgix.net/projects/1686481/photo-original.jpg?v=1426005009&w=1536&h=1152&fit=crop&auto=format&q=92&s=87f75e49e15cb3f528e94d87eef14a75

Figure 4. www.grocycle.com/wp-content/uploads/2013/08/MUSHROOMS8.jpg

Figure 5. www.snohetta.com/uploads/project/186/max_d0cc27a43eec37ddbabf1221f0ee2d82.jpg

Figure 6. www.wharferj.files.wordpress.com/2011/07/urban-physic-garden-illustration-highres-e1309784167456.jpg

Figure 7. www.api.ning.com/files/l7biqbcZ7Gt9czSIUDcZLNNRUIYyiGnltDl5YuhSRKCn-4QgpYSiLSA5N9QxfWSA77klTE*ss4s*uU8nORMKHq049Cm3b1vU-/859033_424078307669190_281017643_o.jpg

Figure 8. Jim Wilson // The New York Times

Figure 9. www.motherearthnews.com/~/media/Images/MEN/Editorial/Articles/Magazine%20Articles/2012/06-01/Supporting%20Farmers%20Eating%20Local%20Food/Salatin-2.jpg

LIST OF TABLES

LIST OF ABBREVIATIONS

ASLA	American Society of Landscape Architects
AUTh	Aristotle University of Thessaloniki
BSU	Behörde für Stadtentwicklung und Umwelt // Hamburg, Germany
DTLR	Department for Transport, Local Government and the Regions // London, United Kingdom
EPA	Unites States Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
IGRA	International Green Roof Association
INUAG	International Network for Urban Agriculture
IPCC	Intergovernmental Panel on Climate Change
IFLA	International Federation of Landscape Architects
UHI	urban heat island effect
UN	United Nations
UNDP	United Nations Development Programme
UN-Habitat	United Nations Human Settlements Programme
USA	United States of America
WHO	World Health Organisation

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