

URBAN GREEN INFRASTRUCTURE: THE ROLE OF URBAN AGRICULTURE IN CITY RESILIENCE

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Abstract. Studies about the subject of cultivated land confirmed that it is the part of urban informal open space and the specific land using form in the city's natural area. It has ecological, cultural, social and socio-economic value and help to achieve more sustainable urban forms. The European practice shows that the functions of allotments are changing in the city development process from the producing to the function of traditional city greenery which does not demand the city's budget money. The moving of population into cities drives increasing demands for residential buildings and other urban built up land. From the city planning point of view it is convenient to develop the allotment territories which usually are located near the city centre and has appropriate infrastructure. However the allotments are very popular among the unprosperous people and elders because of contact with the nature and some economic benefits from cultivating the land. Studies show that the complex metropolitan systems cannot be managed by a single set of top-down governmental policies; instead, they require the coordinated action of multiple independent players operating under locally diverse biophysical conditions and constraints, constantly adjusting their behaviour to maintain an optimal balance between human and ecological functions. The increase in urban agriculture in many European cities has been part of a response to a sense of a global crisis, attesting to the resilience of the people living in cities. However, the citizens involved have much to gain from municipal intervention, which can provide and operate some important for agriculture communal infrastructures and define a set of rules. The municipality is also in an ideal position to design and apply a comprehensive strategy for its territory. In conclusion, municipal intervention is instrumental for urban agriculture and for the city's resilience because is as a vital source of food and occupation in times of crisis and help in adaptation to the climate or other sudden change consequences.

Key words: urban agriculture, allotments, urban planning, green infrastructure, urban dynamic in natural area, complex metropolitan system

1. Introduction

Resilience refers to the capacity of a social-ecological system both to withstand perturbations from for instance climate or economic shocks and to rebuild and renew itself afterwards (Hollings, 1973). Resilience is the most evolved step in disaster management after recovery, preparedness and mitigation (Bostenaru, 2005). Community resilience displays technical, organisational, social and economic dimensions (Bruneau *et al.*, 2003). In this sense, a decision tree can be applied taking into account actors from all these disciplinary fields. Resilience theory, considers that humans and nature are strongly coupled and coevolving, and should therefore be conceived of as one “social-ecological” system. Also considers that systems are in constant flux, highly unpredictable when forced to change, and self-organizing with feedbacks across multiple scales in time and space. A key feature of complex adaptive systems is their ability to self-organize in possible sudden shifts between states. Sometimes change is gradual and things move forward in roughly continuous and predictable ways, but at our times, in the beginning of a new millennium and globalization era, change is sudden, disorganizing and turbulent reflected in impacts on many vulnerable regions and challenges the adaptive capacity of the cities of those regions. It is this vulnerability of the landscape against which the disaster management dimension of resilience should intervene. Urban landscapes are socio-ecological systems (Anderson, 2006) where social

and ecological processes are deeply intertwined, and together shape the urban ecosystems (Benson, 2009). When humanity is considered a part of nature, cities themselves can be regarded as a global network of ecosystems (Bolund and Hunhammar, 1999). This system has low stability, different dynamics, more non-native species, different species composition and unique energetic. Mixes of native and non-native species interact in complex, anthropogenically driven successions, but with human participation, they also equilibrate into communities stable over time (Benson, 2009). Bolund and Hunhammar (1999) identify seven different urban natural ecosystems; street trees, lawns/parks, urban forests, cultivated land, wetlands, lakes/sea, and streams. Every of this ecosystem generates different ecological services simultaneously: supporting, cultural, provisioning and regulating (Andersson, 2006). Those systems constitute the Green Infrastructure of the City and defined as outdoor places with significant amounts of vegetation, mainly semi-natural areas that represent the last remnants of nature in urban territory. They preserve biodiversity in urban areas, sequester CO₂, produce O₂, reduce air pollution and noise, regulate microclimates, reduce the heat island effect, affect house prices, have recreational value and are useful for health, well-being and social safety (Bolund and Hunhammar, 1999). Stratu *et al.* (2016) investigated the role of wooden species in providing microclimate control and reduction of pollution, while Panagopoulos *et al.* (2016) investigated in

a similar way the role of green infrastructure on urban health.

A particular case is that of Pavia, a small city in northern Italy, where rice production is integrated into the city not via the allotments, but through green strips. In the periphery housing and rice culture alternate on different parts of the street. Bostenaru (2015) is a study on how games theory can be applied to model the decision on rice culture in this context. The paper further explores the improvement of ecological conditions mentioned, through the habitat provided by rice cultures helping maintaining biodiversity through a literature review. Studies about the subject of cultivated land confirmed that it is the part of urban informal open space and the specific land using form in the city's natural area. The cultivated lands in urban ecosystem usually possess a diversity of vegetation structures (trees, shrubs, herbaceous plants and grasses) and together with compost heaps, hedges, walls and ponds, gardens have considerable diversity of plant and animal, particularly invertebrates habitats (Alberti and Marzluff, 2008).

Urban greening in Europe has developed synchronized with the evolution of civilization and society. The innate desire to re-establish the severed links with nature in cities was explained by the biophilia concept of Wilson in 1984. Urban planners and landscape architects persistently defended the integration of rural to the interior of the city for historical and cultural reason because we should maintain the identity of the place and keep its *genius loci*. Recent publications have dealt with the subject of urban renewal and sustainability in Western Europe. Urban sprawl areas as mixtures of urban and rural land uses are

being created increasingly rapidly in the suburbs of the cities. The trend in all big cities around the world is that rural life becomes urban life in green scenery. Natural systems take from their environment but they give something back. Cities consume significant amount of resources and have environmental impact far further than their borders. Cities should help sustain and enrich our human communities in our bioregions keeping part of the land as natural or rural.

Urban allotments consist of land divided into a series of small parcels which are used by individuals and families as a place to grow a wide array of flowers, vegetables and fruit, which coexist in the city with the raising of rabbits, poultry, or other stock. With regard to the areas, we consider urban open spaces and inner courtyard plots any small cultivated strips located within town boundaries as well as larger peripheral areas (Fig. 1). This trend had no East West segregation even in times of cold war, as in Hungary hobby gardeners used this second employment to grow vegetables and fruits (the urban agriculture allotment being called "hobby") and the trend is present also in Germany, where the allotments are called *Schrebergarden*. "Hobbygardens" were also present in Slovakia, from before the 1990s, and this second lot of a family could be used as vacation slot or for visitors, as it was foreseen with a temporary habitative building (personal experience in Bratislava, Maria Bostenaru). Actually Slovakia displays the third highest number of members in the association of urban agriculture allotments („Office International du Coin de Terre et des Jardins Familiaux"). Talking also from personal experience, urban agriculture allotments are proposed for intercultural

integration practices, for example in Karlsruhe (Germany) or Vienna (Austria), in the student dormitory HaDiKo in the vicinity of the Schrebergärten, or for integration of migrant women (Doris Damyanovic project Urbanes Gärtnern von und mit Frauen, presentation at the Rome conference of genderSTE September 2014).

Historically urban agriculture draws on the model of the Italian villa, which was a productive villa in the periphery of the city. The villa Medici in Rome conserves traces of the Lucullus gardens. The villa Lante in Bagnaia, also Italy, has a part which is a urban forest apart of the formal garden with water plays, just to name two personally visited examples. Current structural funds European projects of Nicolas Triboi (Atelier Foai Verde) in Romania build on this model in providing urban agriculture instead of dense housing neighbourhoods (see Bostenaru, 2015 for an example near Bucharest). Also in contemporary Italy the issue is not foreign to the research. Michele Nori from the European University Institute is looking into rural pastoralism today, as well as Roxana Triboi from Romania in the doctorate work.



Fig. 1. Urban agriculture in Faro, Portugal.

Urban agriculture is more advanced in developed countries than it is in the

developing and emerging economies where its practice would be comparatively more critical to the wellbeing of city dwellers. In cities of the developed world, municipal initiatives promoted household and community gardening for food security in times of economic crises. Today, cities such as New York, Tokyo, Montreal, London, Stockholm, Lisbon and St Petersburg have connected urban agriculture with resource recycling, biodiversity conservation, therapy, recreation, education, safe food provision, community development and green architecture (Jankovska and Panagopoulos, 2010).

Urban performance depends on the city's hard infrastructure, but increasingly also on the availability and quality of knowledge communication and social infrastructure. The latter is decisive for urban competitiveness and depends mostly on soft infrastructure like knowledge networks, voluntary organisations, crime-free environment, entertainment economy (Hollands, 2008), and green infrastructure (Benedict and McMahon, 2006).

European urban planning laws require that the municipalities should draw up their "municipal green infrastructure plan" in order to protect its values and natural resources. The idea is to form the so-called greenways and green space networks crossing the city and link various land uses because creating an interconnected system of parks, allotments, urban forests and open space is manifestly more beneficial than creating parks in isolation (Benedict and McMahon, 2002).

Planning for urban agriculture to provide the urban need has a long-standing history to many parts of the world. The

question raised in the present study is which role can play the urban allotments in green infrastructure and city resilience. To understand the urban agricultural situation, the study focuses on the Riga metropolitan area as the case for the main part of the discussion.

2. Socioeconomic and environmental conditions of Riga city in the current crisis situation

Latvia's income level remains among the lowest in the EU with more than half of Latvia's Gross Domestic Product (GDP) produced in the Riga region. Riga is a major industrial, commercial, cultural and financial centre of the Baltics, and an important seaport although; Riga's economy is mainly service-based.

The seasonally adjusted unemployment rate Latvia in November (2009) reached 22.3% and for the third month is the highest in the EU (EU's statistical office Eurostat data). Last year, the unemployment rate had risen fully in all EU countries, but the largest increases occurred in Latvia - from 10.2% to 22.3% (Table 1).

Table 1. Unemployment rate in economically active population in Latvia (15-64) (source: Central Statistical Bureau <http://www.csb.gov.lv/>)

	1. quarter	2. quarter	3. quarter	4. quarter
2008	6.8	6.6	7.5	10.1
2009	14.3	17.2	18.6	20.1
2010	20.7	19.8	18.2	-

The direct result of this increase in unemployment due to the recent global crisis is an accelerating increase in emigration. According to the Central Statistical Bureau of Latvia, there is a constant increase in emigration to other countries from 500 average monthly persons in 2008, to 615/month in 2009 to 882 persons per month in 2010.

Another result of the crisis is an increase in small crimes related to self subsistence. Overall, in 2009 to 1,000 people last year were made in 252 crimes; about 48% of crimes consisted of property theft, which occurred in 27,067 cases (instead of 19629 in 2007), followed by the property stolen from the apartment - 4133 times in 2009 compared to 3654 in 2007 (Table 2).

Table 2. Registered crime rate in Latvia (source: Central Statistical Bureau, <http://www.csb.gov.lv/>)

	2007	2008	2009
Total	55260	57475	56748
Property theft	19639	23639	27067
Thefts of apartments	3654	3538	4133
Robberies	1468	1441	1516

Other indirect effect of the recent crisis is the increase in social help of Riga residents. Riga City Council Welfare Department informed that in 2010 annual budget for the social help of Riga residents' allocated 15.754 million LVL. Compared with 2009, in the first two months of 2010, the number of people who receive a contribution of guaranteed minimum of income level increases till 82%. A year ago this contribution received 8695 people, but in the first two months of 2010 - 15831 people. The number of recipients of housing contribution increases till 12.7%: the first two months of 2009, housing benefit got 26 911, but this year - 30,329 people.

Among new clients of Riga Social Services increases the number of persons in working ages - in 2009 in the first two months the total amount of such clients was 419 or 31.7%, but in the similar period of 2010 - 447 or 37.1% of all new customers. In the end of February' 2010 the State Employment Agency in Riga registered 48700 unemployed persons, but vacancies - only 798 (about 168 jobs less than a month before). Per job

claiming in February it was noticed an average of 61 unemployed citizens. Unemployment contribution in January in Riga was only for 53% of the registered unemployed persons. Compared with January of 2010, in February, the number of unemployed persons in working ages increased till 750 persons which asked for municipal social assistance; it is the largest increase in the last year. The municipal social assistance received 12.5% of registered unemployed persons. This is explained with increasing number of unemployed persons, who do not receive unemployment contribution. Compared with February 2009, the number of long-term unemployed person's increases in double and it is 382 people (www.riga.lv).

And if the above are some indirect costs of crisis that the city has to pay without to have any increase in income, there are other costs related to green area maintenance and municipal waste disposal that remain constant and only with municipal policy that maintain its green areas without to ask for the city budget money but by offering it as allotment green space. Like this the function of urban agriculture products are changed into the function of traditional city green area which doesn't need city maintenance.

The municipality is also in an ideal position to design and apply a comprehensive strategy for its territory and promote partly a recycling of the organic daily waste and use in allotments.

In Riga, one person produces on average 290 kg of municipal waste per year (www.riga.lv). Precise information on the composition of the waste is not available, however just a few data suggest that the

cities organic waste particles are more than 50%, but in villages is less than 10% of the total waste. An essential condition for the waste management plan is to reduce the amount of bio-disposed to the 2020th was targeted to be only 35% of the 1995th deposited amount. In practical terms this means that biodegradable waste - kitchen and garden green waste - as well as production biowaste be recycled in a compost way to the cities allotments and other green areas. In other words the municipal intervention is also instrumental for urban agriculture.

4. The importance of green infrastructure for sustainable city

There has been a rapid increase in knowledge about the importance of the external environment to our health and wellbeing (Nilsson *et al.*, 2011). The results of a range of studies gives strong support that the human body reacts involuntarily to natural elements and people feel more satisfied with their homes, jobs and lives when they have sufficient access to nature in the urban environment (Fuller *et al.*, 2007). The word 'nature' has different meanings as obvious and direct qualities of natural environment which are well recognized by the city dwellers as values and benefits of nature in urban space like health, peace, loneliness and freedom (Fig. 2). From this point of view the widespread need and desire to cultivate a garden is seen as an expression of the vital-utilitarian meaning of nature and to experience nature as an environment where they can rest and recover from daily stress (Maas, 2006). Moreover, such projects can offer the opportunity for community empowerment, attachment to the local community and a sense of ownership and can lead to 'defend and improve local communities' (Woolley, 2005).



Fig. 2. A close view of a forest in Riga city.

According to Nilsson *et al.*, (2011), the factors contributing to poor health of city dwellers are: an increasingly sedentary population, increasing levels of mental stress associated with modern urban life, work practices and hazardous environments, such as air polluted. The natural areas and natural features like forests and trees are recognized as capable of providing conditions to improve those negative factors. Stress and related conditions, as reflected in medical records, have increased dramatically among adults and children in Western societies (Grahn and Stigsdotter, 2003). In the process of improvement of urban environments, it is essential to facilitate the access to local green areas that can relieve environmental stress and provide conditions for rest and relaxation, as well as seeking to reduce levels of traffic noise (Gidlöf and Ohrstrom, 2007).

According to Skärbäck, (2007) the stress is significantly reduced when people interact with natural areas and scenic values. The landscape affects humans in many ways including aesthetic appreciation, health and welfare. There are a range of landscapes used in studies of environmental psychology, and there is evidence of health effects related to the watching of these landscapes. According

to Velarde *et al.* (2007) watching of natural landscapes gives a positive impact with respect to health compared to urban landscapes.

Today the wide nature territories and green areas of Riga occupy 44.8% of the city territory, together with the natural overland water systems. These resources are essential for recreation purposes and ensuring long-term development of the city. Therefore it is essential to promote the maintenance and development plan of Riga greenery system.

The forest lands within the administrative borders of the city are maintained with a purpose to provide the interconnection of the nature and greenery territories of the city with the forests of the suburbs and to facilitate the maintenance of the biological and landscape diversity in the territory of the city (Fig. 3).

The mentioned city of Karlsruhe presents also a dialogue between urban agriculture and the forest in the city. Such Schrebergärten are on the periphery of the forest part of the city, making the transition between the part left natural and the mineral cultivated city. Some of them are even included in the touristic circuit of the little train crossing the forest park, an area otherwise not accessible for non owners.

The architecture of Riga reflects the interweaving between natural and cultural, between the city and the forest. When with the arrival of the 20th century the international trend was for new materials like steel, glass and concrete, in Riga the traditional material of timber was employed. It resulted thus an exotic architectural landscape of National Romanticism, drawing on tradition. In the

Baltic landscape this is not unique, in Tallinn, Estonia, this draws on the calcar stone employed in both Art Nouveau and Functionalism. Less visible in Riga itself, the timber Art Nouveau is very well represented in Jurmala, the seaside holiday resort of the city. Riga is also member of the Reseau Art Nouveau, since this architecture shaped the city. The Reseau is running now a European project called Art Nouveau and Ecology, emphasizing how nature and culture played together in this style. One further feature to be analysed in this is the representation of plants in Art Nouveau ornaments, which are many times of vegetal inspiration.

Different of today's green walls, they can represent exotic plants.

Apart of hosting an Art Nouveau and Ecology meeting and exhibition, Riga recently hosted also a meeting on Intelligent Management of Heritage Buildings COST meeting, looking into integration of buildings in their surroundings (leading the working group). Earlier on, it hosted on on sustainable development in digital representation, with focus on transport. Making periurban green space accessible is a challenge for transport systems in the city, and these include the holiday resort.



Fig. 3. Riga's urban forests.

Green in terms of buildings has been a possibility for city branding, for example in the context of Dubai (Pataki, 2015), in a city with problems assuring the energy problems, where the next Solar Decathlon will be held. Urban agriculture through its export of biomass is a good competitor in this sense, as biomass is a kind of renewable energy. This topic has been recently discussed in the COST action “Renewable energy and landscape quality”, emphasizing the need to spread to Eastern Europe. Not only new buildings need to be green, but also intervention on existing buildings, such as the mentioned Art Nouveau. An insight is given in Balliana *et al.* (2016).

One of the objectives set for the Riga long-term development strategy until the year 2025 is to be “Clean and green city”. The further development policy of nature territories and green areas of the city will be very important for the achievement of this objective. Thus the most important development objectives of the structure of the nature territories and green areas in Riga are:

- 1) To ensure rational use of the city territory corresponding to the sustainable development principles.
- 2) To maintain and develop the nature territories and green areas in order they could fully carry out the functions provided for them.
- 3) To ensure access to the overland water objects and the public land nature territories for the city inhabitants and guests.

It could be a great goal of the city of Riga to design an accessible, healthy and green city and to enter the as a member of the European Network of Healthy Cities. For that purpose Riga should take into account WHO’s charters that call for the

promotion of urban forestry and urban agriculture as a means to increase the amount and distribution of locally grown food, especially fresh vegetables, which provide several health benefits.

The policy of Riga City Council on allotments is to maintain the gardening plots in the city as the type of temporary use of land in places under the risk of floods or because they have special importance in maintaining cultural and historic environment, nature and green areas; to carry out monitoring on regular basis; to elaborate special Riga City Council binding regulations for use of gardening plots; not to allow any type of building; to facilitate development of long-term gardening plots in the area of Tīraine Street and Olaine parish.

5. General features of urban agriculture in Riga, Latvia

Riga city development plan (2006-2018) emphasises that the family allotments as well as parks, schools, other green spaces cemeteries and river/lake banks have a great significance in preserving different species of birds and invertebrates (RDP, 2014). The amount of agricultural and natural green in the living environment increases the level of species richness and is positively related to perceived general health (Mass, 2006).

The movement of introduction of nature into the city began in nineteenth century. This was a carefully constructed image of nature but it did not remind people of the agricultural landscapes recently left behind by many new urban dwellers (Woolley *et al.*, 2005). Urban areas have recently experienced a decline in the quality and quantity of their green space and the enjoyment of nature is not obvious anymore, therefore every access to green spaces and spending time in

nature give important physical and psychological benefits gained by green space users (Maas and Verheij, 2006; Fuller *et al.*, 2007).

The rapid growth of cities drives increasing demands for residential buildings and other urban built up land (Benson, 2009). The most traditional typologies of natural world have been determined from the point of view of the planner, designer or manager – sometimes as a tool for the distribution of resources or to help prioritise urban open spaces for development or regeneration (Woolley, 2005). People from low socioeconomic groups without resources to move to greener areas outside the cities are affected and this may lead to environmental injustice with regard to the distribution of public green spaces (Maas and Verheij, 2006). From the city planning point of view it is convenient to develop the allotment territories which are near the city centre because it decreases people movement and consequently new street network construction, as mentioned in the need for transport and accessibility of green space. Nevertheless, lessons can be drawn from green belts of more developed green city policies such as in Frankfurt on the Maine or Vienna. In Vienna the urban agriculture of vineries is an essential part of the green belt (Bostenaru, 2015).

The landscape network Le Notre Institute draws on 4 lines for the yearly forums, which include rural landscape and urban periphery. A communication between the two might take in discussion the urban agriculture on the periphery of the cities. Cities for which this was discussed include Eastern European ones such as Sarajevo or Bucharest, but not yet Riga.

As historically allotments were formed on the territories of Riga city in the places where the capital construction was possible only with additional costs because of the ground problems. The allotments were not planned taking into consideration the suitability of ground, water and air quality for producing fresh food. When the construction industry and methods developed became possible to make constructions in vacant territories and most of these territories are provided from allotments.



Fig. 4. Urban allotments in Riga, Latvia.

The last conflict arises between owners of allotments and Riga municipality was about territory (~45ha), owned by municipality, close to the city centre – in the opposite side of the Old City over river Daugava. This area was chose for the new city centre and now the detailed plans of this centre are worked out. Similar long term conflict is about territory of allotments on the island Lucavsala on river Daugava – also close to the city centre – unique place where encounter a lot of different interests.

A lot of areas of current family allotments are located in the territory of Free Port of Riga. This adds a political dimension to green areas that engages different groups to take a stand in emergent conflict. Since these social and political processes

nevertheless influence the spatial patterns of green areas, they come to influence at local and greater scales the ecology of the city and its capacity to generate ecosystem services (Benson, 2009). As emphasize Alberti *et al.* (2008), complex metropolitan systems cannot be managed by a single set of top-down governmental policies; instead, they require the coordinated action of multiple independent players operating under locally diverse biophysical conditions and constraints, constantly adjusting their behaviour to maintain an optimal balance between human and ecological functions.

The two counter opinions about the cultivated land in the space of contemporary city create a structural conflict arises between interest groups viewing green areas as unexploited space appropriate for physical infrastructure, and groups considering green areas of value in their existing form (Jankovska *et al.*, 2010). For this reason, creating decision structures between the resilience stakeholders is necessary, and can be simulated with game theory as mentioned. Other conflict situations software is available, but essential is to understand the urban management problem and propose operations in the urban space.

Allotments in Latvia and Riga have a long history. The use and status of them over the years have varied with changes being influenced by national land use requirements, legislation and personal choice (Woolley, 2005). During 1710-1814 the people made the so called "kitchen gardens" which can be considered the origin of contemporary family allotments. The first colonies of family allotments in Riga were formed already in 1907 and they had an important place in the green structure of Riga. In the 1930s there was a

great culture of allotments in Riga reaching the amount of 7500 allotments in 65 colonies.

Having a family garden was a matter of survival in Soviet time, and the government gave urban residents rights to a 600m² plot in garden colonies, frequently located at some distance from the city. They performed the function of leisure-time areas, mainly for the less wealthy, working-class segment of society. They were a sort of a bonus for the members of the working class of large cities. Conveniently located, often near the city centre, they were an excellent spatial manifestation of socialised urban structures, which under socialism were egalitarian by definition. In the city of that time, one could find many examples of areas emphasising the assumptions of social egalitarianism of the socialist state.

The layout of these sites is always a simple grid with access to individual parcels via alleys, which are not paved and not wide enough to accommodate a real street (Grava, 2007). Even during the Soviet period, many people built structures (classified officially as "utility buildings") that could accommodate overnight stays. Considerable ingenuity had to be applied and miniaturized dimensions utilized to stay within the norms (Grava, 2007). In 1995 in Riga city were about 32 000 family allotments on 1600ha in the inner city.

After the regaining of independence of Latvia in 1991 it was approved in 1995, the first Riga city development plan (1995 - 2005). One of the city development aims it was to form a healthy environment and give a priority to preserving the nature values and renaturalisation and recultivation of the degraded environment

in the former development of the city. The notion "nature base" appeared in the document for the first time. According to the Riga city development plan (RDP, 2014) the nature base is made of six different but mutually connected nature

elements: forests, meadows, greenery, wetlands and channels with their bank lines, allotments and fallows. The 20th century marked the straightening of rivers for less floods, and therefore cutting meadows from the river.

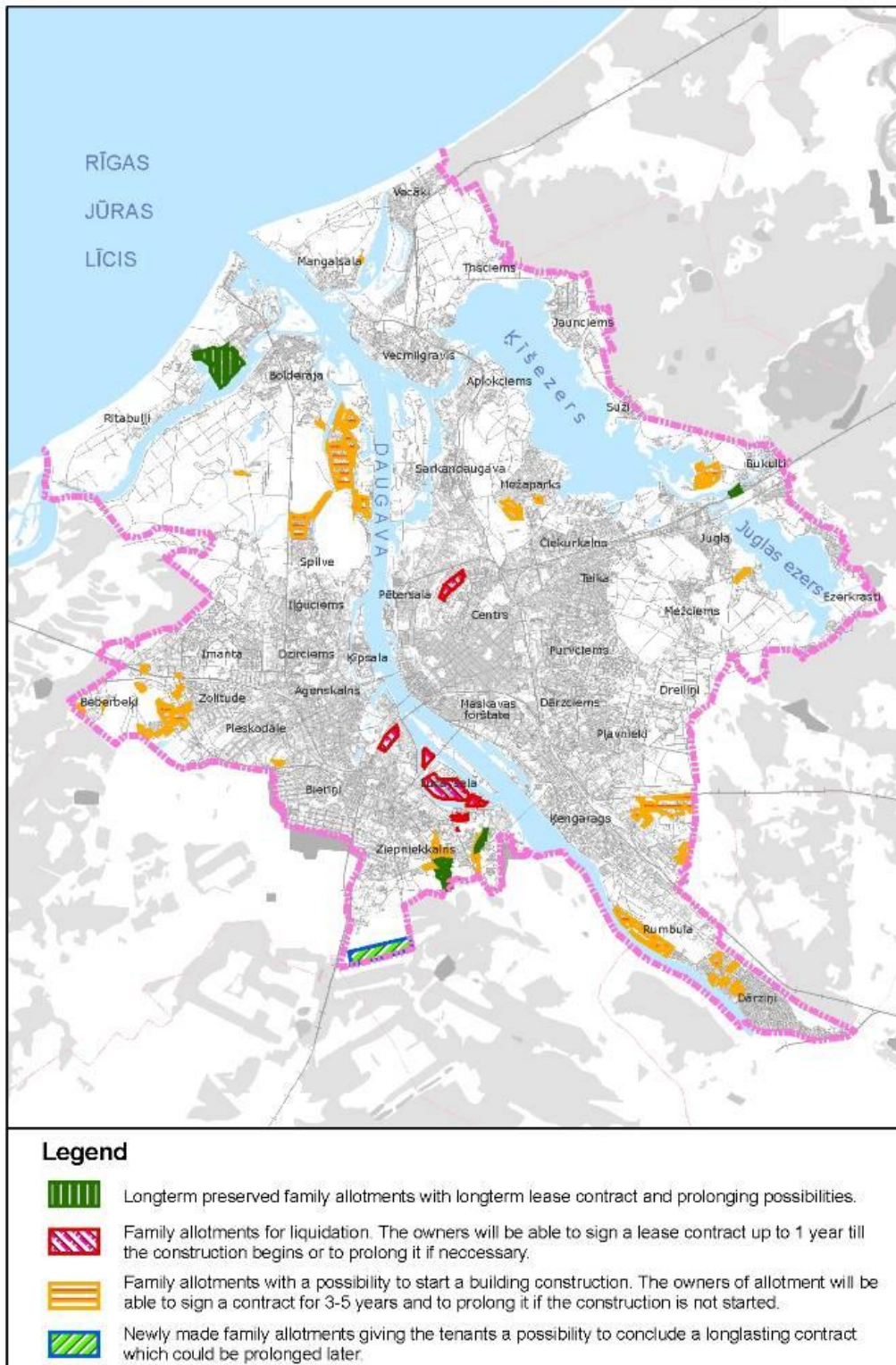


Fig. 5. The urban allotments in Riga are divided in 4 categories according to contract.

The contemporary trend is renaturalisation also because the floodplain prevents the disaster. Cities which use the heritage qualities of inclusion of water may fight the hazard through including nature and becoming thus more resilient (Bostenaru and Gheorghe, 2015) and more ecological.

In the following – Riga city development plan 2006-2018 (RDP, 2014) the allotments have been classified as the territory parts of nature and greenery and are defined as a territory for a family garden with or without temporary buildings according to the definite time in the contract and they were divided in 4 categories as it can be seen in Fig. 5. In the 21st century, there should be adequate level of awareness and other considerations in urban agriculture. So, the Riga city development plan 2006-2018 supposes the allotments mainly to be used temporarily till the territory zoning according to the development plan where a temporary construction up to 30m² is allowed (RDP, 2014).

6. Discussion and conclusions

There are many problems connected with the allotments. The aesthetic quality of allotments is low because of the different kind of allotment houses and fences. Many allotments are deserted and that is why the environment is degraded: there is a high soil and ground-water pollution at some places and insecure social environment because of homeless people and tramps. People do not invest in facilities and the maintenance of these territories is not checked because of the short land lease contract time. The tenants do not have a necessity to form an aesthetic and ecological landscape space. There are in Riga no rules about the exterior look of the existing houses, fences and etc. and their maintenance and

the consequences of the trespassing these rules. Several years ago Department of Environment of Riga City Council worked out the conception of the allotments and their maintenance but it was not supported.

Accumulation of heavy metals or organic, xenobiotic organic compounds in soils is common in urban areas and research carried out of Department of Environment (2006) show that many allotments in Riga are polluted with heavy metals and oil products. Harmful substances are delivered to allotments partly from the amendment soil used to improve fertility which is derived from former dumping places. A solution of reusing former dumping grounds and areas along the motorways could be the transformation to flower garden allotments. In yard greeneries could turn into small allotments. Those points should be estimated properly and must be included in Regulations concerning the utilization and building of the territory of Riga, but many believe that the allotments in the central part of the city and along the main streets are not suitable for allotments because of air and soil pollution. According to the policy of Riga City Council (RDP, 2014) family allotments in the city should be limited in places of flood risk which come in contradiction with the rule of the Protection Zone Law (Republic of Latvia, 1997) that aim to decrease the negative effect of pollution on water ecosystems and to limit the activities at flooded territories.

The city of Riga is facing difficulties in finding an adequate solution to the main problem of how to apply methods of sustainable development and enhance the areas in the long term. The European practice shows that the functions of

allotments are changing in the city development process. The function of urban agriculture products has changed into the function of traditional city green area which doesn't ask for the city budget money. Despite the rapid increase of the built environment in the city, family gardens have ecological, cultural, social and socio-economic value and help to achieve more sustainability (Alberti *et al.*, 2006). The desire of Riga inhabitants is to continue urban agriculture as in many other big cities of the developed economies. The involvement of civil society in protecting nature is on the rise and plays an important role in articulating the ecological and social values that exist in green areas (Mazzotti and Morgenstern, 2009). We need tools and methods for increasing the sustainability of urban areas by protecting and connecting green spaces, given the fact that ecological, social and economical conditions are often mutually dependent.

Urban allotments were mentioned as a traditional urban form with a long and distinguished history. Research indicates a relationship between sensory perception of natural environments and human health Grahn and Stigsdotter (2010) and for this the urban allotments can be viewed as elements of importance to public mental health. Lisbon is a successful example of urban allotments used as simultaneous environmental and agriculture projects within a framework of sustainable city.

For the Riga family allotments the main problems are political interests in land development and absence of normative which constrains the maintaining of this area and prescribe the criteria for visual qualities. The Department of Riga City Development ought to finish the inventory of Riga landscape for forming

and maintenance of green areas, family allotments and parks. The conception plan of Riga green areas could help to understand which should be the places of the protected areas in Riga and which the places of nature base areas with possible parks. The involvement of landscape architects and landscape urbanists in the development of the master plan and later on of the local plans is essential. Table 3 shows the strengths, opportunities, weaknesses and threats of urban allotments in Riga city.

Table 3. SWOT analyses of urban agriculture in Riga.

Strengths	Fresh food supply Urban green infrastructure improvement Secondary income for part-time farmers Leisure activities for weekend Biodiversity enhancement Reduce risk of flood Improve city microclimate
Weaknesses	Agriculture is decaying industry Lack of research on urban agriculture Lack of urban spaces for agriculture Allotments are temporary Lack of aesthetics Insecure social environment
Opportunities	Occupation for elderly Reduce poverty and unemployment Environmental education Enhance human-nature relationship Growing demand for organic food Available free time for city-dweller
Threats	Rising cost of land Lack of City Green infrastructure Plan Lack of agricultural policies, laws, and regulations affecting urban farmers Lack of investment in agriculture communal infrastructure. Lacking large scale operation Environmental pollution

The paper by Petrișor *et al.* (2016) shows the context of Green Infrastructure in Romania, in different contexts, including geographic conditions (such as vicinity of the Danube) and urban sociology conditions (such as the presence of ethnic

minorities). An interesting part of the study is the application of fractal analysis to the developed taxonomy. Fractal analysis permits the study of urban development in time on the selected items which are in this case instead of the roadways the green corridors. Buhociu *et al.* (2013) brings agricultural development at the Danube to detail, this time in rural areas.

At European level the COST network Green in Urbs is dealing with comparing green infrastructure across countries and is due to come to a final conference in Orvieto, Italy, in April 2017.

Without a City Green Infrastructure Plan, Riga is in risk to be an example that commercial investors may create the spatial structure of the post-socialist city. Too little attention is paid to the experience of Western cities, both American and European, which faced the problems of urban sprawl and inner-city decline much earlier. Despite the fast increasing urban land commercialisation, it is easy to find in the city's structure examples of nature reserves, allotment gardens and urban forests. Unfortunately, those spaces are expected to fall victim to commercially oriented investors if the city authorities will not implement fast the RDP. Meanwhile, the importance of the clever landscaping will be increasingly important in the context of urban flooding exacerbated by climate change. Therefore urban forests and allotments, green corridors, green drainage, and green urbanism have to be seen by city planners as means to increase city resilience.

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