THE CLIMATE ADAPTATION POTENTIAL OF THE RURAL-URBAN FRINGE

EXPLORING THE CLIMATE IMPACTS IN THE BRUSSELS' TERRITORY THROUGH RESEARCH BY DESIGN

A VÁROSI PEREMTERÜLETEK KLÍMAADAPTÁCIÓS LEHETŐSÉGEI

TERVEZÉSI GYAKORLATON ALAPULÓ KUTATÁS A KLÍMAVÁLTOZÁS HATÁSAINAK FELTÁRÁSÁRA BRÜSSZEL TÉRSÉGÉBEN

SZERZŐ/*BY:* JEROEN DE WAEGEMAEKER, MAARTEN VAN ACKER, EVA KERSELAERS, ELKE ROGGE

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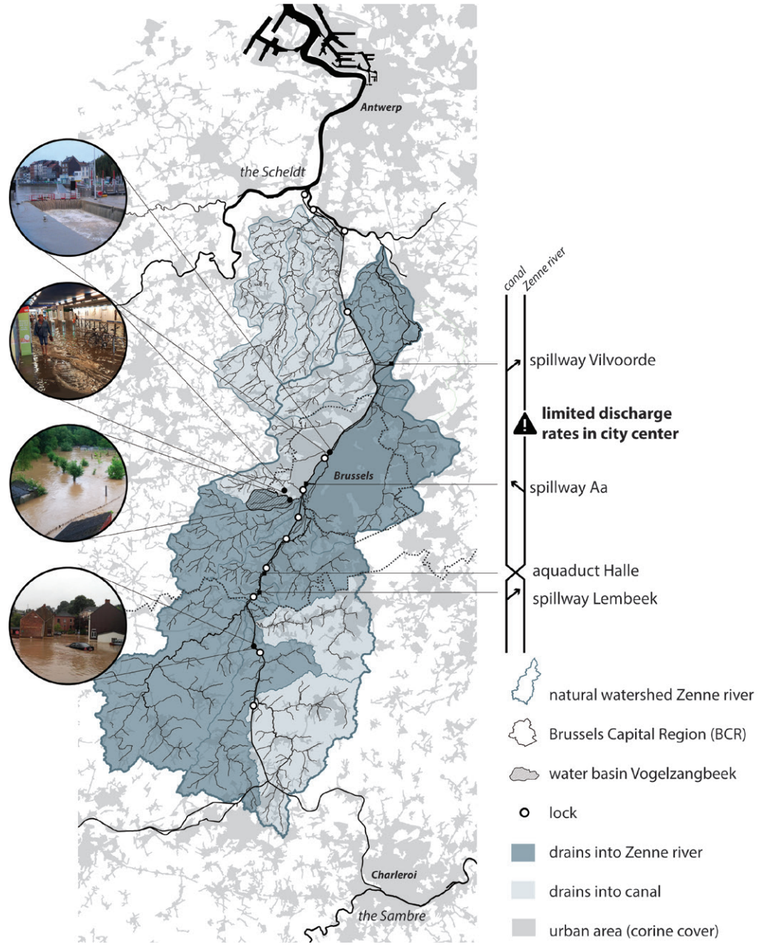

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Fig. 1: As climate change aggravates, the highly-engineered valley of the Zenne faces a dual challenge. During dry periods (left) the provision of a minimal ecological river flow is under pressure. During wet periods (right), however, the Zenne is increasingly unable to drain, especially at the city center where the Zenne is covered-up and urban run-off is high (GRAPHICAL WORK BY THE AUTHORS BASED ON THE FOLLOWING DATA SOURCES: EUROPEAN ENVIRONMENTAL AGENCY, 2006, CORINE LAND COVER / FLEMISH ENVIRONMENT AGENCY, 2016, FLEMISH HYDROGRAPHIC ATLAS / BRUSSELS ENVIRONMENT, 2008, HYDROGRAPHIC NETWORK / GENERAL DIRECTION FOR AGRICULTURE, NATURAL RESOURCES AND THE ENVIRONMENT, 2016, ATLAS OF NON-NAVIGABLE STREAMS / PHOTOS FROM THE FLOODS IN NOVEMBER 2010 AND JUNE 2016)

ABSTRACT

As global warming continues, cities need to adapt to the changing climate including aggravating floods and increased heat stress. Urban and landscape planners build such climate-proof city through the development of green open spaces, who serve as climate buffers. At the rural-urban fringe (RUF) the green open spaces, and farmland in particular, are changing rapidly: re-allocation to built-up land uses and creation of private open spaces such as gardens and horse pastures. This paper studies how these developments at the RUF affect the floods and heat stress in the nearby city. Moreover, it explores the potential of green open spaces at the RUF to alleviate climate impacts at the local as well as the metropolitan scale. The research employs research by design (RbD) on a case study: the Brussels' RUF, and the watershed of the Vogelzang in particular. Via maps, sections and other design instruments, this paper unravels the complexity of climate adaptation in Brussels and highlights the interlinkage between the city center and the south-western RUF. Due to its' geographical location, the watershed of the Vogelzang is of climate-strategic importance to manage floods, droughts and heat stress in the urban conglomeration. Following that analysis the paper explores how the watershed of the Vogelzang water can be climate-proofed. The RbD builds on a new masterplan for the area that proposes to develop an alternative food network in the area. The paper provides insights into the Brussels' situation but equally feeds back into the debate about sustainable planning at the RUF. Firstly, it highlights the potential of the RUF's green open spaces to contribute to climate adaption at the local as well as the metropolitan scale. Hence, the challenge of planning for urban climate adaptation exceeds the limitations of the urban conglomeration and planners must incorporate the RUF within the vision on local climate adaptation. Secondly, this paper illustrates how the farmland at the RUF has great potential to sustainably develop the area, including the creation of climate buffers.

Keywords: Climate adaptation, Rural-urban fringe (RUF), Research by design (RbD), Floods, Droughts, Soil Erosion, Urban Heat Island (UHI)

1. INTRODUCTION

For a long time climate adaptation was disregarded as the lazy, arrogant and naïve option but today that taboo on adaptation has been lifted [1]. Hence, the issue of climate adaptation pops up in both research as well as policy. A lot of attention is paid to the adaptation of cities [2]. After all, the worlds' urban population is rapidly growing and much of the worlds' cities are located on land at high weather-related risks; near the coastline or in flood prone valleys. Furthermore, the urban concentration of sealed surfaces creates urban-induced impacts such as Urban Heat Island (UHI) and pluvial flooding. Various planning and design concepts are regarded as pathways to a climate adaptive city;

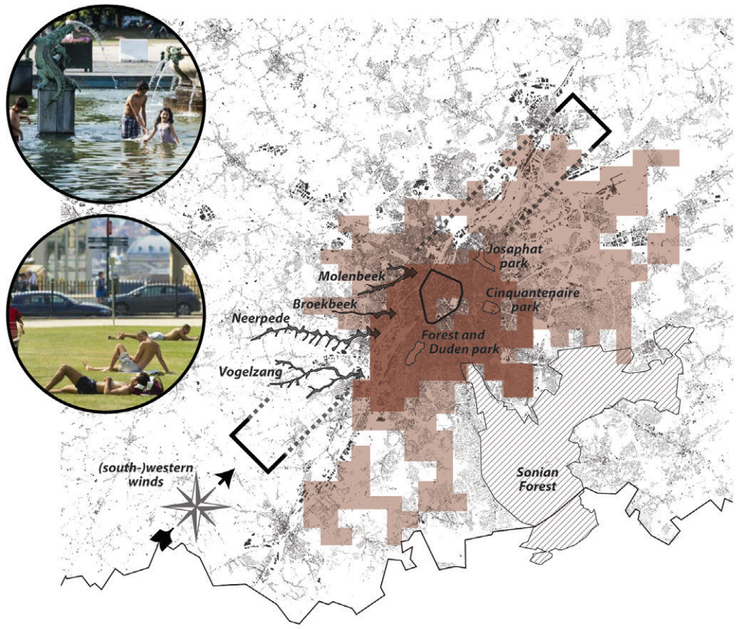

Fig. 2: Cool south-western winds and small streams temper heat stress at city center, at least for now (GRAPHICAL WORK BY THE AUTHORS BASED ON THE FOLLOWING DATA SOURCES: AGENCY FACILITY MANAGEMENT, 2013, CADASTRE / BRUSSELS REGIONAL INFORMATICS CENTRE, 2013, DATASET URBIS / PICTURES FROM THE HEAT WAVE IN JULY 2015)

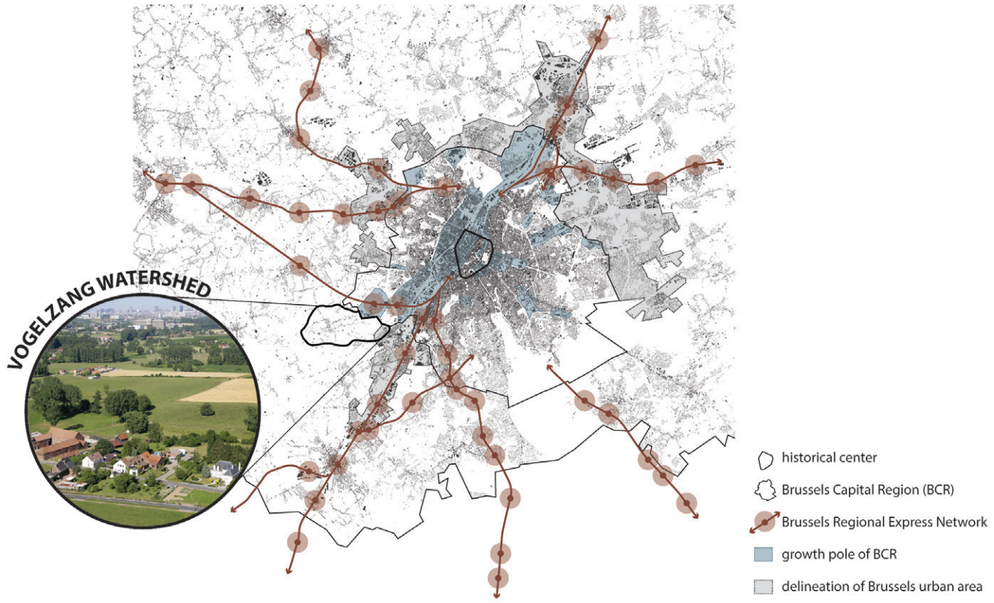

Fig. 3: The upper section of the Vogelzang watershed is part of the rural-urban fringe of Brussels. Nearby urban projects put urban pressure on the area's open space (GRAPHICAL WORK BY THE AUTHORS BASED ON THE FOLLOWING DATA SOURCES: AGENCY FACILITY MANAGEMENT, 2013, CADASTRE / BRUSSELS REGIONAL INFORMATICS CENTRE, 2013, DATASET URBIS)

Green Blue Networks [3], Green Infrastructure [4], Ecopolis or Lobed City [5-6]. These concepts call on the alleviating capacity of green open spaces, and thus these spaces are subsequently branded as climate buffers that absorb climate impacts. The concepts tend to focus on the parks and other green infrastructures within the urban agglomeration.

Open space is, however, most under pressure at the rural-urban fringe (RUF); the heterogeneous 20th century landscape that surrounds the urban conglomeration. The RUF has long time been outside the realm of urban as well as rural planners and, as a consequence, the local developments are highly uncoordinated [7]. In the RUF the green open spaces, and farmland in particular, are changing rapidly. Although soils are fertile and agricultural productivity is high [8], much peri-urban farmland is re-allocated for other land uses. To a great extent, the loss of farmland is ingrained in the current planning system, based on land allocations. Whenever land is needed to develop housing, industry, infrastructure or nature, agriculture is the primary supplier since it is the cheapest and most easily available [9]. Next to these planned developments, the farmland at the RUF is also undergoing unplanned transformations: none-farmers buy up farmland to create their own private open space such as a garden [10] or a horse pasture [11-12]. At an individual level these changes are small but their collective sum is considerable and, as a result, they require planners' attention [13].

This paper explores spatial planning for climate adaptation, which predominantly builds on the alleviating capacity of green open spaces, at the rural-urban fringe, an area where the green open spaces are undergoing rapid transformations. The following research questions arise; How do developments at the RUF, e.g. ongoing seal surfacing, affect the occurrence and intensity of climate impacts such as floods and urban heat island. What is the potential of the RUF's open spaces in alleviating climate impacts? How can the RUF be climate-proofed?

2. METHODOLOGY

This paper studies these research questions through research by design (RbD) on a specific case: the Vogelzang watershed, part of Brussels' south-western rural-urban fringe. Recently, RbD has been applied in an academic context to the RUF; Beijing [14], Perth [15] and Tucson [16]. In this study, RbD is employed to explore climate adaptation at the RUF. The RbD provides insights on the local case study and contributes to the debate about the design of a climate adaptive city and the sustainable development of the RUF.

The RbD was effectuated by the authors of this paper and was based on an extensive review of local climate literature as well as interviews with local stakeholders. In the first phase of the RbD, from mid-2014 to mid-2015, the research focused on problem scoping and in particular on grasping the climate-strategic important of the south-western RUF (see paragraph 3). These first results were presented at five academic conferences and thus the analysis was discussed with other experts in the field of spatial planning, rural development and climate adaptation. In the second phase of the RbD, from mid-2016 until the end of 2016, the research explored how the alternative food network that is currently being developed in the south-west RUF can be climate-proofed (see paragraph 4-5). The resulting design proposal for the south-western RUF of Brussels was discussed with local stakeholders in face-to-face interviews. These stakeholders represented various policy levels (the municipal, the provincial and the regional level) and diverging policy areas; spatial planning and urban design (3 interviewees), green open space (2 interviewees), water management (5 interviewees) and agricultural policy (4 interviewees).

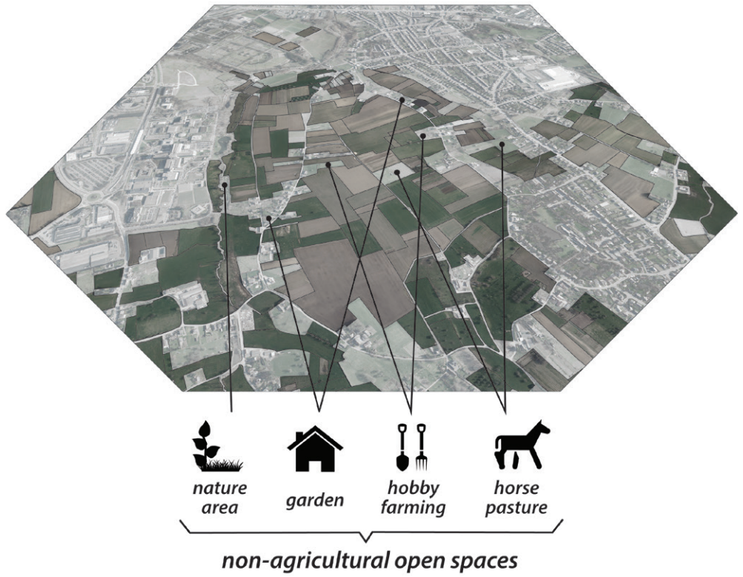

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Fig. 4: A widespread emergence of non-agricultural land uses cut up the farmland. Meanwhile, traditional and new organic farmers produce vegetables for local consumption (GRAPHICAL WORK BY THE AUTHORS BASED ON THE FOLLOWING DATA SOURCES: AGENCY FOR AGRICULTURE AND FISHERIES, 2013 , PARCELS OF LAND IN AGRICULTURAL USE)

3. RURAL AND URBAN CLIMATE IMPACTS AT THE VOGELZANG WATERSHED

The watershed of the Vogelzang is a tributary of the Zenne river and is located in the south-west of Brussels, the capital of Belgium. The Vogelzang watershed is the case study of this research. This section takes a closer look at the Brussels' territory and highlights the pivotal role of the Vogelzang watershed, and the entire south-western RUF, in climate adaptation. While the Vogelzang watershed is challenged by increasing soil erosion, the main weather-related concerns of Brussels' policy makers and inhabitants are flood risks and heat stress, typically urban climate impacts. The south-western RUF has climate-strategic importance: the area has the potential to alleviate flood risks and UHI in Brussels' city center. In other words, interventions at the level of the Vogelzang watershed do not only lower *(rural)* climate vulnerability *locally,* but also contribute to *(urban)* climate adaptation at the *metropolitan* scale.

3.1 Growing pressure on water management of the Zenne river

The flood risks are partly inherent to the city's location; *'Brussels'* is derived from *'Bruocsella',* meaning settlement near marshes. Until the midst 18th century the local watercourse Zenne bursts its banks on a regular basis, flooding the lower parts of the city. Throughout the past two centuries, however, multiple water infrastructures such as a canal and a sewage network were developed and these in turn have created a complex 'hydraulic hydrography', a term coined by Farhat [17] to describe a highly engineered natural watershed.

In the urban agglomeration, there are multiple interactions between the various water systems (see figure 1). During wet periods, the canal acts as the main drain of the Brussels' upstream valley [18]. In this way, water levels in the Zenne river are kept artificially low in order to secure sufficient drainage and buffering capacity at the city center. In addition, water courses to the west of the canal exceptionally drain into the canal in order to alleviate pressure on the Zenne river. In contrast, water levels in the Zenne river are problematically low during dry periods (see figure 1). At such times all available surface water is sent to the canal in order to secure shipping activities. As a consequence, the provision of a minimum quantity of clean water, the so-called ecological flow, to the Zenne is jeopardized (local policy maker, water management). The ecological flow is essential to the rivers' ecosystem and is an European obligation since the EU Water Framework Directive of 2009.

Via the research by design of Brussels' hydraulic hydrography, e.g. fabricating maps, sections and schemes, highlights the strategic importance of the south-western RUF. The case area is the sole open space *-at a metropolitan scale-* that drains towards Brussels' city center, the bottleneck of the local water system. Other open spaces at the Brussels' urban-rural fringe are located downstream of the city's center or within another watershed. Thus, while the Brussels' water system needs to adapt to aggravating floods and droughts as a result of climate change [18], slumbering urbanization in the south-western RUF leads to additional pressure on the water system. In interviews local water managers acknowledge the pivotal role of the case study area. They indicated, however, that the area remains 'out of their scopes' as there are no large-scale urban projects in planning, only small-scale transformations. Moreover, other stakeholders highlight that also open space transformations, e.g. the use of arable fields as a horse pasture, can increase local runoff and, as a consequence, exacerbate the pressure on Brussels' water management.

3.2 A cool spot near Brussels' overheated city center

The Urban Heat Island (UHI) is another climate challenge for the urban conglomeration. During a calm summers' night, the Brussels' city center is up to 4 degrees Celsius warmer than the surrounding rural areas [19]. As global warming persists, the number of extreme hot days (above 25 degrees Celsius) in Belgium is expected to increase by 0 (low scenario) up to 19 days (high scenario) in the next 30 years [20]. Thus, policy makers need to speed up measures in order to temper aggravating heat stress. To some extent, an UHI is the inevitable side-effect of a city's size but there are area-specific characteristics that must be acknowledged [21].

Local climate research shows how the local territory molds today's Brussels' UHI and highlights area-specific opportunities to mitigate future urban heat stress (see figure 2). The Sonian Forest is a popular place to cool off during hot summer days and has a cooling effect on the south-east suburbs [22]. Likewise, the RUF's open spaces offer cool spots to the urban dwellers. Their cool conditions result from the evapotranspiration of plants and trees. Those cool conditions are, however, no given but demand soils to be unsealed and sufficiently moist. As global warming causes decreased summer precipitation, soils are expected to dry up and rural cool conditions decline [22]. Loss of cool conditions at the south-west of Brussels is particularly disadvantageous. On many summer days there is a breeze from the south-west, Belgium's prevailing wind direction, that tempers the UHI. The UHI's peak does not exceed 2 degrees Celsius during westerly winds [19]. Thus, the design of a cooling RUF entails the creation of moist soil conditions and the facilitation of soothing western winds.

Watercourses are another designers' tool to alleviate the urban heat stress as

uncovered watercourses are known to lower temperatures on a hot summer's day. The popular planning concept 'green-blue network' -*also adopted in Brussels' planning policies*- proposes the reintegration of small watercourses in the urban environment. In the Brussels Capital Region there is a geographical east-west disparity with regards to UHI. At the east side of the Brussels' UHI peak there are the great Sonian Forest and multiple large-scale 19th century parks that provide cool spots. At the west, however, there are very few parks and most small watercourses, including the Vogelzang, are situated subsurface. These western watercourses have the potential to cool the city center if they were to be reintegrated in the urban streetscape and if sufficient water was to be supplied to these watercourse. The latter requirement means that some kind of minimal flow in the Vogelzang stream must be ensured.

3.3 Aggravating soil erosion risk

As the soils of the Vogelzang watershed are sandy loam, the area is at high risk of soil erosion: a process in which heavy rainfall washes away the top layer. This risk is inherently linked to the agricultural activities in the area. As the fields lay bare after ploughing and sowing, the soils are vulnerable to storms in early spring. These storms are expected to occur more frequently as a result of climate change [20], thus the soil erosion risk increases. There is a multitude of erosion-reducing agricultural practices, including soil, crop, slope or run-off management. The most effective climate adaptation, however, is a change of land use, from arable fields to permanent grassland.

4. OTHER CHALLENGES ON THE LOCAL PLANNING AGENDA

4.1 Rapid urbanization

The watershed of the Vogelzang is a textbook example of a RUF's ambiguous character (figure 3). The area is an interface between the metropolitan Brussels and the bucolic region of Pajottenland. Situated at the edge of Brussels' urban conglomeration, the landscape is a complex mosaic of urban land uses, such as housing and infrastructure, and rural land uses, such as farmland and nature. There is a lot of urban pressure since the area lies in-between two poles for urban growth; the site of the Erasmus hospital to the north and the residential and commercial area of Negenmanneke to the south. This ongoing urban sprawl is a major challenge for the local landscape. In addition, much of the local farmland is converted to private recreational land uses such as gardens and horse pastures (figure 4). These 'soft' transformations are widespread and highly unstructured. What is more, the traditional agricultural landscape of pastures in the valleys and grain fields on the glowing hills is rapidly changing.

4.2 Ambitions for local agriculture

Recently, however, a new masterplan for the south-west RUF is put in place to protect and develop the valley's rural identity [23]. An important pillar of the masterplan is farmland preservation through the development of an Alternative Food Network (AFN), although that term is not mentioned by name. AFN's re-establish short-chain food supply to the city and (re)-approach agriculture from a territorial perspective; food production is based on local physical

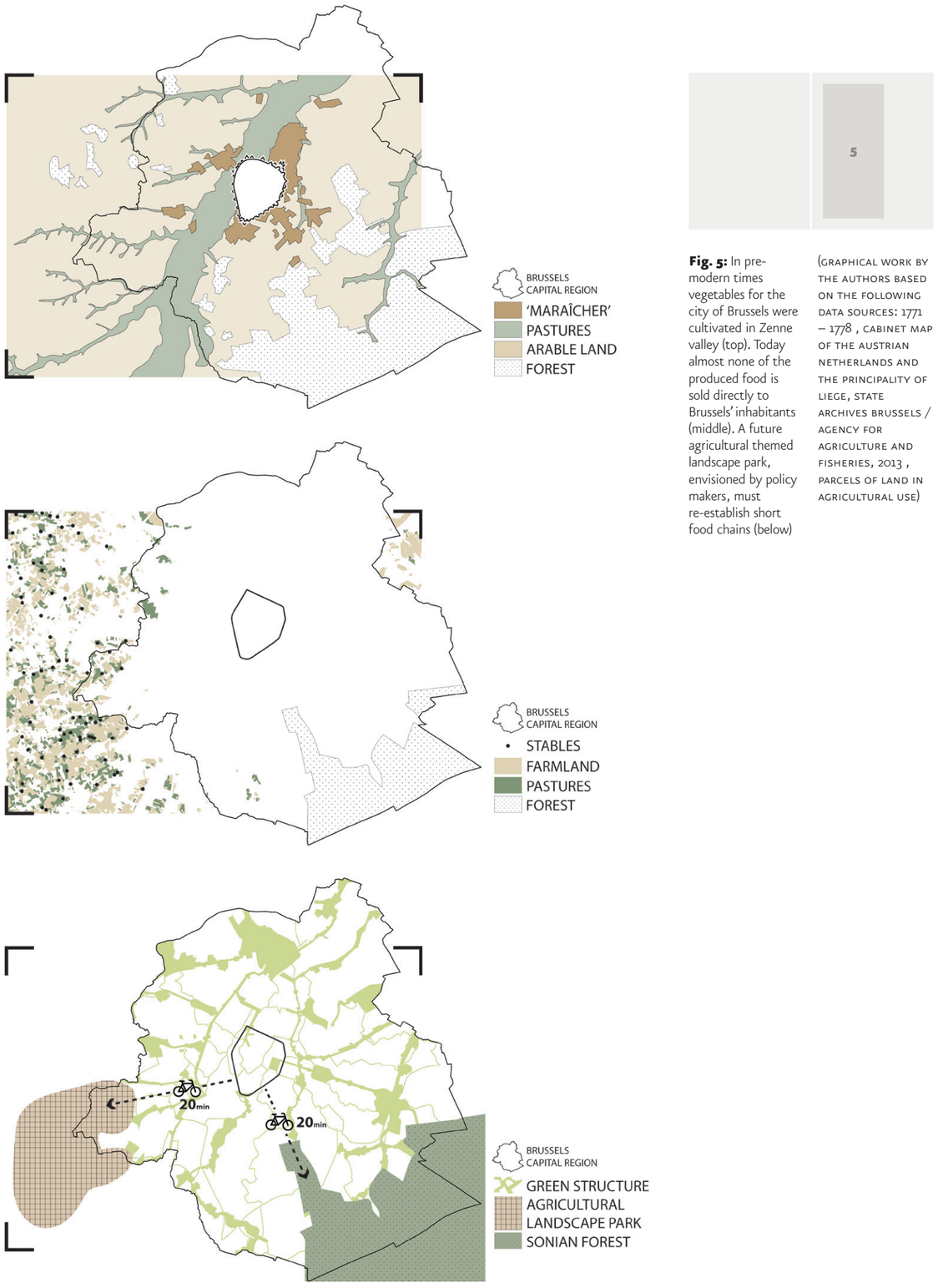

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Fig. 5: In pre-modern times vegetables for the city of Brussels were cultivated in Zenne valley (top). Today almost none of the produced food is sold directly to Brussels' inhabitants (middle). A future agricultural themed landscape park, envisioned by policy makers, must re-establish short food chains (below) (GRAPHICAL WORK BY THE AUTHORS BASED ON THE FOLLOWING DATA SOURCES: 1771 – 1778 , CABINET MAP OF THE AUSTRIAN NETHERLANDS AND THE PRINCIPALITY OF LIEGE, STATE ARCHIVES BRUSSELS / AGENCY FOR AGRICULTURE AND FISHERIES, 2013 , PARCELS OF LAND IN AGRICULTURAL USE)

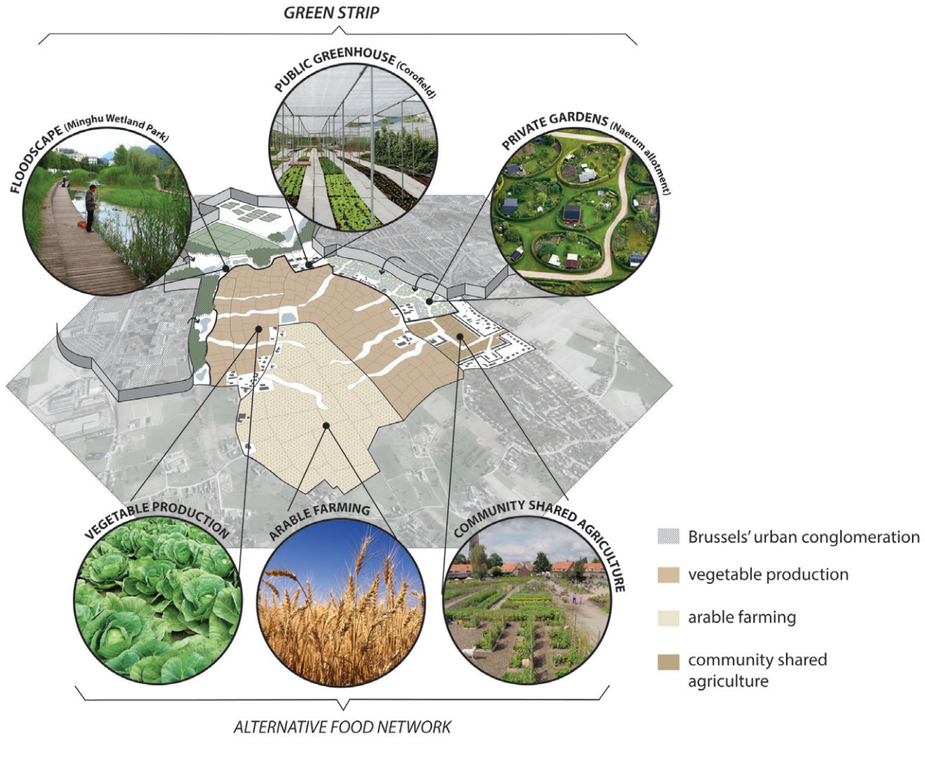

Fig. 6: A green strip creates a distinct rural-urban border and alleviates Brussels' recreational pressure on the farmland. Agricultural land uses in the AFN are rearranged according to soil conditions (GRAPHICAL WORK BY THE AUTHORS)

conditions and socio-cultural traditions [24]. The masterplan recalls the local history of *Boerkozen* [Dutch] or *Maraîcher* [French] who were horticulturists that grew vegetables near Brussels and that sold their produce directly in the city's markets (figure 5). These horticultural activities were vital to feed Brussels in pre-modern times [25]. Today, that connection between the city and the surrounding farmland is lost as most farmers in the RUF do not sell their produce directly to the city's inhabitants. The masterplan for the area aspires the (re)development of short-chain farming, through an *agrobiopôle*,[1] in order to create a bio-productive area that can withstand the ongoing urbanization.

In addition, the masterplan calls on (short-chain) agriculture to ensure an attractive landscape, one that recalls the original agricultural landscape. The designers highlight the area's uncovered potential at a regional level. While Brussels' west side is well-equipped with multiple 19th century large-scale parks, the eastside lacks green infrastructure. This east-west disparity of parks dates back to the nineteenth century when King Leopold II developped a park structure that favored the plateaus of the east to the mountainous west [26]. Moreover, inhabitants of the south-east have access to the Sonian Forest, a large woodland that is highly popular with Brussels residents. The designers propose to develop the south-western RUF into an agricultural themed landscape park: a vast and highly qualitative rural landscape of similar scale as the Sonian Forest that provides the west of Brussels with high-quality open space.

5. RESULTS AND DISCUSSION

Climate adaptation is just one of today's multiple planning challenges and must be embedded in a comprehensive masterplan for sustainability. As such, the south-western RUF of Brussels is an interesting case study. The masterplan for the area sets a direction for the sustainable development of this part of Brussels' RUF, yet it does not address climate adaptation. Moreover, policy makers agree on the premise to develop an AFN but there is no detailed plan that outlines the layout of such new AFN. How can the envisioned AFN be designed in order to climate-proof the RUF and the nearby city? In this section we explore through research by design spatial interventions to reduce climate vulnerability both locally as well as on the metropolitan scale. The final design proposal for a climate adaptive RUF can be seen in figures 6-10.

5.1 A green strip to delineate the urban conglomeration

A first design intervention is the creation of a green strip (figure 6); a transitional area that follows the contours of the urban conglomeration, as delineated in Brussels' and Flemish planning policies. The green structure (re)creates a distinct rural-urban border and puts a stop to the slumbering urban sprawl. The green strip is inspired by the 'Agriculture on the Edge'-proposal to lower urban pressure on Vancouver's farmland by providing land for gardens and other recreational uses at the rural-urban edge [27]. Likewise, the green strip offers land to multiple existing and new urban green open spaces; a small nature reserve (valley of the Vogelzang), a cemetery, several football pitches, gardens and horse pastures. As such, the design hopes to alleviates the recreational pressure on the nearby farmland, especially the most fertile soils. The green strip is located in the valley of the Vogelzang watercourse, an area that is only suited for pastures and not arable fields.

Moreover, the green strip creates a rural-urban boundary space that is publically accessible and that offers green open spaces to nearby urban dwellers. The width, layout and use of the strip are flexible. In the fold of the urban conglomeration the demand for outdoor leisure is high and thus the green strip bulges. Here, we propose to expand the existing sport facilities and to redesign the nearby, wear-down greenhouses as a new kind of public space, inspired by the agro-tourism project Corofield in Thailand by the design office Integrated Field. In the area in between Bezemstraat and Brusselstraat the green strip offers land for individual recreational land uses such as horse pastures and gardens. These private plots of land are, however, embedded in a fine-meshed network of public paths. This network must ensure that the strips remains fordable and attractive, even for non-garden owners. The design proposal recalls the iconic Nærum allotment gardens, designed by Sørensen, and modern versions of such private-public patchwork like Park Groot Schijn in Antwerp by Maxwan.

The goal of the green strip is not just to preserve farmland by creating a distinct rural-urban border but to create a climate buffer (figure 7). The green strip comprises the valleys of the Vogelzang watercourse and the tributary Beek watercourse and both watercourses are at risk of flooding. To alleviate flood risks the green strip is flood-proofed. What is more, these flood-proofing interventions also aim to increase the strategic water buffering capacities of the south-western RUF, an area that drains towards Brussels' city center. For years the small

1 The agrobiopôle Neerpede is a project by the Brussels government, financed by EFRO, to stimulate short-chain organic farming near Brussels. During a period of two years, new starters can farm on land of the agrobiopôle while they seek for agricultural parcels on the private market. Furthermore, shared infrastructure lower farm management and food processing costs.

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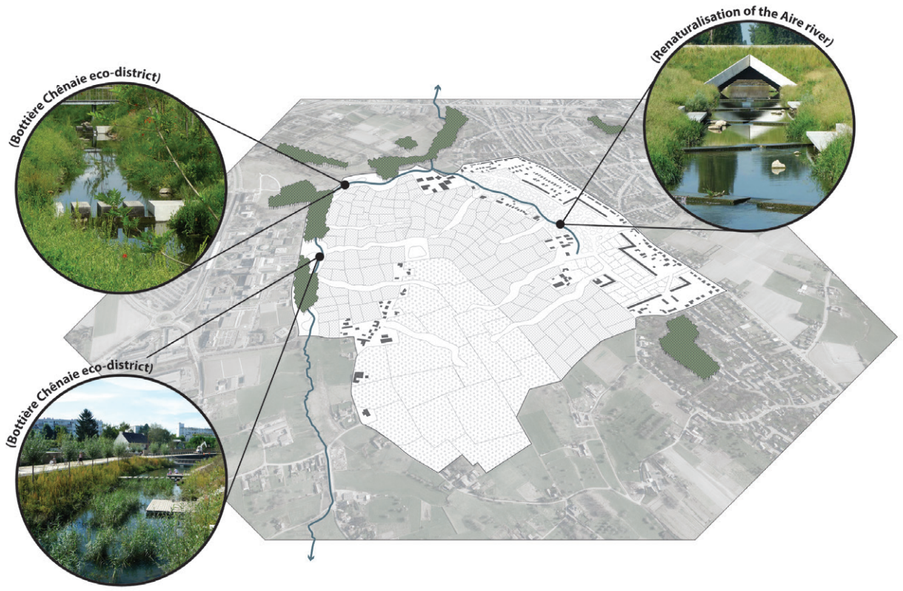

Fig. 7: The green strip is 'flood-proofed'; watercourse are re-naturalized and river beds are remodeled (GRAPHICAL WORK BY THE AUTHORS)

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Fig. 8: Grassed waterways slow down run-off. Hedgerows at the edge of the AFN catch mud and create a distinct border (GRAPHICAL WORK BY THE AUTHORS)

watercourses have been straighten, deepened and covered in order to facilitate agricultural activities. The design proposes to revise those past interventions and to redesign both valleys by applying methods from the Landscape Ecology and Water Urbanism roster; re-naturalization of watercourses and remodeling of river beds.

5.2 An alternative food network to buffers weathers' whims

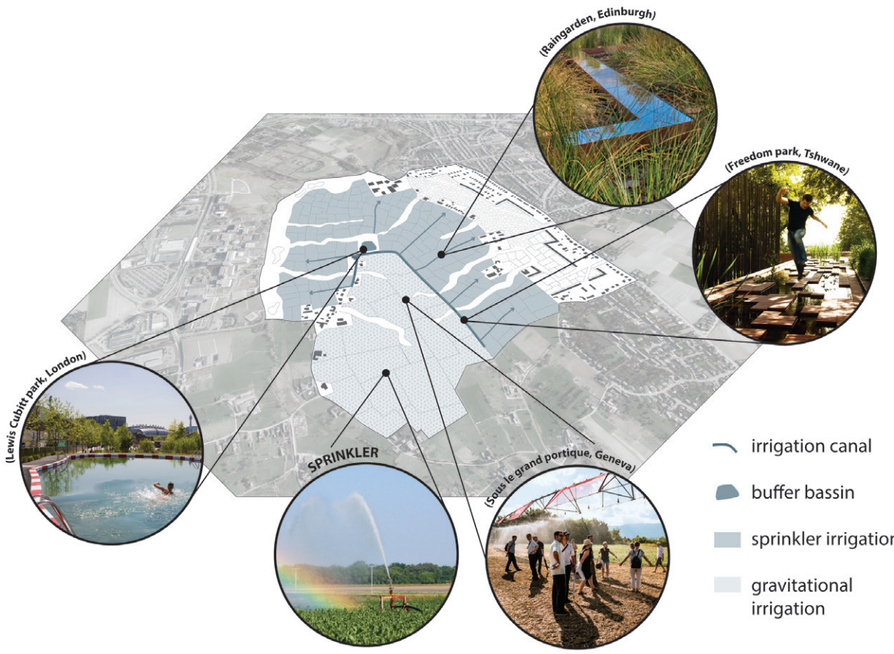
A second area of intervention is the alternative food network. Firstly, the design rearranges farming activities based on today's land uses and soil erosion risks. Arable farming is situated on top of the glowing hill where there is medium risk of soil erosion. Lower lying plots are less at risk of soil erosion and they are reserved for vegetable production. The design also reimagines todays' chaotic parceling, offering right-sized plots to traditional and organic vegetable producers. Finally, a third zone of the AFN, situated in between the residential area Jagersdal and the urban conglomeration, is at high risk of soil erosion but it is located too far away from the urban conglomeration to be part of the green strip. The area is converted to community shared agriculture (CSA) where vegetables are cultivated in (elevated) growing boxes and urbanites help to harvest. New low-rise housing outlines the CSA, providing a definite border and a new front to the open space.

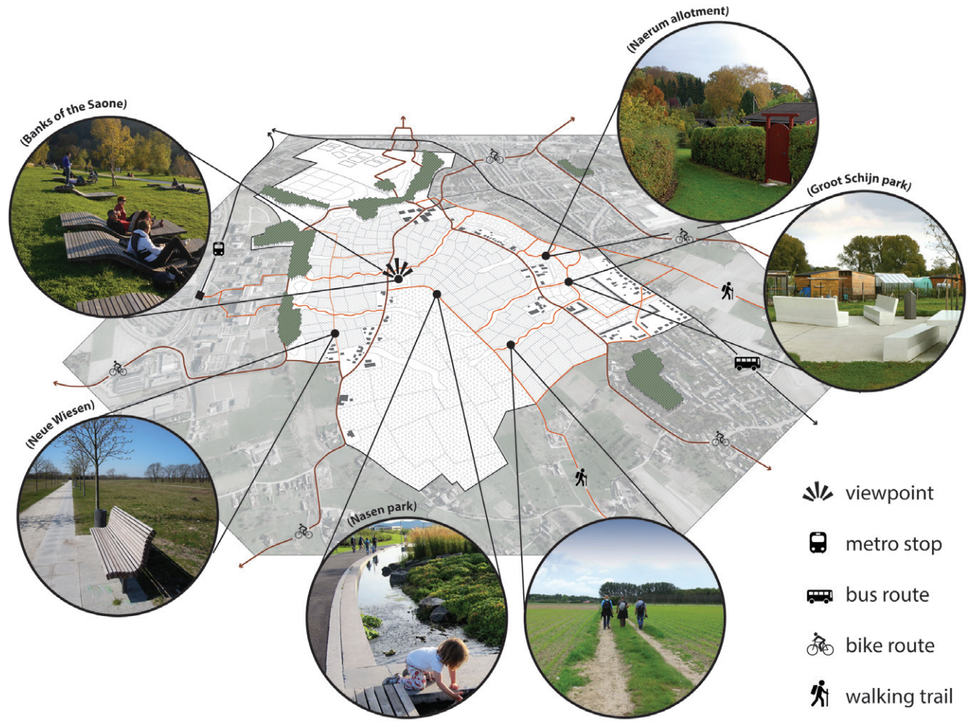
The design of the AFN is not limited to the reallocation of agricultural land uses. A new layer of (agricultural) infrastructures ensures the long-term livability of agricultural activities in times of aggravating weather extremes. Contrary to today's situation where climate adaptation interventions are limited to one farm and/or one field, the added infrastructures in this design proposal span the entire AFN. A first set of new infrastructures (see figure 8) tackles the issue of soil erosion, today's most pressing local challenge. In addition to the reallocation of agricultural activities based upon soil erosion risks, the design employs tools the landscape ecology roster. Grassed waterways[2] are installed in local thalwegs to slow down and retain the run-off from the adjacent fields. In addition, the design constructs check dams and hedgerows at the edge of the AFN, creating a clear border between AFN and green strip.

Secondly, the agricultural water infrastructure is redesigned in order to ensure the long-term viability of farming practices and minimal moisture levels that provide cooling conditions (see paragraph 4.3). In the current climate, vegetable plots and grain fields need irrigation during summers' droughts. Local farmers have acquired groundwater pumps, buffer basins, pipelines and sprinklers on an individual basis. The design creates an alternative common irrigation infrastructure (see figure 9). A large-scale water basin nourishes a canal, situated on the border between grain and vegetable production. This strip of land is charged with right of way easement, yet the pathway became obsolete. The common canal provides water to the adjacent private-owned arable fields (sprinkler installations) and vegetable plots (gravitational irrigation). The new, common irrigation infrastructures facilitates the transition to more sustainable water sources. Today's vegetable production depends on individual groundwater extractions, which risk to deplete groundwater resources on the long-term. The design creates a large, central water basin with a flow rate that is far higher than current small-scale, dispersed basins. As such, the AFN farming collective can opt for other sources of water,[3] e.g. the re-use of water of the nearby water treatment plant Brussels South. This re-use strategy is currently being tested in various locations around Europe, including El Prat de Llobregat in Barcelona and Westland in Rotterdam [28].

Moreover, the new irrigation infrastructures double as water features in the agricultural themed landscape

2 *Grassed waterways are grassland corridors of 2 to 4 meters wide perpendicular to the hillside.*
3 *At present, the organic farming start-ups of the agrobiopôle look for sustainable sources of water (local policy maker, agricultural policy department). The current idea is to reuse rainwater run-off of the adjacent sport facilities.*





park. They offer refreshment to urban dwellers during hot summer days. The common water pond is designed as a public swimming pond with panoramic view on Brussels and constitutes the center of the park. The irrigation canals incorporate playful elements such as stepping stones and cascades. In the arable fields, passers-by are sprayed with a cool mist by sprinkler sculptures, inspired by the 'Sous le grand portique' project in Geneva.

The new irrigation infrastructure also serves as a recreational framework (see figure 10). While the green strip offers urban outdoor leisure space, the AFN serves as an agricultural themed landscape park. A first step in the development of such agricultural landscape park is the redesign of existing infrastructures. Local roads are downsized to discourage through traffic and dirt tracks are upgraded. This network connects to regional bicycle and hiking routes and offers a high quality network for soft mobility. The new irrigation infrastructure provide an additional, smaller scale network of pathways. The grassed waterways serve as low-tech pathways with no sealing and no lighting.

6. CONCLUSION

This research by design has highlighted key issues in the development of the south-western part of the Brussels' RUF. These local insights nourish the worldwide debate on sustainable planning at the RUF.

Firstly, this research emphasizes the need to protect the green open spaces at the RUF and to valorize the green-blue services that they deliver. The multiple environmental impacts of urbanization are well-known and the call to contain urban sprawl dates back to the 1960's. This paper demonstrates that the green open spaces at the RUF have the potential to alleviate climate impacts at the local level as well as the metropolitan level. Moreover, it showcases that this potential highly depends on territorial characteristics including the watershed, the soil and the dominant wind direction. Hence, planning for urban climate adaptation mustn't stop at the edge of the urban conglomeration but needs to incorporate a vision for future developments at the RUF. In addition, we stress that planners need a comprehensive understanding of the local territory in order to uncover the climate adaptation potential of the RUF.

Secondly, the research illustrates the need for an integrative design of the RUF by collating concepts and strategies from multiple disciplines. To conceptualize a climate-proof Vogelzang, this RbD applied concepts and strategies from the rosters of urban design and planning, agro-ecology, landscape ecology, and landscape architecture. As the RUF is a complex mosaic of rural and urban land uses, it is fertile ground for innovative combinations of planning and design interventions from both realms. In particular the farmland at the RUF, which is often forgotten in design and planning, has great potential to redevelop the area. In this case study the creation of an alternative food network *–and the underlying premise to base food production on territorial conditions–* represented an important opportunity to rethink the farmland as a climate buffer. As such, this RbD feeds into the growing number of research and pilot projects that illustrate the strategic role of farmland in the RUF in sustainable development, including but not limited to climate adaptation.

Fig. 9: A new, communal canal provides water to vegetable plots (gravitational irrigation) and grain fields (sprinklers). Urbanites can profit from the cool conditions this irrigation provides (GRAPHICAL WORK BY THE AUTHORS)

Fig. 10: Redesigned roads, new paths along irrigation canals and grassed waterways make the AFN accessible to nearby urbanites. At the center of the AFN the new buffer basin doubles as a public swimming pond, with panoramic view on Brussels (GRAPHICAL WORK BY THE AUTHORS)

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ÖSSZEFOGLALÓ

A VÁROSI PEREMTERÜLETEK KLÍMAADAPTÁCIÓS LEHETŐSÉGEI – TERVEZÉSI GYAKORLATON ALAPULÓ KUTATÁS A KLÍMAVÁLTOZÁS HATÁSAINAK FELTÁRÁSÁRA BRÜSSZEL TÉRSÉGÉBEN

A globális felmelegedés következtében a városoknak alkalmazkodniuk kell a változó éghajlathoz, beleértve a súlyosbodó árvizeket és a megnövekedett hőstresszt. A település- és tájtervezők klímabiztos városokat alakítanak ki olyan zöld terek létrehozásával, melyek képesek mérsékelni, kiegyenlíteni a klimatikus hatásokat. A városi peremterületeken (VPT) a zöldfelületek, és különösen a termőföldek, gyors változáson mennek keresztül: beépített területté sorolják át őket, kisebb magántulajdonú parcellákat alakítanak ki (például kerteket, lovardák legelőit). A tanulmányunkban azt vizsgáltuk, hogy ezek a városi peremterületeken bekövetkezett fejlesztések hogyan befolyásolják az árvizeket és a hőstressz hatását a környező városi területeken. Ezen túlmenően feltártuk a VPT zöldfelületeiben rejlő lehetőségeket a klímahatások enyhítésére helyi és nagyvárosi szinten egyaránt. A kutatásunkat egy esettanulmány keretén belül végeztük a brüsszeli városi peremterületeken, azon belül pedig a Vogelzang vízgyűjtő területén. A tanulmány térképek, metszetek és egyéb grafikai eszközök segítségével feltárta Brüsszel éghajlathoz alkalmazkodásának összetettségét, és rámutatott a városközpont és a dél-nyugati VPT közötti kapcsolatokra. Földrajzi elhelyezkedéséből adódóan a Vogelzang vízgyűjtő területe klímastratégiai jelentőséggel bír az árvizek, aszályok és a hőstressz kezelésében, a városi területeken belül is. Munkánk során azt is vizsgáltuk, hogyan lehet a Vogelzang vízgyűjtő területe „éghajlathoz alkalmazkodó". Az esettanulmány egy olyan koncepcióra épül, amely új élelmiszerlánc-ellátásra tesz javaslatot. Cikkünk áttekintést ad a brüsszeli adottságokról, ugyanakkor visszacsatolást nyújt a VPT fenntartható tervezéséhez kapcsolódó szakmai vitához. Először is rávilágít arra, hogy a VPT zöldfelületei hozzájárulhatnak az éghajlati alkalmazkodáshoz, lokális és nagyvárosi szinten is. Ezért a városok klímaadaptív tervezésének kihívásai túllépnek a város határain, és a tervezőknek be kell vonniuk a városi peremterületeket is a helyi éghajlati alkalmazkodás jövőképébe.

Bemutattuk továbbá, hogy a VPT mezőgazdasági területei milyen nagy potenciállal rendelkeznek a terület fenntartható fejlesztését illetően, beleértve az klímaváltozás hatásait kiegyenlítő felületek létrehozását.