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Il verde pensile per rigenerare le città

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Green roof for regenerating cities

a cura di/edited by
Adriana Ghersi
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La collana si propone di valorizzare e diffondere il ruolo, i contenuti specifici e la cultura dell'Architettura del Paesaggio per dialogare e accogliere le molteplici competenze e discipline che studiano il Paesaggio, con l'obiettivo di comprendere e valorizzare sul piano ecologico, sociale e culturale i diversi elementi che caratterizzano i paesaggi, per affrontare le sfide della contemporaneità, attraverso strumenti innovativi.

La complessità del Paesaggio richiede l'individuazione delle conoscenze necessarie alla sua comprensione e interpretazione attraverso la lettura degli elementi strutturanti e delle relazioni che ne determinano la morfologia e il funzionamento ecologico, dei diversi significati a esso attribuiti, delle stratificazioni e delle tracce degli elementi scomparsi in relazione ai mutamenti economici e sociali e, quindi, l'elaborazione di proposte nelle quali conservazione e rinnovamento siano fortemente integrati.

La collana accoglie contributi e studi che affrontano i temi più rilevanti del dibattito contemporaneo, in una visione transdisciplinare e a diverse scale spazio-temporali, per costruire occasioni di confronto rispetto agli aspetti teorico metodologici e all'analisi critica di opere e progetti di trasformazione e gestione del Paesaggio.

Studi monografici, testi di più autori, atti di convegni e saggi saranno sottoposti a peer review.

The series wants to enhance and spread the role, the specific contents and the culture of Landscape Architecture to dialogue with and welcome the multiple skills and disciplines that study the Landscape, with the aim of understanding and enhancing at the ecological, social and cultural level, the different elements that characterize the landscapes, to face the challenges of the contemporary age, through innovative tools.

The complexity of the Landscape requires the identification of the necessary knowledge for its understanding and interpretation through the reading of the structuring elements and the relationships that determine its morphology and ecological functioning, the different meanings attributed to it, the stratifications and the traces of the disappeared elements in relation to economic and social changes and, therefore, the elaboration of proposals in which conservation and renewal are strongly integrated.

The series includes contributions and studies that face the most relevant topics of the contemporary debate, in a transdisciplinary vision and at different space-time scales, to build opportunities for comparison with the methodological theoretical aspects and critical analysis of works and projects for the transformation and management of Landscape.

Monographic studies, texts by several authors, conference proceedings and essays will be subjected to peer review.

Indice

Greening urban roofscapes: exploring urban creative design potentials

Emanuele Sommariva
Dipartimento Architettura e Design, Università di Genova

Green actions for urban regeneration through surface manipulation

In a world characterised by a rapid growth of urbanisation and by neo-liberalization processes, the awareness of the environmental impacts of climate change has multiplied the attention on ecological transition of cities, through the implementation of Nature-based Solutions and of urban greening strategies. (Fink, 2016; Frantzeskaki *et al.*, 2017; Anguelovski *et al.*, 2018) Cities, indeed, represent strategic contexts to face global sustainability challenges due to their environmental footprints, which extend far beyond the administrative borders of a territory. At the same time, cities can be pivotal areas of green innovation, at different spatial and temporal scales, by directly mobilizing greater engagement in peoples' daily lives with an inherent understanding of the socio-economic conditions and local vulnerabilities of Water-Energy-Food (WEF) Nexus. (D'Odorico *et al.*, 2018; Cristiano *et al.*, 2021).

Known for its performance-based benefits to public health, local cultural values and ecosystem services provision, urban greening has been identified as tangible response to urban regeneration in the post-industrial society and a contribute to effects produced by the 'Antropocene' (Crutzen, 2002; Sijmons, 2014).

As such, the architecture of the urban greening has evolved into a processual (design-oriented) approach, which implement open configurations and diverse connectivity of natural-mediated elements able to adapt to heterogeneous urban ecosystem demands and diverse landscape functional treatments (Band *et al.*, 2005).

It introduces an operative idea of sustainability, such as that described by the notion of «ecological resilience» (Holling 1986): not as a form of pure stability, but the result of persistence borne out of change through the creative adaptation or renewal of socio-ecological systems (Walker *et al.*, 2004).

Designing more effective greening trajectories for cities and their strategic assessment in the urban agenda passes by the capacity to enhance the unexpressed potentials of every kind of urban surfaces, even those not originally conceived to accommodate eco-infrastructural functions (*i.e.*, backyards, parking spots, vacant plots, privately run public spaces, community-based areas, collective commons, rooftop surfaces) in line with the typological reinvention of residuals (*délaissé*) and fallow lands (*friche*) as exposed by Gilles Clément in the Manifesto of the Third landscape (2005).

Landscape, at the very end, is an art of surface; extending the traditional topographic articulation has become a primary instrument in design. The manipulation of surfaces has been always a constant for landscape architecture, transforming an element that usually bears a flat coding into an active, complex, mutating field.

Drosscapes, terrain vague, residual surfaces (Berger, 2007; Barron & Mariani, 2013; Gasparrini & Terracciano, 2017) open up new areas of applicability for green infrastructures and their contribution to the concept of *Urban Metabolism.* A collection of micro-ecosystems enabling local dynamic life cycles, which connect goods, people, energy, food, biota, water, soils, vegetation, mutually influenced by each other and whose cross-interactions are apparently invisible to people (Sommariva, 2020).

Beyond boosting neighbourhood morphological qualities, making urban greening aesthetically appealing for citizens through Nature-based Solutions is a matter of urban and landscape design, optimizing the perceptive values and the accessibility to green spaces through co-creation practices.

This in turn produces new green urban commons that require multi-actor collaborations for their design and governance, but at the same time it fosters civic awareness regarding positive externalities in

Fig. 1 Eagle Street rooftop organic farm on Greenpoint warehouse in Brooklyn, New York, 2014 (© A. Novak).

Fig. 2 Constructed landscapes is art of surface as in the case of Netherlands Pavilion Expo Hannover 2000 (© MVRDV).

place, such as the enhancement of urban soil permeability, the preservation of spontaneous forms of nature and biodiversity, or the mitigation of climate change effects (*i.e.*, water shortage, heat islands).

The relevance of this new approach based on the eco-environmental performance of green infrastructures is recognised globally: in urban areas, they bring public health benefits such as improved air quality, groundwater quality, reproduction of ecosystem services while strengthening the sense of community and green care, by counteracting social isolation (Benedict & McMahon, 2006). They can nurturer environmentally impoverished contexts, becoming a valid means of compensating and mitigating the impacts generated by the urbanisation of the territory; suitable for triggering the formation of semi-natural ecosystems in densely populated territories, by overcoming the relational ontology of 'City-in-Nature' or the dialectic dualism of 'Urban landscapes' and 'Nature and Society' (Swyngedouw *et al.*, 2005; Moore, 2011; Gausa, 2012).

In the context of this paper, special attention is given to urban roofscapes as potential area of expansion for green infrastructures, especially when linked to new contribution and diversification for urban food systems.

Green roofs are strategic tools in the creation of sustainable and resilient urban environments, playing a direct role in mitigating climate change impacts at the micro and macro-urban scale. At the same time, they extend new socio-spatial arrangements with local communities looking for new amenities, self-productivity or simply places to take care of. In this way, urban agriculture[1] and other

1 Urban agriculture, despite a lack of a formal definition, includes a number of different ecological hybrid practices (ranging between horticulture, urban farming, community/social gardening) associate with the growing of plants and animals within cities (FAO, 2011); practices which leverage

rooftop gardening practices can intercept spaces, actors and dynamics present in a city, moving from a 'take-consume-dispose' model towards a new integrated agro-urban ecosystem, in which sustainable and multiscale productions give access to healthy grown food and socio-ecological benefits on a local basis (Steel, 2009; Sommariva, 2014).

Urban rooftop functional design offers a promising option to enable creative inventiveness through Tactical Urbanism principles (Lydon & Garcia, 2015) and to promote urban land-use diversification and regeneration according to the Open City model argued by Jane Jacobs and later by Richard Sennet (2018).

Advancing urban ecology through productive urban rooftop farms

Although the articulation of urban green systems has increasingly gained prominence in public and academic debate, also by means of the *Active Healthy Cities model* (Duhl, 2005; Dorato, 2020), the care and enhancement of urban space has not, for the most part, accounted equitable and democratic forms of post-implementation access to green spaces. As experienced in the example of numerous high-profile greening projects, such as the High Line in New York[2], attractive new green amenities tend to boost adjacent property values, increase speculative behaviour and gentrification, by narrowing socio-cultural representation against resident-driven design. On the other hand, urban farming activism and Guerrilla Gardening, by lying at the more informal end of the urban greening movements, offer with their collective campaigns of local empowerment forms of temporary reappropriation and re-naturalization of urban leftovers, by claiming socio-ecological resilience as civic right. In this way, micro-designed actions intertwine food policies and greening governance for urban commons, by addressing the collaborative distribution of welfare services in conflicted contexts to be regenerated by creative interventions.

The adaptability of larger terraces and hanging surfaces is only one of the various possibilities in contributing to urban greening by means of constructed ecosystems (Harada & Whitlow, 2020). Particularly linked to the topic of this conference as '*New Forms of Nature*', constructed ecosystems required both a sensitivity to reproduce spaces characterised by natural association of the plants (Lucas, 2011), and the sustainability of their maintenance by fostering green economies and new entrepreneurial opportunities, such as the *prosumer* model[3], in the form of «continuous productive urban landscapes» (Viljoen *et al.*, 2005).

Ideal for collaborative research on biodiversity migrations, ecological values, plant selection and adaptation, these new productive grounds can be expanded into commercial farming operations that help to grow and deliver local vegetables, aromatic herbs and diaries to markets and households, thereby saving on transport costs. In this way, rooftop farms can contribute to ecosystem service provision, local pollination and water management strategies which can be manipulated through site-specific design practices (Felson *et al.*, 2013).

Typologically, urban rooftop farms exist in many different forms and their farming methods can vary depending on the project (Thomaier *et al.*, 2015). Rooftop greenhouses represent an emerging category commonly associated with more complex tech-mediated growing systems (*e.g.*, aquaponics, hydroponics, aeroponics) used to monitor both production capacity and resource efficiency in an open-loop (Orsini *et al.*, 2020). Nevertheless, open-air rooftop farms are most notable examples of building-integrated agriculture, which utilize low-tech systems with raised

pre-existing urban energy flows characterised by supply activities such as producing and delivering ecosystem services as well as processing and marketing of local/organic products. For a more extensive literature see Bakker *et al.*, 2000. *Growing Cities, Growing Food: urban agriculture in the policy agenda*; Viljoen *et al.* 2005. *Continuous Productive Urban Landscapes: designing Urban Agriculture for sustainable cities*; Sommariva E., 2014. *Creating City. Urban Agriculture. Strategies for city resilience*.

2 The High Line (2006-2009) is a linear park designed by Diller Scofidio + Renfro and Field Operations, on a disused section of New York's West Side Line. An agri-tecture project which alternates landscape inspired rooms with gradients and colours of pioneer plant species. For more info see Dimendberg E., 2013. *Diller Scofidio+Renfro: Architecture after Images*.

3 A 'prosumer' is an individual who both consumes and produces. The term coined in 1980 by Alvin Toffle refers to commons-based peer production and user participation, in line with the principles of the sharing economy and other movements adopting a Do It Yourself (DIY) approach. In the same trends is possible to include the open-source software movement, the Fablab movement or the voluntary simplicity that seeks socio-environmental goals through prosumer activities. See Tapscott D., 2006. *Wikinomics: How Mass Collaboration Changes Everything*.

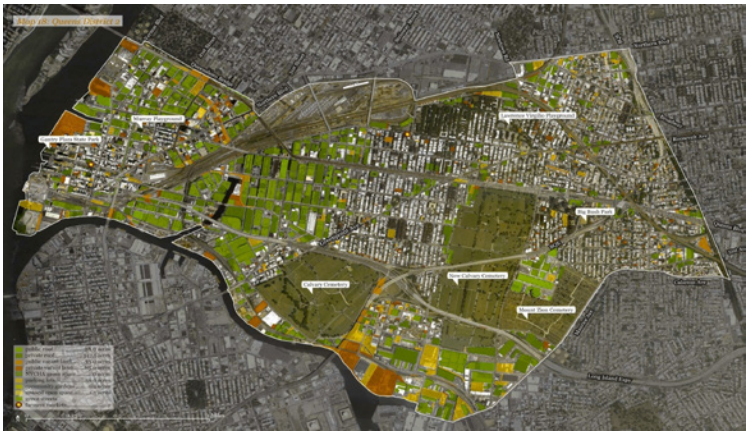

Fig. 3 NY Urban agriculture potential development of vacant plots and grey rooftops (© Columbia University, MaPLUTO).

Fig. 4 Open-air cultivation activities with children on the rooftop garden of Gary Comer Youth Center, Chicago.

beds allowing a wide cultivation spectrum and a long-term multifunctional scalability and transferability through: (1) cross-experimentation of farming practices, methods and tools which can involve diverse target audiences, visitors and educational programmes; (2) specific marketing strategies based on consumers' groups loyalty sensitive to green transition, bio-based materials, organic cultivation and permaculture; (3) promotion of place-making initiatives, and designing of extra-farming services such as gastronomic tours, social events, environmental education, green job training, culinary sessions, nature therapy, and creation of lively neighbourhood (Bell *et al.*, 2016).

Against the positive environmental externalities and growing interests on the urban rooftop farming at global reach, most frequent challenges are the physical feasibility (structural loading, rooftop accessibility), restrictions from safety regulations and municipal codes (historical constraints, height limitations, fire code), and amplified climate conditions (heavy rains, elevated radiative fluxes and temperature ranges) that occur on rooftops (Caputo *et al.*, 2017), which may limit its application and cultivation performance. However, scientific evidence demonstrates the potential of rooftop farms to improve building environmental (*e.g.*, by increasing thermal insulation or integrating rainwater harvesting systems) and employ building by-products (*e.g.*, greywater, heat, CO2 and organic waste) as farming inputs.

Many cities around the world are experiencing various forms of rooftop farming initiatives that are not easily categorized, responding to multifunctional programmes which mix commercial production to local stakeholders' needs and respond to an open design logic. The Gary Comer Youth Centre (Chicago, US); Les Parisculteurs Nature Urbaine (Paris, FR); Rooftop Republic project connecting more than 60 elevated urban farms (Honk Kong, CN); the Østergro (Copenhagen, DK); the Organoponicos de alto rendimiento (Havana, Cuba); LufaFarms (Montreal, CAN); *Fed Square pop-up patch* (Melbourne, AU), the micro-community of Orti Alti (Turin, IT); the landscaping project for Les Jardin de la Duche (Nyon, CH); Boston Medical Center kitchen garden (Boston, US); DakAkker intensive farm (Rotterdam, NL); Thammasat University, the largest organic rooftop farm in Asia (Bangkok, TH) are just few of the most interesting interventions sprouted in the last years involving a variable geometry of temporary land-uses, actors and performances to catalyse existing urban facilities, by fostering new urban commons, transitory practices, sharing uses and micro-economies which conceptualise those «Spaces of Uncertainty» (Cupers & Miessen, 2002) produced by urban sprawl.

Among others, one of the most interesting and pioneering case is the Brooklyn Grange Rooftop Farms in New York, as a wider urban regeneration programme for the NY Naval Shipyard into a new creative eco-district which includes movie sets, museums, fish markets and rooftop farms (Plakias, 2016).

Fig. 5 Community-Based Green Infrastructure Program of NYC used Brooklyn Grange as hotspot for green regeneration, 2012.

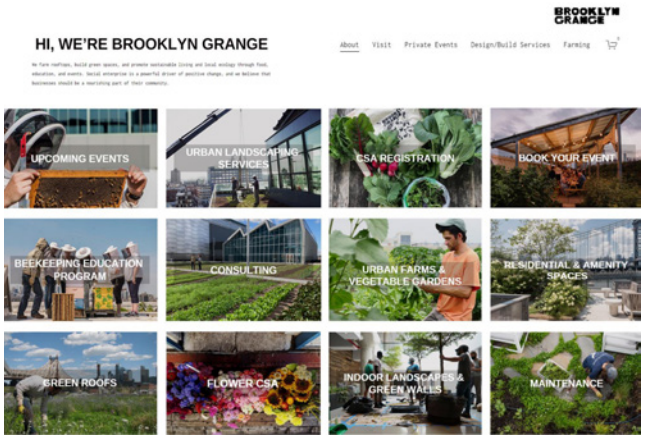

Fig. 6 Greening services and social enterprise for local ecology through food offered at Brooklyn Grange, New York.

Since 2011, in fact, Community-Based Green Infrastructure Program of NYC Department of Environmental Protection provides grants for construction of green infrastructure projects including rooftop farms as a part of 20-year green infrastructure masterplan. Brooklyn Grange has been launched on the same year to support local restaurants, schools and to fight against the proliferation of *food deserts*[4] in metropolitan area. In a few years it has become a centre of attraction for all newyorkers who are looking for organic products over a cultivated area of 4200 m^2. Today, the production of Brooklyn Grange ranges from 18,000 to 22,000 kg of vegetables/year with a high variety in crops of 40 species of vegetables, fruits, honey and aromatics. Brooklyn Grange, however, is not just a farm, but is weekly converted into a place of happenings with an ethnic restaurant where visitors, especially children, are involved in the preparation of healthy fresh recipes.

In 2012 the association Bushwick Food Cooperative has decided to open two other suburban farms respectively of 3600 m^2 and 4500 m^2, involving other stakeholders, such as those from the fish market on Northern Boulevard and the beekeepers of the Brooklyn Grange Bees, the largest urban beehive of New York.

Co-design strategies for temporary reuse of roofscapes: the case of Rotterdam

One crucial way in which roofscapes can contribute to improve urban landscape and local environmental performances, is mobilising self-made practices and community-driven initiatives to reorganise topologically vacant or underused surfaces in shared rooftop gardens and urban rooftop farms. Similarly, larger rooftops can also serve as stages for exhibitions, open-air cinemas or theatres, thereby fostering much more culturally-based uses on a new elevated ground level for the city. Even simple schemes, such as rooftop bars, promenades and sport grounds — which have almost become a cliché— can help to revitalise otherwise lost surfaces, opening up previously inaccessible areas, and inspiring new ideas and approaches to roofscapes. This exploration of rooftops as new spaces for community and public action can be interpreted as growing interest in public space by multiple stakeholders of society (Wienese, 2017).

The *right to use* and to define new form of managements and spatial arrangements in place is an intrinsic quality of communing, especially when organised in a network-oriented system of spaces for inclusion through the implementation of co-creation initiatives towards the *right to contribute*. Many

4 The term 'food deserts' refers to an urban/peri-urban/rural area which has limited access to affordable and quality foodstuffs, without being subject to supermarket or big retailers. The designation considers the type and the quality of food available to the population, in addition to the accessibility of the food through the size and the proximity of the food stores. The food deserts are the result of a weakening of local commercial networks, typical within small and medium size towns, towards the adoption of new retail models based on large-scale supply chains. See: Beaulac J. *et al.* 2009. *A Systematic Review of Food Deserts*, 1966-2007.

of the most promising ideas, in this regard, are the reformulation and recovery of the 'in-betweens': partitioning of open spaces and articulation of clustered activities, which don't fit neatly together but producing new integrated land-uses and patterns; including quirky, jerry-built adaptations or greening opportunities for roofscapes.

In line with this principle, the municipality of Rotterdam, often considered to be a hotspot of contemporary urban renewal through architectural festivals, film and arts, represents one of the most notable case studies on greening strategies and cultural creativity on roofscapes. Post-war urban reconstruction, heavily influenced by rationalist movement and new infrastructural development, has created the suitable conditions for roofscapes to be experimented on, resulting in a total surface of 18,5 km^2, of which 1 km^2 only in the city centre, the same surface covered by Dakpark, one of the largest rooftop parks in Europe.

In the last years, Rotterdam has been targeted by several climate mitigation action, such as the *Rooftop Revolution Rotterdam* or the LIFE project *@Urban Roofs* to support Water-Energy-Food Nexus approach to sedum roofs, terrace gardening or similar greening solution able to enhance local biodiversity and species conservation as well as viability for multifunctional combination. The municipality itself promoted a multi-year program to foster further development pilot projects to recycle existing grey rooftops into new productive surfaces by means of urban agriculture applications and citizens participation on different operational levels (*i.e.*, *Dakakker on Schieblock, Rotterdam Hofplein station*).

The *Multifunctionele Daken* program has defined in particular seven typological category of urban rooftops, which are ascribed different colours (see Tab. 1). City's rooftop ambition is to promote visionary combination of these functions and thereby reinforce cultural knowledge of the ecological transition benefits for the city, building owners and the local community. In this regard, the most noteworthy culturally-driven initiative led by the municipality along with the architectural studio MVRDV is the *Rotterdamse Dakendagen* (Rotterdam Rooftop days)[5], a recurring

Fig. 7 Multi-functional roof plan strategy described in 'Rooftop Catalogue', 2021 (© MVRDV & Rotterdamse Dakendagen).

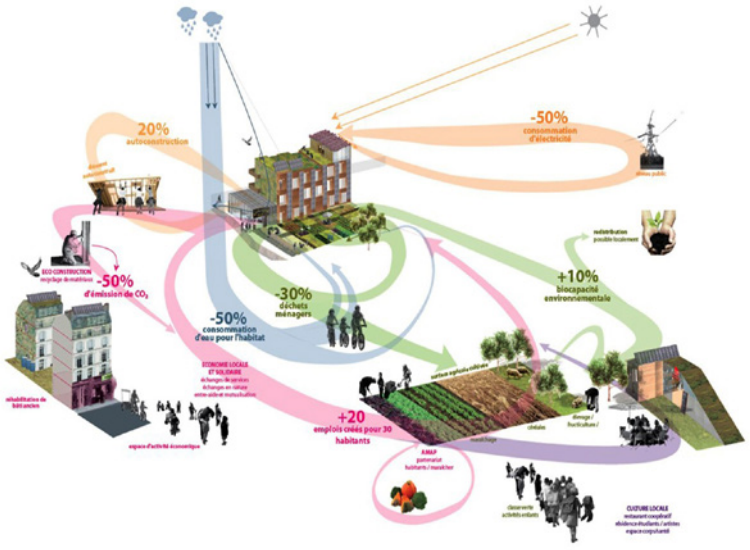

Fig. 8 Diagram of closed-loops metabolism through local sustainable sourcing (© R-Urban strategy _ AAA,2010-12).

5 The Rotterdam Rooftop days festival and the other temporary cultural activities organised include a great variety of imaginary roof appropriations from live concerts, to architectural promenade, from group sunbathing to open theatre and is free and accessible to all.
For more info see: https://rotterdamsedakendagen.nl/

Tab. 1 The rooftop colours of the Multifunctionele Daken program. Source: Gemeente Rotterdam, 2019.

colour	function	example
Green	Green rooftops are **roofs gardens** that reduce urban heat stress, increase biodiversity or grow food	Roof gardens or parks: *Dakpark or Hofbogen.*
Blue	Blue roofs serve **water retention and decrease runoff** in cases of heavy rain to be stored for droughts	Sponge buildings or rooftops: *Slimdak at the Schieblock*
Yellow	Yellow roofs serve **energy generation**, through a variety of methods, such as solar panels or wind turbines	Rooftop solar panels: Rotterdam Central station
Orange	Orange roofs serve **transportation and connecting places** between roofs delivery drones in the future	no prominent rooftops yet for this function
Red	Red roofs cater to **social functions** and can serve as places for recreation or as places for activity and sports.	Tennis courts or rooftop bars: Suicide Club on the Groot Handelsgebouw.
Violet	Violet roofs are places for **living and co-habitation**, in the form of self-sufficient 'tiny houses'	no prominent rooftops yet for this function
Grey	Grey roofs serve for **technical components** for office, commercial, residential building (chimneys or A/C units)	dominant type of rooftop in the city
Golden	Golden roofs are roofs that **combine different functions** creatively with one another	Schieblock: green + blue + red function.

event since 2015 which attract more than 20.000 visitors/year, aiming to promote the unique feature of temporary occupation and new forms of exploitation over 60 rooftop terraces in Rotterdam.

Rotterdamse Dakendagen deals with many rooftop-related themes and internally sorts all activities into four general areas, which also already highlights some of the festival's ambitions. They are the following.

The city and its inhabitants // Architecture
Special activities dedicate to open-day lab and co-design workshop with citizen on urban planning, sustainable development, enabled by the new perspectives offered by rooftops creative reuse.

Learning from others // Sharing society
World cafes and transect walk to foster reciprocal exchanges between visitors and experts by offering walking lectures and readings on the city and the role of open space design in Active Healthy Cities.

The city as decoration // Culture
Open-air cultural and musical cross-overs together with other forms of art and entertainment such as dance or poetry, especially by young creative performers to reach younger target audience, but also to make the city of tomorrow more attractive and age-friendly.

Spaces for connection // Living together
Sport and social activities to encourage the sensitivity towards barrier-free public spaces and rooftop design potentials. Inclusive approaches are focused on stakeholders' interviews and focus groups to avoid service specialisation and functional conflicts.

In the landscape of rooftop pioneers, Rotterdam 2021 festival's edition stands out due to its alternate approach to the subject and the presentation of the Rooftop Catalogue, which presents over 130 possible ways to use or retrofit any building's rooftop. Using as a case study the architectural typologies of Rotterdam, MVRDV proposals range from parks to flexible residential units,

as long as they can address one or more Sustainable Development Goals. This catalogue along with its analysis and the imaginative programmatic interpretations presented lay the basis for a new elevated public city life, securing Rooftop days a place in the city's list of cultural institutions of special importance.

In this way, planning the new post-urban condition when places become both dense and diverse, it means to rethink not only the spatial form of cities, which is always subject to change, but to conceive its forms of aggregation on different semantic levels, extending the concepts of accessibility to open public and green spaces as an integral part of the 'right to the city' (Lefebvre, 2009).

Conclusions

This work presented a review of benefits and limitations of green roofs, as a form of operational grounds for constructed urban ecosystems different from traditional subjects of landscape ecology. In many cases flat roofscapes are direct outcomes of urban post-war reconstruction with no specific attention for positive externalities which can produce at city scale if re-oriented through the Water-Energy-Food-Ecosystem nexus. Landscape design can guide the large-scale installation of multi-layered green roofs to reduce climatic stress in cities, heat island effects, the pressure on the water supply system and provide food from urban agriculture. Democratic governance principles are thus associated with hands-on actions whose consequences are visible with tangible spatial effects, where the micro-transformation dynamics and pop-up urbanism practices extend to co-design dimension the concept of urban green infrastructures.

The articulations of local spatial reproduction of collective arrangements in place find in the physical materialisation of places for production to distribution (*i.e.*, rooftop farms, greenhouse farms, recycle labs, micro-hubs) and from distribution to consumption (*i.e.*, pop-up markets, bio-reactors and local distribution chains) potential areas of investigation with research-by-design methodology.

More than just a method of adaptation, resilient practices are considered within these examples as catalysts for urban innovation and creativity. In this sense, the principle of multi-functionality applied to urban landscapes can become a tactic to react to the specific challenges of demands of the contemporary city, in terms of living space, new services, food provision (Sommariva, 2014).

In conclusion, roofscapes represent a strategic context of intervention for the future, able to fuel both creativity and multi-functional pilot projects, by defining locally closed circuits, and catalysing existing grey surfaces toward new urban commons as well as their performance-based design.

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