INVENTORY OF NATURE-BASED INNOVATIONS

GOOD PRACTICES IN GREEN SPACE MANAGEMENT AND STORMWATER MANAGEMENT IN EUROPE

INTRODUCTION

Climate change is already exerting a major impact both in Europe and in the rest of the world. This impact is foreseen to intensify with extreme weather events, including droughts and floods, becoming more frequent. Mitigating and adapting to the impacts of climate change as quickly as possible is therefore among the most important challenges of our time. Local authorities have a major role to play in this, as they can implement a range of climate and environmental good practices in their planning processes, developments, investments, urban management practices and in the design of their blue and green infrastructure networks.

The overall aim of the international project „Nature-Based Innovations for Urban Forest and Rainwater Management", led by Reflex Environmental Association, is to help European municipalities/communities/ stakeholders of local communities/NGOs/institutions prepare for climate change by providing guidance on possible solutions.
As part of the project, the consortium has compiled exemplary practices from 6 countries in this online publication. The nature-based solutions presented focus on good examples of green space management, urban forests, rainwater collection, biodiversity enhancement, as well as blue and green infrastructure schemes. It will also serve as the basis for a handbook to promote green urban development, which will be implemented in the next phase of the project.

In the first part of the project, an online fact sheet was invited to briefly present exemplary innovations in municipal green space management and stormwater management in the partner countries. Municipal tree planting programs; urban forests; online tree inventories; climate-adaptive grass communities and wildflower urban fields replacing intensively managed grass; green roofs and green facades; rainwater harvesting and retention systems – these examples and similar ones were submitted from all over Europe. The collection was open not only to local authorities but also to citizens, institutions, and NGOs.

In spring 2021, the project partners jointly selected the 14 best good practices from 6 countries, based on a set of criteria developed in advance, which are presented in this publication. In compiling the catalogue of examples, it was important to ensure that the compilation included solutions that could be applied in both small towns and cities.
We hope that these inspiring examples will encourage more cities and communities to adopt climate-smart planning, climate-friendly urban management and climate protection as systemic practices.

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Project title: NABI – Nature-Based Innovations for Urban Forest and Rainwater Management
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Partners: Reflex Environmental Association (Hungary), Cospe – Cooperazione per lo Sviluppo dei Paesi Emergenti Onlus (Italy), Klimabuendnis Oesterreich Gemeinnuetzige Foerderungs- und Beratungs GmbH (Austria), FocusEco Center (Romania), Istarska Razvojna Agencija (Croatia), Aiforia GmbH (Germany)

Co-funded by the Erasmus+ Programme of the European Union

ECO STREET OBERGRAFENDORF

DESCRIPTION

The Eco Street was realised in the municipality Ober-Grafendorf, which is located in the Mostviertel in Lower Austria. In total the municipality covers an area of 24,56 square kilometres. A whole 14,9 percent of it is forested.

In a residential road, Buchengasse, the project was implemented. It is a 100 metres long and eleven metres wide street in the new settlement zone in the north of the municipality. For a more detailed insight into the geographical location, look up the following coordinates: 48.15755549198019, 15.549344989100291.

In general, Buchengasse is an ordinary residential road that runs from east to west and has rows of houses on each side. Three other streets border on it.

Case study type
Municipal rainwater collection and utilization scheme

City or municipality
Ober-Grafendorf

Location
Buchenstraße, 3200 Ober-Grafendorf, Austria

Project owner
Market town Ober-Grafendorf, BOKU, Zenebio GmbH

Time of implementation
2015

More information
Website of Municipality Obergrafendorf
Covenant of Mayors cities' and regions' adaptation actions

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HISTORY, JUSTIFICATION

More frequent and intense rainfall creates small-scale flooding on impermeable surfaces, overburdens the canalisation and wastewater treatment plants, as well as uppens the costs of their preservation and maintenance. Extensive heat waves and droughts also heighten the effort needed for watering and tending green spaces. The answer of the municipality Ober-Grafendorf is an intelligent, ecosystem-oriented rainwater-management in combination with an environmentally friendly street design. (https://www.ioeb.at/erfolgreiche-projekte-detail/neue-wege-fuer-die-strasse-projekt-oekostrasse-in-ober-grafendorf)
With the project „Eco Street" (©Draingarden), the goal is to stop diverting rainwater from the streets into the canal system, and instead letting it seep into specifically designed green spaces that are bordering the street. This offers many advantages, like the improvement of the microclimate, the easier maintenance (no watering in summer months or high energy expendure for cleaning the rainwater) as well as the simple flood control.
In the long run, the eco street aims to be a best practice example for other municipalities, cities and regions. The intent is to warrant a general reduction of sealed space in the residential streets. This means conservation and efficient use of water resources plus the saving of energy.

IMPLEMENTATION

The Eco Street in Ober-Grafendorf was implemented in 2015.

Financing: For the process management and support services, a budget of 65.000 Euros was available to all municipalities that were part of a regional pilot adaptation process of the EU-project C3-Alps (Interreg Alpine Space Programme 2007-2013). The decision for the financing and installing of the adaptation measure in Ober-Grafendorf was made by the local council and therefore financed by the regular municipal budget. Because the costs of roadwork and street design would have been used for conventional green on the roadside anyways, the Eco Street was cost-neutral.

Execution: The Eco Street was designed in collaboration with the gardening shop Anton Rath and conceptualized as a scientific experiment. Therefore, the performance parameters were constantly monitored. The foundation of the Eco Street is the specifically developed ©Draingarden system, an intelligent rainwater management tool. It works due to an optimal synergy of ground substrate and plants in the green spaces.

Partners: Austrian Federal Environmental Agency for administration of the program „C3-Alps", mayor Rainer Handlfinger for public administration, 2 institutes of the University of Natural Resources and Life Sciences, the gardening center Anton Rath and Zenebio GmbH (for planning and implementation) as well as Stefan Schmidt from Schönbrunn. (https://www.ioeb.at/erfolgreiche-projekte-detail/neue-wege-fuer-die-strasse-projekt-oekostrasse-in-ober-grafendorf)

Difficulties and challenges: In terms of the whole regional adaption process, the recency of climate adaption as a local topic turned out to be a restrictive factor. It took a considerable amount of effort to translate and compress measurement suggestions that were made on a national level, to a local and concrete plan.
Another challening factor was holding the motivation of stakeholders for their participation, while also avoiding to overburden their resources and capatities.

(Info: DI Sonja Kadanka, Ober-Grafendorf)

INNOVATIVE CHARACTER

The new innovation behind the Eco Street is the specifically designed ©Draingarden system of the Zenebio GmbH, which was researched for ten years beforehand. The granulate-, substrate- and plant-mix was tested in a research project by the institutes for urban water construction, industrial water economy and water protection, as well as soil bioengineering and landscaping.
The 100 metres long residential street „Buchenstraße" is characterized through innovative technologies for rainwater management as a sustainable best practice example for other municipalities. Rainfall and surface water from the streets seeps into the plant beds which then provide a year-long blossoming supply for insects. Ecologically valuable street trees were planted and soon there will be regionally popular Dirndl-bushes added.
Once a year, the bushes and shrubs are cut back – the maintenance level is low. All expenses for the watering of the plant beds can additionally be saved.
Another advantage of the filtration effect of the special substrate: surface water enters the groundwater in a clean state. The municipality therefore saves itself the trouble of cleaning rainwater in a wastewater treatment plant.

What is working well, what are the threats, SWOT analysis – there is no size limit

Thanks to the Eco Street, rainwater stays available for plants and flood control can be guaranteed on the same level as with conventional techniques. Due to the storing in those spaces, the local canal system is relieved and rainwater can be used by the plants instead of going through a resource-heavy cleaning process. Additionally, Draingarden-green spaces reduce the amount of sealed ground, which contributes to soil and energy conservation. (Info: DI Sonja Kadanka, Ober-Grafendorf)
It is important to consider that Draingardens usually activate already planned planting areas. For clients like the municipality Ober-Grafendorf that meant that the costs for designing the street space hardly differed – but only because expenses had already been planned. On the other hand, costs for the construction of the canal system can drop away. (https://www.e5-gemeinden.at/e5-gemeinden/best-practice-beispiele/detail/ober-grafendorf-noe-oekostrasse-212)
Another thing to keep in mind would be the orientation of the street. In the case of Ober-Grafendorf, having the shading on the other side would have been smart, because it is very sunny there.
It is also recommended to implement the Eco Street in collaboration with proper experts. The risk of a wrong plan and execution could result in the seeping effect not working. This would double the costs.

SOCIAL IMPACT

The two-way aligned plant beds on the roadside do not only contribute to a higher aesthetic value but also to more biodiversity in the settlement area. Due to the bigger street profile on the finished new streets, the roadway is tilted. With that, the driving speed is automatically reduced, making the street safer.
Thanks to the gradual extension of Draingarden spaces along the newly built streets, more and more residents in Ober-Grafendorf profit from a natural and colorful environment.
The more green and the less sealed the area is, the better is the humidification and active cooling of the surrounding air – and therefore the microclimate and air quality is improved for everyone.
The people enjoy the cooling effect and that the street looks beautiful thanks to the vegetation.

REPEATABILITY

Eco Streets have been implemented multiple times. Ideally, they can be transferred to new regions and residential roads. The project should also work in cities, especially to counter the heat in summer.

Eco Streets – like the one in Buchengasse – have already been realised in other Austrian municipalities. Examples include Schulgasse in Herzogenburg, where trees were planted within a few metres of distance between and lots of storage space below them, or the Landesklinikum St. Pölten, where the garden area also has a positive effect on visitors and patients (also see https://zenebio.at/weitere-referenzprojekte/). In total, the Draingarden system has been implemented in 70 projects so far. For every one of them, it has been individually adapted to fit the local ecosystem.
Ober-Grafendorf is also planning on turning more of their municipal roads into Eco Streets.

CONCLUSIONS, RECOMMENDATIONS

The Eco Street is a future-oriented project that implements a system that is applicable in many types of regions. It allows a climate-conscious design of local areas and brings hardly any downsides with it, according to the mayor. To ensure a high air and living quality, as well as to protect the area from flooding, the Eco Street can be a good solution.
To quote mayor Rainer Handlfinger: „We will only do it this way!”

THE CLIMATE-RESILIENT PLACA-MART-PARK-HYBRID

DESCRIPTION

The project is part of an upgrading of an urban quarter, the Kreuzgassenviertel in Vienna's 18th district. It is a Gründerzeit quarter with a street grid and perimeter block development. In the run-up to the project, the municipal area management and the district administration conducted surveys among residents and local businesses in order to identify the needs and wishes for changes in the public space.
As a result, Johann-Nepomuk-Vogl-Platz and its surroundings should be redesigned as a more usable public space. An improvement of the connection to public transport through the installation of a new tram stop directly at the square was also a result of the surveys and part of the implementation.

The square is surrounded by streets on three sides. One of them, Kreuzgasse, is lined with tram tracks. Within the pavement zone on the square, there are market stalls on three sides, some of which sell food and goods for daily use and some of which are small catering establishments. Within the market stalls is the screened-off centre of the square as a recreational area...

City or municipality
Vienna

Location
Johann Nepomuk Platz, Vienna, Austria

Project owner
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Time of implementation
2019-2020

More information
gbstern.at – something happens at Vogl-Market
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DESCRIPTION

The actual planning area covered 2,700m² This includes the pavements of the surrounding street spaces, the parking strip in Teschnergasse and the area within the market stalls, which is partly dedicated as a market area and partly as a recreational area park (Epk). There is a children's playground in the area of the Epk dedication.
The open space in the centre of the square has been widened by the relocation of the toilet facility and the waste material collection point and is enclosed by the surrounding permanent market stalls in a U-shape. The south-western boundary is formed by the children's playground, as well as two trees (old growth) with associated green spaces. Towards the street, the market is accessed in a ring shape by a pavement and a footpath along the southern frontage of the houses. On three sides, trees (existing and newly planted) reinforce the spatial boundaries and separate the roadways from the pavements. The tree bases in the public area are designed as additional green spaces in the form of perennial beds.

Six trees were planted on the central common area according to the sponge city principle. Under the paved surface, an extended root space of 35 m³ per tree was created from coarse aggregate with washed-in fine material for water and nutrient storage. The tree bases were supplemented with platforms and invited people to linger. Between the new trees there is a splash pad as well as additional seating. The water feature combines ground jets for fountains and for mist and provides cooling and fun for the children in hot weather. Perennial beds with climbing aids were created at the backs of the market stalls, which are tended by the market stallholders. The stable lattice fence around the children's playground was planted with climbing plants. The perennial climbing plants have a positive influence on the overall appearance of the square and contribute to a climate-sensitive design.

The rainwater management of the redesigned Johann Nepomuk Vogl Square was designed in such a way that all surface water from the square, the water from the water feature and the roof water runoff from the market stalls is not directed into the combined sewer but into the retention area of the sponge city, where it is stored and infiltrated in a way that is available to plants.
The asphalt surfaces of the square interior and partly at the pavements were replaced by light sand-coloured concrete slabs, which were laid unbound and with open joints.
A drinking fountain was relocated at the square, and an existing hydrant was also given a drinking fountain attachment.

In addition to these climate change adaptation measures, further adaptations were made in the course of the redesign:
- The central square space was expanded and cleared. For this purpose, the waste collection point and the toilet facilities were relocated to the edge of the square.
- The diagonal passage of the square in east-west direction was improved in order to better integrate the inner area of the square into everyday routes.
- The playground equipment at the children's playground was renewed.
- An existing table tennis table was supplemented by a second one.
- The number and variety of seats were increased and an open bookcase was added.
- the perennial planting was renewed - except in the area of the existing urban gardening „Gartln ums Eck" - and equipped with automatic irrigation.
- the perennial areas in the central area were bordered with seat walls
- in the area of the parking lane in Teschnergasse, the conditions for a weekly market (farmers market) were created in order to expand the market offer.
- bouncy games were painted on the footpath on the south side of the square.
- the public lighting was renewed.
- bollards with electrical connections were placed in the area of the weekly market and on the square.

HISTORY, JUSTIFICATION

The aim was to upgrade a neighbourhood centre by making it climate-friendly as a public space and significantly improving the quality of stay. The existing market was to be strengthened for local supply and as a meeting place.

IMPLEMENTATION

The preparations began in 2017 and 2018 with the surveys by the district and municipal area management and with the coordination of the responsible municipal departments and the Vienna Transport Authority. The property management in the planning area alone falls under the responsibility of three different municipal departments. This was solved in such a way that the Wiener Stadtgärten (Vienna city gardens) took the lead of the project in the planning and construction phase. Further departments were involved with regard to urban design and infrastructures.

The market vendors, whose operations were severely affected during the construction phase, were involved in planning and preparation by the district and municipal services.
The total cost of the project is 1.8 million euros. The district received EU funding of 900,000 euros. The rest is shared by the district and the city.

INNOVATIVE CHARACTER

The sponge city principle in urban forestry was implemented here for the first time in the city of Vienna and for the first time in Austria in such a way that not only rain water from street and square surfaces, but also from the surrounding roofs and also the run-off water from a splash pad are integrated. The integration of the splash pad is groundbreaking because, for hygienic reasons, drinking water is used in the splash pad. The water that runs off is thus no longer discharged into the canal, but is used to water the trees. Also, the times of greatest water demand in the water feature and the greatest water demand of the trees coincide in summer heat periods. The water feature, which is operated with mains water pressure, was developed in such a way that a combination of fountains and ground-borne mist nozzles allows significant adjustments to the water flow rate via the control system.

SWOT ANALYSIS

The acceptance by the users and the population is high. The square is very popular and much better visited than before.

The sponge city principle for urban trees works without any problems. There are no known complaints or critical comments from the population or the services in charge.
The control system for the water feature on the square was reprogrammed in spring 2021. Measurements in autumn 2020 had shown that the drinking water flow rate through the splash pad at full operation was approx. 14 m^3 per day. This amount of water cannot be reliably disposed of by evaporation from 6 trees and by infiltration. Therefore, the programming was adjusted to a higher proportion of water mist and a lower proportion of water fountains, so that the drinking water throughput is now approx. 6 m^3 per day. This amount of water can be handled by the sponge city principle for urban trees.

The main risks do not lie in the realised project itself. It functions without any problems. The main risks lie in an improper application of the sponge city principle for urban trees in further projects. The method is spreading rapidly as a buzzword. The basic principles are simple and therefore it appears easy to apply. In fact, however, a fundamental understanding of plant physiological, soil and hydraulic processes is necessary to plan site-adapted and functional solutions. The greatest risk currently lies in the improper duplication and dissemination of the method without full understanding of the processes.

SOCIAL IMPACT

In the Kreuzgassenviertel, a very densely built-up part of the 18th district of Vienna in the 19th century, a previously inconspicuous and rather unattractive public space was renewed. A toilet facility and a collection of used materials behind the market houses located on the square had obstructed a lot of space here, the existing trees suffered from drought stress and there were no appropriate offers for using the square, whereby ideas and suggestions from neighbors from a participation process were incorporated. People wanted an open space with plenty of room to move around and things to do for children, events and a weekly market.
The area is now a space-park-market hybrid. It is partly dedicated as a market area, partly as a park recreation area significantly improving the quality of stay for vulnerable groups.

REPEATABILITY

The measure can be repeated or transferred, but needs a high quality planning, whereby ideas and suggestions from neighbors from a participation process should be incorporated.

CONCLUSIONS, RECOMMENDATIONS

The Sponge City Principle for Urban Trees is a well-functioning method to multifunctionally combine stormwater management, climate change adaptation, amenity qualities and appealing design through green infrastructure in streetscapes and urban areas.

The sponge city principle for urban trees is not a product. Therefore, no patents or trademark rights are secured.

It requires knowledge and skills in several disciplines and usually the cooperation of different departments of the administration. This can be challenging.

With a simple basic principle, there are many possible combinations of individual elements. Therefore, the development of guidelines for action and methods for quality assurance, as well as the ongoing exchange of experiences on levels of practical application and on an academic level are important. At present, it is difficult to obtain funding for this necessary further development.
Securing financial means for the ongoing development, documentation and quality assurance is a pressing concern.

ŠIJANA WATERSHED AND KING TOMISLAV SQUARE

DESCRIPTION

City of Pula

The Town of Pula is one of the largest coastal towns in Croatia which, besides having the lowest average amount of annual precipitation compared to other large towns, has the largest issues with precipitation water drainage. There are several reasons for this – starting with the complex town structure whose specifications have not been adequately respected in the creation of spatial and planning documents, the unplanned construction of urban facilities in natural conditions of occasionally flooded zones, and the life-long applications of old precipitation water drainage concepts. Simultaneously with the expansion of the town of Pula, which grew much faster than the development of its infrastructural systems for reception, drainage, and the disposal of its precipitation waters so too grew its drainage problem with regard to precipitation waters which could not be collected in the capacity-limited system of collection drainage constructed in the past. The new drainage concept of the analyzed area of Pula, in accordance with modern world trends, has radically changed its existing approach – precipitation waters tend to be kept and, in as large quantities as possible, treated in the place they appear in the watershed.

Stormwater infrastructure

City or municipality
Pula

Location
Šijana Watershed and King Tomislav Square

Project owner
City of Pula, Hrvatske vode - legal entity for water management
Hrvatske ceste - Management, construction and maintenance of state roads

Time of implementation
2015

More informations
Article in the local newspaper
Article in the local newspaper

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DESCRIPTION

Above all, we have tended to minimize the quantity of precipitation waters by holding them at green areas (free water level in the field and/or underground retention) and after purification further infiltrating the terrain. We achieved this by applying the wsud (water sensitive urban design) principle of stormwater drainage.

ŠIJANA WATERSHED

The Šijana watershed is one of the largest watersheds in the city of Pula and is located at the northern entrance to the city and is intersected by the main direction of the Istrian highway.
In the watershed area there is mostly an industrial zone, the main roundabout with side collection streets at the entrance to the city and a forest park.
Due to the configuration of the terrain and purpose, during heavy rains, the whole area has been flooding and the newly built rotor of 15000 m2 (central part) further increased the runoff from the upper part of the watershed to the lower part.
An additional burden is the inflow of large amounts of rainwater into the city itself, to the sea, and from the pipe system of the Istrian highway. With this project, the WSUD principle of drainage was applied, integrally with the landscape solution of the area, applying the following systems:
Wet lagoons, lagoons with extended retention, rain gardens and infiltration ditches. In wet lagoons and lagoons with extended retention, water is discharged from the pipeline drainage system of the motorway, retained and, after the peak flow passed, discharged into the existing mixed drainage system. From the surfaces of the rotor and collecting streets, water is discharged directly through the openings in the curbs into rain gardens, infiltration trenches along roads and other green areas, which have been partially converted into park areas.
Within the roundabout itself, three lagoons have been built that retain water for as long as necessary (in this case min.24 hours) to reduce the load on the existing mixed drainage system and to reduce pollution.

KING TOMISLAV SQUARE

King Tomislav Square was an unarranged parking lot that was flooded during heavy rains. Together with the architects, the arrangement of the square was designed, and the proposed solution won the public architectural and urban tender. The square is designed so that in one part it is possible to gather more people and the other part as a promenade. All stormwater drainage is planned through rain gardens, and larger amounts of stormwater (PP 100 g.) and more, are partially retained at the lowest point of the square, the children's playground. After surface retention, rainwater is stored in underground retention and is gradually discharged partly into the underground and partly into the mixed sewer.

HISTORY, JUSTIFICATION

Such systems of accommodation of elements that relieve the drainage system resulted in a sustainable system that greatly helped the problem of drainage of rainwater in the city of Pula.By creating complete systems of green and open spaces, urban landscapes become the identity of the city and thus reduce the negative consequences of climate change. This is manifested in the reduction of air temperature during the summer months, in the establishment of green communication and recreational routes, which in turn solve not only these but also many other roles of the landscape in the city. By creating a system of green and other open areas of the city, ecological connections are realized in the area for which it is necessary to develop complete connections from the hinterland to the sea in order for the system itself to be sustainable.

By planting plants that, in addition to water purification, also play an important role in evapotranspiration, the area has been further enriched. A young tree can absorb approximately 200 liters of water per day. If we take into account only the trees planted by the project, it can be calculated that the overall reduction in the amount of water from planting trees is 7400 l / day (37 trees X 200 l water/day = 7,400 l / day). At the same time, they reduce CO2 because one young tree assimilates 20 kg of CO2 per year. Consequently, it is estimated that 37 planted trees in the green area in question can assimilate approximately 740 kg of CO2 per year.King Tomislav Square: 40 planted trees = 20x40 = 800 kg of CO2 per year.

IMPLEMENTATION

ŠIJANA WATERSHED

Implementation
2015

Project owner
City of Pula
Hrvatske vode - Legal entity for water management
Hrvatske ceste - Management, construction and maintenance of state roads
Partners: Starum d.o.o. Pula, Cesta Pula d.o.o.

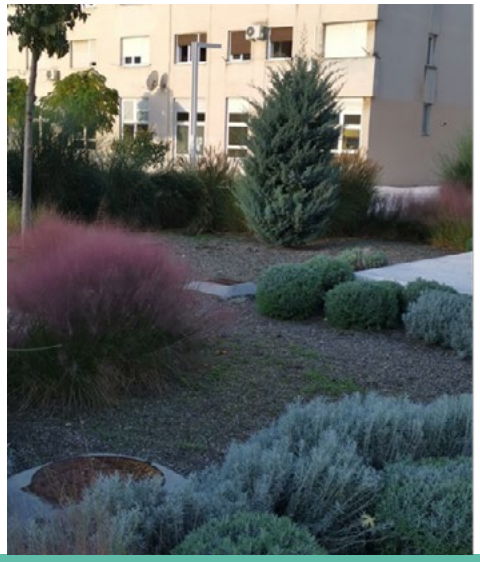
The project was implemented through a public tender. The biggest problems were the lack of regulation, ignorance of climate change, ignorance that a completely different innovative approach can solve flooding. In addition to not believing in the flooding solution of the area, additional mistrust was caused by the extremely cheap and easy to implement the solution, using existing unused surfaces and existing materials. Also, the contractors could easily perform all the works, without any special additional training.

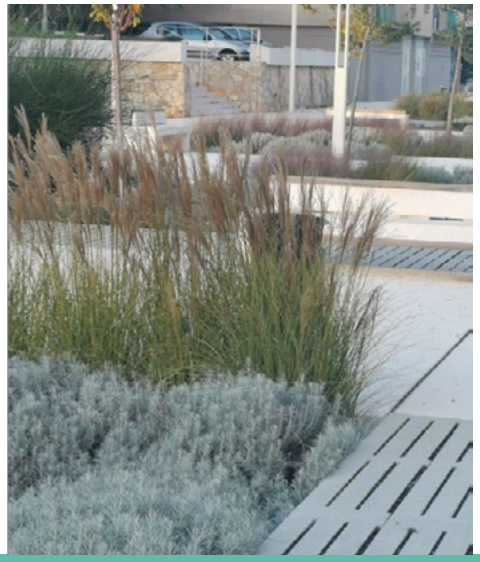
KING TOMISLAV SQUARE

Implementation
2014

Project owner
City of Pula

Partners: Starum d.o.o. Pula, BIF Studio d.o.o. Zagreb
The project was implemented through a public tender. The biggest problems were the lack of regulations, ignorance of climate change, ignorance that a completely different approach can solve floods. The biggest challenge was the collaboration of architects and engineers and parallel work until solutions were obtained that were both functionally and aesthetically acceptable.
Additional problems were the dilapidation of the existing infrastructure and the synthesis of all installations in a way to enable stormwater drainage with an innovative approach and to protect and relieve the existing main mixed city sewer that serves as a recipient and drains all mixed water to the pumping station.





INNOVATIVE CHARACTER

The city of Pula was the first in the state to create a conceptual concept of drainage according to wsud principles, and the city council made a decision on implementation in the entire area of the city in 2011. This was preceded by the construction of Nazorova Street as a pilot project in 2009. The following wsud elements were used:

Vegetated swales
Vegetated swales can be used instead of pipes to transport runoff water and provide a 'buffer' between the area receiving water and areas allocated for infiltration. The vegetation in the swale also serves as the first treatment step to encourage settling of pollutants and uptake of nutrients by plants. In addition, swales can also have amenity value and provide habitats for wildlife.

Infiltration Trenches
Infiltration trenches are shallow excavated trenches filled with gravel or crushed stone that are designed to filtrate storm water through permeable soils into the groundwater aquifer. This is often used to treat runoff water from impervious surfaces, such as sidewalks and parking lots, on sites where there is limited space available for managing stormwater.

Retention and Detention Basin
Retention basins are pond-like features with vegetation around their perimeters. They have a permanent pool of water and the water level is allowed to vary as a result of rain events. Water is released slowly from the retention basin into another body of water on the surface or partially infiltrates into groundwater. Contrary to retention basins, detention basins are not permanently wet, they are sometimes called "dry ponds''. Both detention and retention ponds delay runoff and contribute to the treatment of stormwater through different passive treatment processes such as filtration, sedimentation, absorption and biological processes.

Raingardens
In raingardens, stormwater runoff is filtered through a vegetated sand media layer. It is then collected through perforated pipes so it can flow to downstream waterways or into other features such as retention or detention ponds. The vegetation that grows in the filter media enhances its function by:
Preventing erosion of the filter medium;
Taking up nutrients and water;
Continuously breaking up the media through root growth to prevent clogging of the system;
Providing biofilms on plant roots into which pollutants can adsorb.

Constructed Wetlands - Lagoons
Constructed wetlands are man-made vegetated structures that are partially saturated with water, either permanently or temporarily. They mimic the treatment processes that are taking place in natural wetlands. Constructed wetlands can be similar to a pond, where water flows horizontally over the soil, or comparable to a raingarden. In the latter, the water will infiltrate into a coarse medium, such as sand, that is planted with macrophytes. These can be reeds (e.g. Phragmites australis or Typha latifolia) or ornamentals (e.g. Canna andHeliconia) that are sometimes used depending on local conditions. The water is treated through physical (sedimentation, filtration), biological (microbial activity and uptake by plants) and chemical (adsorption, UV degradation) processes. The roots of the macrophytes ensure that the filter medium will not get clogged. Wetlands can also provide habitat for wildlife and a focus for recreation, such as walking paths and resting areas.

SWOT ANALYSIS

STRENGTHS
Protects properties from water and flood damage
Provides an ecological solutions
Rainwater harvesting

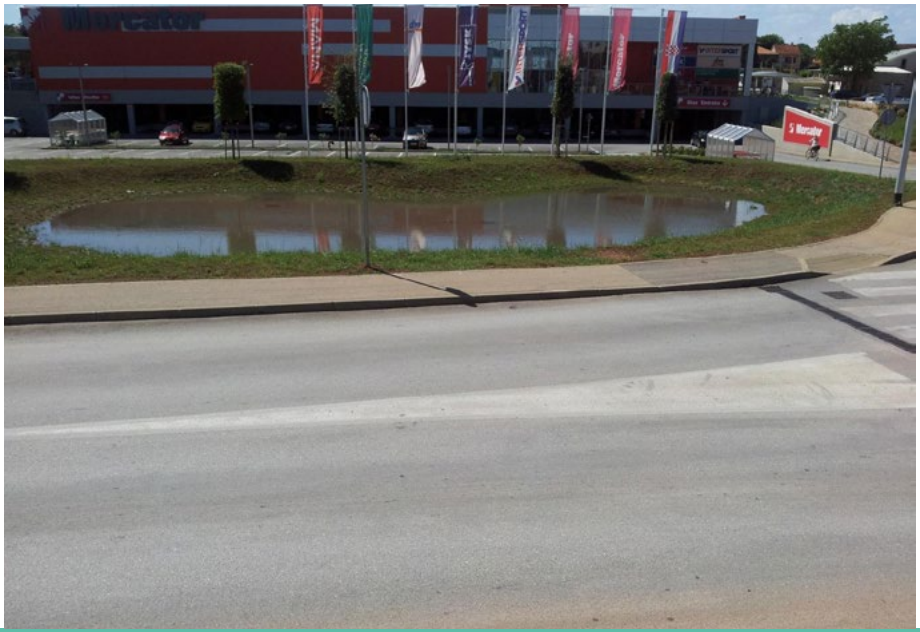
WEAKNESS
Lack of regulation
The linkage between concept and construction is often not well established
Some stakeholders are also yet to be convinced of the extent of effectiveness of WSUD methods in practice.

OPPORTUNITIES
Urban space planning as an interactive, ecological infrastructure publicly visible, technically simple and beautiful - is the basis of the future approach.

THREATS
Lack of knowledge and lack of knowledge transfer
Institutional fragmentation as well as gaps in knowledge and awareness
A need for significant research to recognising core barriers and drivers
Additional research and education for public and institutions, government

SOCIAL IMPACT

Changing mindsets, where we see cities not only through roads, buildings, asphalt, concrete, sewage and other infrastructure but for growing climate change challenges we also use water and greenery to address floods, temperature islands, pollution, social and economic challenges as well as sustainability of the cities themselves.
Solutions should combine function, aesthetics and usability.



REPEATABILITY

The project was repeated in the cities of Rovinj, the Municipality of Stupnik, the city of Vodice, the shipyard Viktor Lenac and is currently planned to be implemented through the Stream project in the cities of Poreč, Gospić, Zadar, Biograd na Moru, Split and Metković.
The municipality of Stupnik is located next to Zagreb, and it can be said that it is an industrial zone of the city of Zagreb. Due to the existing infrastructure, it was not possible to build a classic storm sewer and rainwater drainage was solved by applying wsud standards in all places along the existing roads. The project covers approximately 10 km of roads, and drainage is solved by rain gardens and infiltration ditches along the roads. The preliminary cost estimate showed that even with the purchase of additional land, the new system requires less expenditure, and when a positive impact on the environment and society is added to it, the effect is much more cost-effective.
A brochure has been prepared for the locals to educate them on how to easily build a rain garden for rainwater in their own backyards. Municipality of Stupnik distributes seedlings of trees and shrubs to everyone, thus enabling better connection between local authorities and locals, and common care for the environment. Maintaining the gardens will enable additional socializing and exchange of knowledge and experience between locals. The biggest problem of implementation was not the locals but the Croatian Waters and the lack of knowledge and regulations.

CONCLUSIONS, RECOMMENDATIONS

Stakeholders can attempt to mainstream WSUD strategies through opportunities provided by knowledge-based urban development and through knowledge transfer. Core components of these include the identification and recognition of pressures and problems, stakeholder engagement, evaluation of decisions and strategies, all elements which come under the overarching umbrella of knowledge transfer. Linking urban stormwater management to a learning process is not a method that has been greatly emphasized, but its inclusion will only produce a more sustainable outcome for urban stormwater.
Improving stormwater quality not only benefits the water bodies it discharges to, but also creates an opportunity whereby stormwater can be used to augment potable water supplies. There are already significant drivers in replacing traditional stormwater management with innovative, sustainable measures such as WSUD, and the current situation is ripe for change agents to conduct further research in the area, revolutionize traditional methods, and build a new paradigm in urban stormwater management.
Solutions should be planned in multi-disciplinary cooperation of urban planning, urban design, landscape architecture and water management.

GRÜN STATT GRAU
GREEN INSTEAD OF GRAY

DESCRIPTION

Cities continue to heat up, but extensive green roofs can be a truly effective solution: The green areas are cooler and air-conditioned much better than a non-green roof, which heats up quickly and stores the heat for a long time. The infrastructure damages related to heavy rainfall can be reduced and the biodiversity in the urban area increases. Because of green roofs the city becomes greener, healthier and more attractive.

Under this perspective, the city of Osnabrück has made available to its inhabitants an interactive green roof cadastre to find out whether their own roof area is suitable for greening and what positive effect it could have on the urban climate.

Green space management and water management

City or municipality
Osnabrück

Location
All city of Osnabrück

Time of implementation
The measure was created in 2019 and since then it is still promoted and implemented.

More information
Website Municipality of Osnabrück
Green roof cadastre
Guidlines for the application

Contact person
Cornelia Saure

Organization
Environmental Planning Service, City of Osnabrück | Department of Environment and Climate Protection

HISTORY/JUSTIFICATION

The city of Osnabrück has set the goal of a sustainable and future-proof urban development. The project Grün statt Grau (Green instead of Grey) is one of the measures identified in the climate adaptation concept of 2017.
This plan, in combination with the city climate assessment, which was updated at the same time, showed that climate change was already detectable in Osnabrück. Like many other German cities, Osnabrück is experiencing a rise in temperatures (in the last 60 years, the average temperature has already risen by 1.6°), which leads to very hot summers, especially in the city centre. The construction of new buildings and the high level of concretisation of the urban area have also led to a collapse of the sewerage system and subsequent flooding.

Green roofs have emerged as key measure to mitigate and reduce these problems and at the same time to improve the urban microclimate, create space for insects and support biodiversity.
The city had therefore initiated a feasibility study to find out how many and which buildings, both existing and under construction, could be converted (green roof, green facade, soil unsealing) and what could have been the positive effects coming from this conversion. As a result of these studies, in 2019 the founding programme Grün statt Grau was developed.

The aim of the project is to support private, entrepreneurial, and institutional land and building owners in Osnabrück in carrying out greening measures on their own buildings and properties. In this way the city wants to counteract the rising temperatures, the low capacity for absorption and reuse of rainwater, while at the same time increasing the amount of green.

IMPLEMENTATION

With the help of a green roof cadastre, a funding program and the definition of ecological criteria in the land-use planning, the city of Osnabrück counteracts the consequences of climate change.
Thanks to the use of an interactive green roof cadastre the citizens can find out whether their own roof area is suitable for greening, if they meet the funding requirements and what positive effect it could have on the urban climate. Anyone who then wants to contribute to a climate-adapted city will receive financial support through the city's Grün statt Grau funding programme.
Private owners and institutions are reimbursed up to 60%, companies depending on their size and, in accordance with the European Commission's block exemption regulation, up to 40% (large companies), 50% (medium-sized companies) and 60% (small companies) of the eligible costs. Measures in the city center are viewed as particularly worthy of funding and receive a surcharge of up to 10%.

Funding comes from the core budget of the Department of Environment of the Municipality.

Other departments were also involved in the project's development, such as the legal office, audit office, Osnabrück Servicebetrieb.

Citizens were informed mainly through the press, but architects, garden and landscaping companies have also contributed by informing their clients about the programme. In addition, the word of mouth played an important role in the dissemination of the project: the evaluation forms created by the municipality and filled by the project participants revealed that many of the persons became aware of the programme through neighbours. Several dialogues were organized with municipalities that already had implemented a similar programme and have tried to process the experiences, in order to exchange information and to avoid the same „mistakes" or improve some aspects.

DIFFICULTIES AND CHALLENGES

So far many private persons have participated in the programme, even if only to greening a part of their house (e.g. garage). At the same time, it is still difficult to reach commercial activities.
These buildings often occupy a larger area than a private house and for this reason their conversion could bring more results in terms of climate adaptation. However, the long term visible effects of this project deter many investors or large businesses from participating in the programme, as they are more focused on immediate results or linked to non-local policies.
Anyway, a number of family-run businesses, which are much more connected to the territory, have instead decided to convert their buildings and implement a green roof. Direct meetings with entrepreneurs and land owners have been planned in order to show the concrete results the project can bring and motivate them to participate in it.

INNOVATIVE CHARACTER

When talking about innovation, the Osnabrück cadastre webpage cannot go unmentioned. Through the interactive website, citizens can check with just a few clicks whether and to what extent they can convert their building into a green roof or facade.
The green roof is not a new measure but still not so developed. In this case, the introduction of an interactive green roof cadastre and an intuitive online application form made the difference, as they provide an easy access to the information and the possibility to fill the application quickly and easily via online questionnaire. The idea of designing a non-bureaucratic registration process can therefore also be considered as an innovative feature of this project. The feedback collected from the municipality through the already mentioned evaluation forms have shown that also because of this accessibility, the programme was, and continues to be very popular and attractive.

SWOT ANALYSIS

STRENGTHS
- The green areas are cooler and much better air-conditioned than a non-green roof, which heats up quickly and stores the heat for a long time.
- Insulation property: green roofs protect against the cold in winter and serve as a heat shield in summer.
- Funding programme.
- Citizens can easily get access to the information.
- A very simple application procedure (online)
- Requalification of already existing buildings.
- Absorption of rainwater and reduction of flooding risks.
- Reduction of the heat island effect, especially in summer in highly dense areas, when it can be up to 10 degrees warmer in cities than in the surrounding countryside due to the higher proportion of densely built-up areas.
- The city becomes greener, healthier and more attractive.
- Aesthetic improvement of the house and significantly extended roof life.

WEAKNESSES
- The structure of commercial properties is often not suitable for the conversion into a green roof or there is not enough economic availability.
- In some of the areas most affected by the negative effects of climate change, there has been little adherence to the programme (city center).
- It is not possible to convert every house, the building must have specific conditions.
- Positive effects visible just in the long term.

OPPORTUNITIES
- The measure is easily repeatable and accessible for citizens and therefore reproducible over time and also in other contexts.
- Thanks to incentives more citizens can afford to convert their roofs
- Acknowledgement of the fact that green roofs are hardly economical without funding or have a very long payback period.
- Extra funds (coming from regional and European level) to revitalise the inner city with a focus on climate and biotope could be an additional economic support for entrepreneurs that decide to participate in the project.
- It saves heating costs and possibly costs for air conditioning.

THREATS
- It is difficult to plan how long it will be possible to finance the project (municipal budget is unstable).
- It is difficult to include commercial facilities in the project.
- Possible future disinterest of citizens in the programme.

SOCIAL IMPACT

The social impacts are clear and visible: thanks to the conversion from a non-green roof to a green roof, people of Osnabrück are going to have better houses (aesthetically and also in terms of energy efficiency) and in general they can benefit from a better air quality in the whole city. Green spaces are increased and biodiversity is preserved even in an urban context, which implicitly creates a more liveable area for humans too.

Finally, the financial help coming from the founding programme makes the measure more accessible and allows more people to be part of the project.

REPEATABILITY

From 2020 the city of Münster has also adopted a green roof cadastre. The reasons that brought to the development of this plan and the lines of action are practically the same.
By using different colours for the roof surfaces, the green roof cadastre not only shows how suitable the building is for a green roof or green facade, but it also gives a detailed estimation about the amount of waste water saved, the CO2 absorption and the fine dust kept per year.
Through a document describing the possible plants that can be used on each roof and their results in terms of climate improvement and absorption, citizens can find out which type of roofing is best suited to their home and can at the best meet their needs.
How is the potential of roof areas as green roofs calculated? Through a three-dimensional surface model (DOM) the buildings are filtered out and divided into the various roof sides. The suitability of a roof surface for use as a green roof depends primarily on the factors of slope and statics. Since a static assessment is not possible within the framework of the calculations for the green roof register, only the slope factor has a limiting effect on suitability.
Also in Münster the municipality supports the citizens who want to join this programme by paying a part of the green roof conversion.

CONCLUSIONS, RECOMMENDATIONS

Green roofs improve air quality and the urban climate, are habitats for animals and plants and thus contribute to species protection and the preservation of biodiversity, they absorb rainwater and thus reduce flooding, they contribute to groundwater recharge and soil protection.
Furthermore, as a design element, it not only increases the attractiveness of the cityscape as a hole, but also the attractiveness of individual spaces and areas - green instead of grey. In short, urban greenery, and specifically green roofs, is not only beautiful to look at, it makes a city more resilient to climate change and extreme weather events and contributes significantly to providing a healthy habitat for humans and animals.

LEIPZIGER BLAUGRÜN

DESCRIPTION

By the year 2030, the population of Leipzig could grow from 600,000 to over 650,000. Based on these expectations, the administration has already started planning how to create sufficient space to welcome the future citizens. At the same time to cope with negative effects of the urban densification and mitigate the effects of climate change, the new district that is going to be built, must follow sustainable principles.

From these two needs the new district "Leipzig 416" was born. Over the next few years, the inner-city part between Eutritzscher Straße, Roscherstraße and the S-Bahn train line (an area the size of about 40 football fields) is going to change its aspect.

The project Leipziger Blaugrün, created in 2019 to support the technical development of Leipzig 416, consists in the requalification of this dismissed area by creating a new sustainable district. Through a multifunctional implementation of blue-green infrastructures, it aims to improve the urban climate by ensuring a greater absorption of CO2 and better water and energy management.

Green space management and water management

City or municipality
Leipzig

Location
Leipzig 416, Eutritzsch, 04129 Leipzig

Project owner
Helmholtz Centre for Environmental, Research GmbH - UFZ, City of Leipzig, Kommunale Wasserwerke Leipzig GmbH, Stadtwerke Leipzig GmbH, Hochschule für Technik Wirtschaft und Kultur Leipzig-IWS, University of Leipzig-IIRM, Fraunhofer-IGB, DHI WASY GmbH, Tilia GmbH, Optigrün International AG, Leipzig 416 Management GmbH, Umweltbundesamt

Time of implementation
Following the preparatory planning phase from 2017, the implementation will start with the renovation of old buildings in 2022 and the formerly aspired deadline of September 2022 is extended until 2024.

More information
Official website
Website Leipzig 416
Projekt LeipzigerBlauGrün (2021)

Contact person
Mr. Ueberham

Organization
UFZ Helmholtz Zentrum für Umweltforschung

HISTORY, JUSTIFICATION

As previously mentioned Leipzig is a growing metropolis, which has to manage several new difficulties connected with climate change and urban development. This is the starting point for the project Leipziger BlauGrün, which goal is to build the Leipzig 416 neighbourhood as a resource-efficient city district.
Thanks to a multifunctional use of different technologies, the new district will be able to cope with the challenges of climate change, as severe rains and droughts are increasingly influencing the quality of life in the city.
In this context, the project Leipziger BlauGrün tries to find a valid solution by designing a natural cycle through the combination of different blue-green infrastructures.
The goals are:

- a significant relief of the central sewage system: the city's canals are working at full capacity and when heavy rain falls, they are overloaded. A canals extension is not possible, because of this, the project's aim is to drain away the rainwater from new residential areas and reduce the runoff to zero;
- an improvement in energy efficiency and the microclimate: by combining different infrastructures as green roofs, retention areas, green areas there is a direct impact on the urban climate and on the energy management of the district;
- a resilient heavy-rainfall management: thanks to the principle of sponge city, the water can be stored for later use during drought times.

Finally, yet importantly, thanks to the application of these technologies the city wants to guarantee a higher quality of life for the future population of Leipzig 416.

IMPLEMENTATION

From 2019, the Leipziger BlauGrün research team was established to support the technical aspects of Leipzig 416 construction. The Helmholtz Centre for Environmental Research GmbH (UFZ), in cooperation with the City of Leipzig, the investors, business enterprises and other scientific institutions, is developing a concept for climate-adapted water and energy management using Leipzig 416 as a concrete starting point.

But, what exactly are blue-green infrastructures?
A Blue-Green Infrastructure (BGI) combines hydrological functions with urban nature, landscaping and urban planning. The blue (water) and the green (nature, squares, and parks) serve to protect against floods and other effects of climate change. To cope with heavy rain and floods, many cities rely on large rainwater drains, flood protection walls or pumping stations. BGI complements this grey infrastructure or in some cases can even replace it. Through targeted infiltration and storage, rainwater can be kept ready for irrigation in the dry summer months. In addition, the associated evaporation effects can also help to improve the microclimate of the new city quarter.
At the moment, different blue-green infrastructures are being studied on a pilot basis at the UFZ.
These include:

- a green roof on an office building with 3+1 variants (intensive green roof, extensive green roof, wetland roof and reference gravel roof).
- a carport green roof with retention volume (water storage) and heat exchanger concept.
- three variants of tree trenches in Kasseler Straße in Leipzig

Quantitative water and energy balances of the infrastructures are investigated (water retention potentials, energy utilization and evaporation potentials). In parallel the relationship between blue-green infrastructures and climate effects, biodiversity, plant ecology and soil chemicals is constantly analyzed.
In a second moment the different BGI are going to be combined to create a multifunctional synergy to optimize the management of water and greenery in the district and improve the lives of the inhabitants.
The research phase deadline was postponed (also because of the pandemic) from 2022 until 2024. This prorogation is going to be essential for the research team to monitor in a deeper way the pilot actions. The use of multifunctional blue-green technologies is new for the city and only an accurate first analysis is going to bring a successful practical implementation.
The project is funded with € 2.8 million within the framework of the Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research) funding guideline „Resource Efficient Urban Neighbourhoods”.

DIFFICULTIES/CHALLENGES

Leipziger BlauGrün is a very ambitious and innovative project: its complexity, which will guarantee all-round results in terms of district's redevelopment, is certainly the hallmark of this plan, but at the same time it presents itself as the great challenge that the various actors involved must be able to grasp and overcome. Surely, the several Blue-Green technologies that are going to be implemented in the district already exist and have been applied for a long time, but always in a separate form. The real challenge of this project is to create a neighbourhood in which these technologies coexist and complement each other: multifunctionality (the combination of different technologies to create a natural cycle in the district, where water and energy are reused and not sealed or wasted) is the element that characterizes this plan, and for sure the most difficult to realize.

The combination of different technologies is something new for the city and it requires a great deal of cooperation between different actors, each specialized in a particular field. This co-design process is often time-consuming, but undoubtedly, it is worthwhile to develop a clear and targeted strategy, which takes into account the many areas of action.

INNOVATIVE CHARACTER

Models of Blue- Green -Infrastructure are already widely used in many cities. However, the novelty that the city of Leipzig proposes is the combination of different infrastructures that aims not only to improve water management and increase green areas within the urban context, but also to reduce energy costs in the new district Leipzig 416.

What they are concretely going to do:

- Creation of central sewer networks with decentralized solutions: more frequent heavy rain events bring an overload of sewers, at the same time high load of pollutants, especially from the busiest surfaces, spills bodies into water (e.g. micro-plastics, heavy metals...). Decentralized wastewater systems convey, treat, dispose and reuse wastewater, while at the same time they improve the protection of groundwater from pollutants and germs and minimize freshwater consumption.
- Implementation of green roofs: they create a more pleasant temperature in the district, store water for irrigation for the summer, promote the biodiversity by creating biotopes, provide domestic water, re-use the stored water, and if they are combined with heat exchangers, they cool the rooms within the building (different kind of plants on the roof give different results in term of cooling/expenses).
- Creation of tree trenches: to absorb the water from the streets, which is going to be collected in a tub under the root, stored and used for dry periods.
- Creation of green areas and planting trees: they filter pollutants and dust from the air, provide shade and cool their immediate surroundings when water evaporates from their leaves. In addition, green areas increase biodiversity and create recreational and leisure spaces for citizens.

The involvement of the community can also be considered an innovative aspect.
Already in the early stages, the citizens were involved in the development of the project. Through the citizens and neighbourhood forums, randomly selected citizens and representatives of clubs and associations discussed and evaluated the designs of the planning teams. The citizens contributed with numerous suggestions and questions. During several workshops, the drafts were analysed and evaluated by the forum and an expert jury. After these exchange moments the ideas were further deepened and refined, and in some cases significantly changed.

SWOT ANALYSIS

STRENGTHS

- The sustainable nature of the project: the work is only done once, but the results will be seen every year, especially in the warmer season.
- The multifunctionality nature of the project (also a threat): this creates a natural cycle in the neighbourhood, where water and energy are going to be reused.
- The project involves many actors (also a weakness), which guarantees a global vision and the collaboration of teams of experts in different fields.
- Revitalisation of a dismissed area.

WEAKNESSES

- The project involves many actors (also a strength), so the decision-making phase is often slow.
- This is the first time the city has undertaken such a project: there is no real prior experience/"guidelines" on how to implement the project in the most effective way.

OPPORTUNITIES

- Possibility to mitigate climate change effects in an urban context.
- Higher quality of life for the future citizens of Leipzig 416 and indirectly also for the whole city.
- Be pioneers in combining different already existing technologies, in order to have better water and energy management.
- More space and infrastructures for the citizens of Leipzig through the creation of a multifunctional district.
- Increasing biodiversity in the urban context.

THREATS

- The positive effects of the project are not immediately visible and palpable: this makes it more difficult to evaluate the short-term project's effectiveness and to convey to future citizens the potential of these measures.
- The multifunctionality nature of the project (also a strength): for the first time blue-green technologies are going to be combined instead of being developed in a separate way.

SOCIAL IMPACT

The social impacts of this project are numerous. The design of blue-green infrastructures will lead to a regulation of the climate within the district, ensuring less scorching summers and also indirectly improving the climate of Leipzig in general. The application of these technologies will lead to lower energy costs due to the reuse of some resources and thus to direct economical savings for future citizens.
One part of the building will probably have higher-priced rents, but the city also wants to destinate a 30% for social housing, allowing different social classes to inhabit the neighbourhood.
Heat in “concrete cities” with little urban greenery leads to heat islands and that has health consequences. The creation of a multifunctional district, in which residential and commercial areas alternate with recreational and green areas, improves the health of the citizens, the quality of public space, the biodiversity and thus the general quality of life of its inhabitants.

REPEATABILITY

BlueGreenStreets „Multifunctional street space design of urban quarters” - Hamburg
In 2019 another similar research project started in Hamburg. The project BlueGreenStreets also investigates the combination of blue-green infrastructure, but in this case instead of an all district, the focus is more on the “street area”.
Heat and drought on the one hand and flooding caused by heavy rains on the other hand, are extreme conditions that cities and their flora will have to cope with in the future. Tree pits are structural elements that store rainwater in the street and can serve as a water reservoir for street trees in dry periods. This can strengthen the vitality of the trees and reduce inner-city heat due to the increased evaporation activity. To test the combination of street trees and rainwater management, the first so-called tree trenches with measuring technology for monitoring were built in spring 2020 in the Hölertwiete in Hamburg. Others are being built in various partner municipalities.
With the construction of the tree pits, a new technical concept was implemented to increase the water storage volume of tree pits and at the same time improve the availability of water for trees. Ongoing monitoring of the maintenance effort as well as the soil water balance and plant development should in future provide insights into the functionality of the plant pits with regard to rainwater infiltration and tree vitality. In addition, to turn the street spaces into “multitalented” inside the city quarters, the possible integration of urban green spaces, water areas and socio-economic, traffic-related, urban ecological factors is going to be investigated.

CONCLUSIONS, RECOMMENDATIONS

Heat and heavy rain are two issues that many other cities have now to live with. The effects of climate change are becoming more and more palpable and the infrastructure of our cities needs to be adapted to these new scenarios, not only to mitigate their effects, but also to counteract their possible growth.
For any new neighbourhood to be built, it is necessary taking into account the important goal of sustainable urban development. Thus the Leipzig approach to apply climate adaptation measures in urban planning can be a lighthouse example for any city committed to developing new districts.

TINY FOREST

DESCRIPTION

More biodiversity, better air quality and contribution to climate protection: this is what a tiny forest can make possible. The first tiny forest in Germany was created in 2020 in Brandenburg. The idea came from two students of the Eberswalde University for Sustainable Development (HNE), Stefan Scharfe and Lukas Steingässer, who wanted to do something concrete to counteract the extinction of species and the effects of climate change.

What is it all about? A Tiny Forest is created by planting a dense mixture of site-appropriate tree and plant species. Such a micro jungle provides a whole range of ecosystem services that have a positive impact on its ecological and social environment in many ways. This method can represent a new, integrative contribution to design a sustainable environment that can be easily implemented in urban spaces.

The Forest of Diversity, this is the name of this project, will serve as an observation area and provide long-term scientific data on air and water balance, soil quality and biodiversity. The vision of the two students is to plant many more tiny forests in the future and inspire as many people as possible to take a hand in shaping a sustainable future.

Green space management

City or municipality
Uckermark (Brandenburg)

Location
An area of 800 square meters in Zichow (Uckermark, Brandenburg)

Project owner
University for Sustainable Development (HNE)

Time of implementation
The measure was created in March 2020.

More information
Interview in Brandeburg.im Wald
Article in UmweltDialog
Article in ESKP (Knowledge Platform Earth and Environment)

Contact person
Stefan Scharfe, Lukas Steingässer

Organization
University for Sustainable Development (HNE)

IMPLEMENTATION

In March 2020, 33 native tree and shrub species were planted in the area of 800 m2 in Zichow in order to form a forest. The tiny forest „Forest of Diversity" is a diverse mixed forest with around 2,500 plants (of these, 99% survived the hot summer).

Two things are crucial to create a Tiny Forest:

- the size: from 200 to 2000 m2
- the analysis of the site and the existing soil

For this project some soil samples were analysed in the landscape ecology laboratory of the university to determine how the soil could be improved and which tree associations would find optimal growing conditions.
Depending on soil type, grain size distribution, pH value and humus content, different local substrates are used to optimise the used soil. For the Forest of Diversity, straw, wood chips and compost were mixed with the existing soil in precisely calculated proportions to a depth of one metre. In this way, the perfect conditions to improve rootability, water holding capacity as well as nutrient availability were created.

During the research, 33 different species were identified as eligible for the specific site. The 2.500 plants were planted with a density of about 3 plants per square metre (this density is based on the natural dynamics of natural regeneration).
Projects in Asia and also in the Netherlands have already shown that such a forest grows up to 10 times faster than a conventional forest. Once the forest is planted and fenced, it needs to be watered occasionally for a maximum of three years before a self-sustaining, stable mini-ecosystem can be created.

The two students could use the private property of an acquaintance for starting their idea. The project was financed by crowdfunding done in Startnext from 23.12.19 and 18.02.20, where the minimum amount for the implementation was € 7,500. In the end, over 14,000 euros have been donated.

INNOVATIVE CHARACTER

The Forest of Diversity was the first tiny forest realized in Germany.
What distinguishes it from conventional forms of forest management? A Tiny Forest is left to its own devices and no biomass is taken from it in any way. Its value is exclusively ecological and social, but not economic. Through the various ecosystem services, it directly serves people and through community planting activities it contributes to education for sustainable development.
Tiny Forests are highly diverse micro-ecosystems that can be realised from an area size of approx. 150 m2 and consist exclusively of native tree and shrub species. As a result, Tiny Forests grow up to 10 times faster than conventionally planted forests. They are also almost 20 times denser and on average 18 times more diverse than other forest systems. Tiny Forests require hardly any maintenance and completely regulate themselves after two to three years.

SWOT ANALYSIS

STRENGTHS:
- Contribution to climate protection.
- They serve as temperature and noise buffers. They purify the air.
They provide a safe refuge for insects and birds (more biodiversity).
- They are a place of recreation for residents.
- They improve the water-holding capacity of the soil. They form small, powerful CO2 sinks in urban areas.

WEAKNESSES:
- Effects are not immediate: positive effects are only achieved after several years, when the forest has grown.

OPPORTUNITIES:
- Easy to reproduce.
- Countless potential locations as it can be implemented in a very small area.
- Community/schools/university can be directly involved in the realization and initial maintenance.

THREATS:
- Finding funds and space to create a tiny forest.

SOCIAL IMPACT

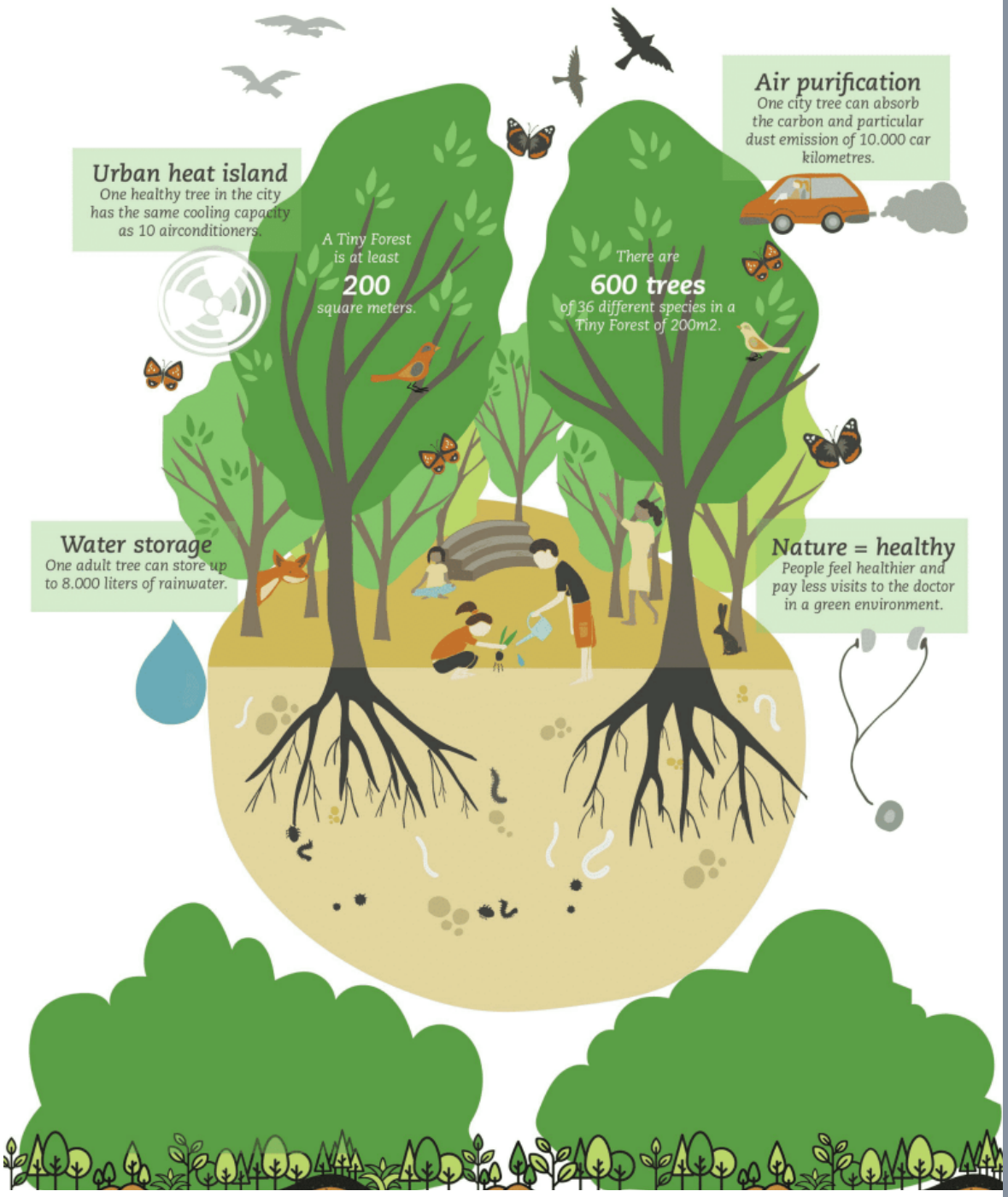
Tiny Forests also have a strong social component. The planting action usually takes place in collaboration with many people and can take place as a teambuilding or educational event. Through this process, participants are empowered to actively protect nature and take responsibility for the environment. The focus is on raising awareness for biodiversity and strengthening a sense of community. The maintenance and scientific monitoring in the following years can also be carried out by a school class, university or the local population.
Tiny Forests are meant to offer people an opportunity to get back in touch with nature, to experience a sense of being part of a community and to do something good for the environment. The Forest of Diversity was planted within one weekend with a total of 20 enthusiastic volunteers.
The numerous positive effects that the creation of a Tiny Forest brings in a residential area affect directly the people living there: tiny forests are a recreational place for residents, at the same time they improve the water-holding capacity of the soil and form small, powerful CO2 sinks that guarantee a purer air in the urban areas. A tiny forest contributes also to mitigating the raising of temperatures and therefore it ensures a better and more liveable environment for the citizens.

REPEATABILITY

This type of urban forest is based on a special methodology that goes back to the Japanese scientist Dr. Akira Miyawaki.
Stefan Scharfe and Lukas Steingässer, together with other two students set up an association to create other tiny forests. With the project UNITY DIGGING 2021 - TINY FORESTS, they are looking forward to implementing several donor-funded Tiny Forest projects in collaboration with students on public land.
Also other German cities decided to implement the concept of tiny forest: several mini-forests are planned in Darmstadt. A tiny forest is currently being created in the area of the bio-supermarket Alnatura and it is not going to be the only one.
The forest created on the Alnatura company premises in Darmstadt, although on a small scale, is exactly the same as the forests normally created by nature. This time, however, the people have a hand in the creation: they remove soil and fill the holes with organic materials and compost, they plant seeds of different species. The forest hosts 36 different plant species.

CONCLUSIONS, RECOMMENDATIONS

We are currently experiencing one of the greatest species extinctions in history. The causes are climatic changes and the loss of natural habitats through anthropogenic land use. Furthermore, modern people are becoming more and more alienated from nature and are thus also losing the effort to consistently protect and regenerate it. The concept of the „Tiny Forest" offers a holistic approach to contributing to the creation of a sustainable future.



BUDAPEST FATÁR - TREE CADASTRE IN BUDAPEST

DESCRIPTION

BP FATÁR is a database and freely downloadable public tree and park inventory application, which provides a map interface to help orientation, knowledge dissemination, and conscious park use in the Hungarian capital. The three main elements of the application are the Tree Inventory, the Park Inventory, and the inventory of Local Protected Areas of the City of Budapest.

The database is not yet complete and needs to be expanded. Currently, it contains 80,000 trees, 38 protected areas, while the park inventory lists 85,000 living and non-living objects (lawns, utilities, street furniture, playground elements, drinking fountains, etc.) located on the nearly 4.5 million square meters of green space in the capital's priority parks.

The application aims to present and aggregate the green infrastructure elements owned and managed by both the metropolitan and district municipalities.

The use of FATÁR can help to demonstrate the role of green infrastructure elements in improving the urban environment not only to professionals but also to a wide range of the population. When using the application, users can also make suggestions for a particular element, for example, to indicate if a tree is affected by disease and needs care.

Green space management

City or municipality
The Municipality of Budapest

Location
Budapest

Project owner
The Municipality of Budapest

Time of implementation
2019

More information
Webpage of the project owner
https://infogardenweb.hu/bpfatar/

Contact person
Sándor Bardóczi

Organization
Municipality of Budapest,
Chief Landscape Architect

HISTORY, JUSTIFICATION

It is estimated that 300,000 trees are owned by the municipality of the capital, and a further 700,000 by the municipalities of the capital's districts. The aim of FATÁR is, on the one hand, to enable the municipality of the capital to collect up-to-date basic data on this tree stock, which will help to make the tree stock of Budapest transparent, and thus to plan the maintenance and development of the green space system.

On the other hand, it is an important tool for shaping the public's attitudes and conscious behavior towards green spaces in the capital. Part of the data collected, i.e., the data likely to provide relevant information to the public, will be made public through the BP FATÁR app. The application has been launched on the basis of partial data, with the aim of allowing decision-makers to see the partial results achieved and to provide additional resources for the development and finalization of the system. The app also aims to encourage cooperation between the district municipalities, so that the data they already own can be included in the register as well.

With the help of the database, city dwellers and administrators can also find out who owns or manages a given tree/park/green area (the metropolitan municipality or a district municipality); i.e., who is responsible for the maintenance and development of the given element. This is otherwise often quite difficult to tell due to the capital's two-tier municipal structure.

IMPLEMENTATION

BP FATÁR was launched in 2019, developed by FŐKERT Nonprofit Zrt (FŐKERT Metropolitan Horticultural Nonprofit Plc.), with the support of the City of Budapest. The data recorded and updated weekly by FŐKERT Nonprofit Zrt. are imported into the application by Info-Garden Kft. The financial resources required to launch the project were provided by reinvesting the proceeds (HUF 60 million) from the sale of a disused site owned by FŐKERT. The data have so far been collected by means of on-site visits with the help of experts. The capital's district municipalities are currently being involved. Several NGOs are also involved in promoting the program and the associated app.

This makes the project difficult to implement:

Two-tier local government - At the time of the regime change, the ownership of public spaces in Budapest was distributed among district municipalities and the city municipality without any clearly discernible logic. As a result, who owns and or is in charge of maintaining a given tree or green surface is not always clear even to the professionals or administrative staff involved.

Missing data - Not all Budapest districts have local/up-to-date/digital data on trees and green spaces.

Consolidation of cadastral data - The district inventories are not drawn up according to a single standardized system, making it lengthy and difficult to harmonize existing data.

Survey time and obsolescence rate - It is difficult to survey and keep up-to-date a database mapping such a large population relying on human effort only. In order to speed up data acquisition, software is being developed to process the 3D data acquired by a LIDAR laser scanner, which would significantly speed up the acquisition and updating of the data.

Shortage of professionals - The number of professionals (both in the fields of software and tree care) employed by FŐKERT is low.

The system has so far cost roughly 100 million forints.

INNOVATIVE CHARACTER

Diversity of data - Tree data (Hungarian and Latin terminology, height, trunk diameter, trunk height, crown diameter; the calculated value in case of protected trees, the exact location - street, house number, coordinates); the amount of lawn area; the amount, location, and ownership of park equipment, tools, and facilities. Photographs are taken of each of the items recorded. In addition to the basic data, the data sheet also includes treatment information (proposed phytosanitary treatment and urgency, obstruction of overhead power lines, other utilities, etc.)

Involving the community - Any user can „report a bug" on the datasheets of the elements of the inventory. Users can not only report problems, such as the need for treatment, but can also leave positive comments, for example about birds nesting in the tree.

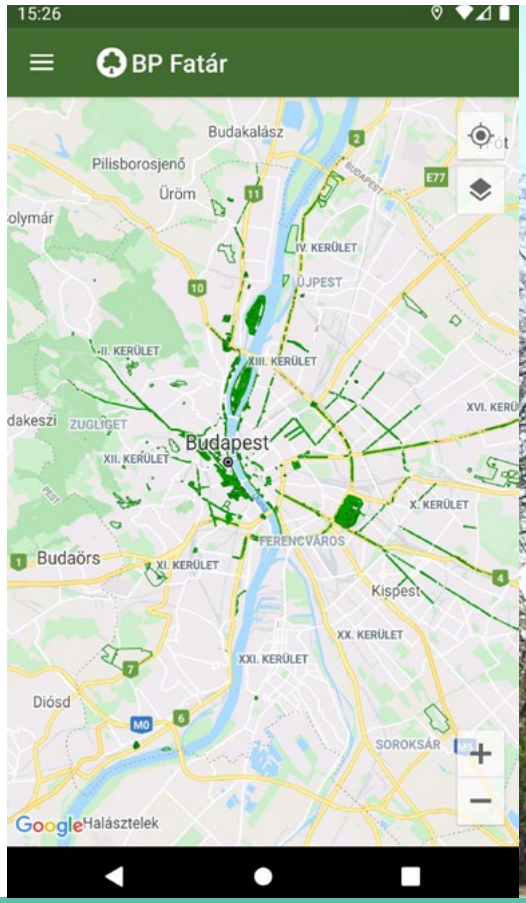
Expanding the database with geospatial information - LIDAR measurements will be integrated into the tree data. Every 3 years, the company surveys the roads managed in Budapest using LIDAR (Light Detection and Ranging) software, a 3-dimensional scanner. In a pilot project, the municipality of the capital handed over part of the raw data, including data concerning rows of trees planted alongside roads, to a Hungarian start-up company with references from Singapore, which is currently developing software to extract final data from such raw data. As a manual survey of such a large volume of trees (hundreds of thousands) is too time-consuming, this method can significantly speed up the process (50,000 trees/day) of preparing and regularly updating the inventory.

FATÁR also provides a community option for users: they can report errors in the data entered, or if something on the spot is different from the status displayed in the app, or even if a tree needs treatment. Each object or tree in the app has its own data sheet, and they can use the report an error menu to report any discrepancies and help ensure that the system is up to date with the latest data. The fault report is sent directly to the operator or maintainer of the site. The reports are reviewed on a weekly basis.

For the 155 notable trees in the database, tree value calculations have also been carried out and are also available on the interface. This good example will help to promote the tree value calculation and encourage local authorities to introduce and apply the method in their own property management. The tree value calculation determines the asset value of a tree and the approximate value of the ecological services it provides over an annual assimilation period.

SWOT ANALYSIS

Ease of use - the app is very easy to use, browsing the map or searching for an address to easily access the data for an item.
A trendsetting development that fills a gap - this is the first online tree inventory in Hungary, which, although incomplete, is accurate and can serve as a model for other municipalities.
Diverse dataset - A large amount of data is available on each individual item, even in an international comparison.
Two-tier public ownership - At the time of the regime change, the ownership of public spaces in Budapest was distributed among district municipalities and the city municipality without any clearly discernible logic. As a result, whether it is the city municipality or one of the districts that owns or is in charge of maintaining a given tree or green surface is not always clear even to the professionals or administrative staff involved.
Missing data - Not all Budapest districts have local/up-to-date/digital data on trees and green spaces.
Divergent databases - The district inventories are not compiled according to a uniform system. As a result, harmonizing and displaying district-level data in the FATÁR system is time-consuming and complicated.
Survey time and obsolescence rate - It is difficult to survey and keep up-to-date a database mapping such a large population relying on human effort only.
Opportunities for spatial data development - In order to speed up data acquisition, software is being developed to process 3D data acquired by a LIDAR laser scanner, which would significantly speed up the acquisition and up-to-date verification of the data.
Shortage of professionals and funds - The number of professionals (both in the fields of software management and tree care) employed by FŐKERT is low; the financial and human resources required to improve the system are scarce.



SOCIAL IMPACT

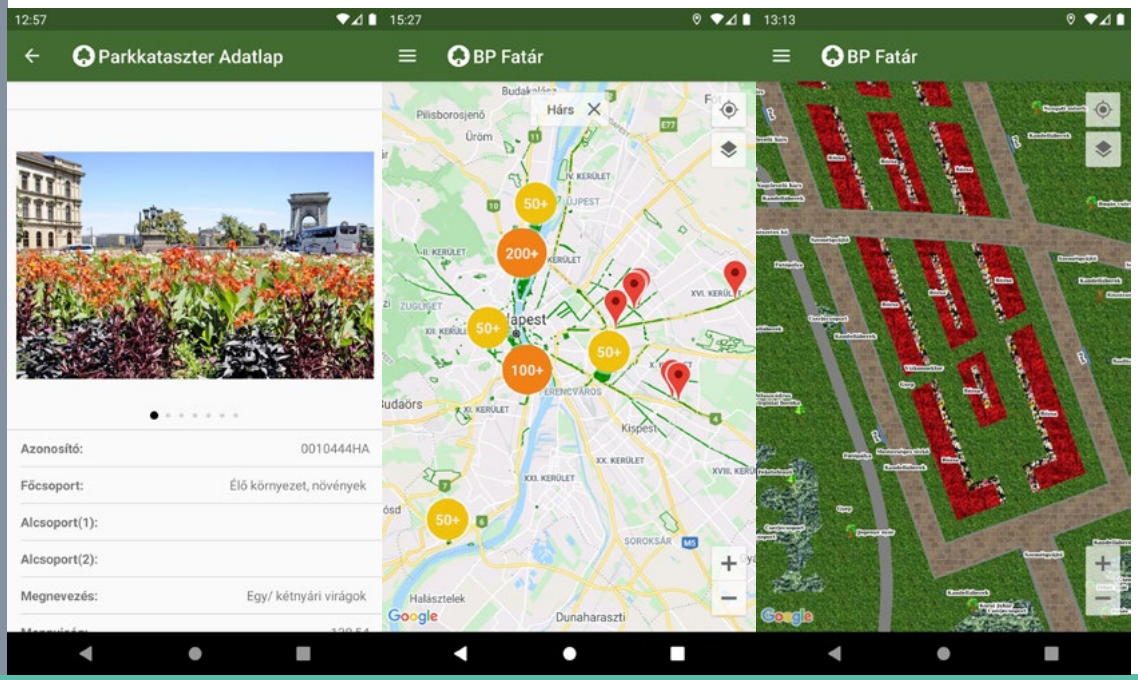
Trees represent value! - The main social benefit of the program consists in helping raise awareness and acceptance of the value of green spaces and trees. The opportunity for community participation - reporting defects - helps to maintain and improve the condition of green spaces.

REPEATABILITY

The pioneering application, without precedent in Hungary, has not yet found a following in any of the major cities in the project.
The LIDAR 3D scanner system used for the development of the project, for the acceleration and automation of data acquisition and data management, is provided by a start-up company. Following Singapore, Budapest is the second location to support the development of the database.
The diversity of the data, the community element, and the LIDAR used for its development could become a best practice even at the international level.

CONCLUSIONS, RECOMMENDATIONS

The Budapest FATÁR tree inventory and application is an innovative niche initiative in Hungary, which can contribute to other Hungarian municipalities developing tree inventories.
Although the database is still incomplete, several elements could be exemplary even at an international level, such as:
- Diversity of the data, including the indication of the material value of trees for several trees;
- Community participation - the users of the app can make suggestions;
- Involvement of geospatial information technology - the use of innovative geospatial applications for the development of the database and for updating the data.



CONTINUOUS COVER FOREST ("DAUERWALD") IN THE CENTRAL AREA OF THE BAKONY

DESCRIPTION

In the foothills of the High Bakony, the village of Pápateszér, with a population of 1200, has decided, with the support of the local community, to regenerate the inner area near the village center as a continuous cover forest ("Dauerwald"). The initiative is backed by WWF Hungary and the Climate Protection Alliance. The green organizations approached the village at the end of 2019 looking for an area suitable for the creation of a semi-natural habitat. The opportunity offered met the vision of the village leadership, which was in the process of settling the ownership of a low-lying area in the center of the village, which the village intended to give a community role.

The necessary funds for the development were provided by the Hungarian National Bank, which offset the environmental impact and carbon dioxide emissions of its international conference in early 2020 by creating a green space. Pápateszér is the first municipality where such a development is being carried out. Although there are similar initiatives where trees are planted to compensate for the air pollution caused by the operation of an organization or an event, this is the first to do so in a complex way: the continuous cover forest ("Dauerwald") is more than just a green space: it is a habitat where the local government has undertaken to care for and maintain the area.

Green space management

City or municipality
Municipality of Pápateszér

Location
Pápateszér, Markovics u. and Jókai u.

Project owner
Municipality of Pápateszér

Year of implementation
2020

More information
Article on the webpage of the Hungarian Climate Alliance

Contact person
the Mayor, Béla Völfinger

Organization
Municipality of Pápateszér

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Municipal green spaces have a very important role to play in the climate change process, both in terms of adaptation and mitigation. Municipal green space development can contribute to improving local living conditions and reducing heat islands.

Responsible economic actors are looking for ways to reduce their environmental impact, or if not possible, to remedy it, in the face of the challenges of the times. Tree planting actions have become a common practice to compensate organizations for the carbon emissions from their operations or an event. Unfortunately, such one-off campaigns often result in trees being left without a host and dying.
The aim of WWF and the Climate Protection Alliance was to create a lasting development that goes beyond the simple planting of trees, and which will create a new, naturally valuable green space and habitat in the inner area of the participating municipality. The long-term management of said green space will be taken on by the local community. The active involvement of the local community has been an important objective of the development: the forest was planted with the help of local residents, who helped to create and maintain the area through community tree planting and tree care activities.

IMPLEMENTATION

WWF and the Climate Protection Alliance published a call for proposals at the end of 2019, in which they were looking for a municipality among their members and partners that would commit to provide 1-2 hectares of land to offset the environmental impact of the international event of the Hungarian National Bank. To create the continuous cover forest ("Dauerwald"), the NGOs and the municipality of Papateszér jointly developed a plan that takes into account the sustainability aspirations of our time:
- The species chosen are typical of the landscape and are expected to withstand the extreme effects of climate change.
- Favoring a long-term perspective, young seedlings have been planted rather than pre-grown seedlings, so that the combination of species would create a diverse habitat that is beneficial to pollinators, reptiles, amphibians, birds and small mammals, in addition to the flora.
- The local community has played and continues to play an important role in the creation of the green space, and is actively involved in its development and maintenance.

The municipality contributed to the development of the area by providing the newly purchased public land, which is only suitable for limited development; the additional costs of the development were provided by the Hungarian National Bank. In the process of seeking potential municipal partners, WWF and the Climate Change Alliance found that there are very few publicly owned areas that could be suitable for similar development, as the reclassification of land suitable for development and listed as building land as green space would imply a loss of value for the municipal property inventory.

INNOVATIVE CHARACTER

A coherent habitat instead of “just trees” – In recent years, more and more operators have been trying to offset the environmental impact of their operations or events by planting trees. This development is one of the first where the parties involved have not only planted trees, but have created a larger 1.5 hectare (two football pitches) habitat with a diverse range of wildlife.
Enhancing the natural character – Young seedlings typical of the landscape are planted instead of pre-grown, several-year-old seedlings. This allows the forest to be established at a lower cost and creates a diverse habitat and ecosystem adapted to the environment.

Offsetting corporate environmental impact – Responsible corporate governance is increasingly focusing on reducing its environmental impact or, where this is not possible – such as replacing air travel at a high-level international conference – offsetting it by supporting improvements. Local opportunities to change carbon emissions are expected to receive increasing attention and resources from companies. The innovative model of Pápateszér offers an opportunity that satisfies long-term sustainability concerns and can even be quantified by environmental indicators (e.g., the amount of carbon dioxide sequestered per year), if necessary.

Partnership – Partnership is essential in the compensation process; environmental NGOs working together in a network can help the donor to find the right local community or municipality. They can also help to ensure the right professional quality, which may be lacking at the municipal level.
Awareness-raising – Awareness-raising is also a key issue in the area of increasing green spaces in municipalities. The benefits of biodiverse green spaces (e.g., semi-natural forests, municipal fields, beekeeping, etc.), which provide a wider range of ecological services, should be highlighted, not only from an environmental point of view but also from the economic, health and social perspectives.

SWOT ANALYSIS

Adequate land for development – It is not always easy to secure adequate contiguous land within a municipality of at least 1 hectare to compensate for environmental damage. For this reason, although many of the Climate Alliance's member and partner municipalities are open to cooperation, the lack of suitable public land in many municipalities means that a similar development is not feasible.
Devaluation of the site as a result of being designated as green space – In particular, similar developments may be hampered by the fact that a change in the zoning of an area may result in its devaluation. If, for example, a municipality wishes to regenerate a brownfield site in a degraded state as greenfield land, the reclassification of the site represents a significant financial loss, as the material value of greenfield land in the inventory of assets is unfortunately much lower than the value of the classification that would allow it to be developed.
Community participation – Community participation worked particularly well in the course of the development. Local residents were open to the development from the outset, with large numbers getting involved in the tree planting and forestry work.
The impact of the COVID19 pandemic – Unfortunately, this development process was also hampered by the restrictions imposed due to the pandemic, which resulted in the cancellation of some community events.
Local acceptance of the development – Local consultation and public involvement in the planning, design and naming of the area will help to ensure local acceptance of the semi-natural community forest.
Two-tier partnership – The implementation was supported by a two-tier partnership:
WWF and the Climate Alliance's network of contacts provided the opportunity to reach potential donors; the local, municipal contacts of the Alliance and its member organizations provided the right venue.
Professionally sound solution – WWF and the Climate Alliance's expertise helped to ensure that the resulting development meets sustainability requirements.

SOCIAL IMPACT

The social impact of the area created, the resulting natural forest, is clearly positive and will contribute to improving local living conditions in the long term. This exemplary development will help to create acceptance of the need for new, biodiverse, semi-natural green spaces for sustainable, livable communities.

REPEATABILITY

This is an innovative and exemplary development, not only in Hungary, but also internationally, where pollution and carbon footprint are compensated not by a simple one-off activity such as tree planting, but by a complex development – the creation of a community habitat.
Based on the model of Papateszér, a similar development was started in Parasznya, another member settlement of the Climate Protection Alliance, which is also supported by WWF and the Climate Protection Alliance, and where the local implementer, in addition to the local government, is the local NGO of the Alliance, the Holocene Association.
The afforested area is located 2 km from the center of Parasznya, in the valley of the Galya stream. A 1.5-hectare alder grove forest was established on a degraded area, which had been degraded by former surface mining activities, with the active involvement of the local community, taking into account the habitat characteristics of the landscape.

CONCLUSIONS, RECOMMENDATIONS

Recognizing the importance of mitigating climate change, more and more companies are choosing to offset the environmental impact of their operations and/or events with developments that help to capture and sequester carbon dioxide. The development in Pápateszér, implemented in a broad partnership, provides an innovative, sustainable model by focusing on the establishment and long-term maintenance of a semi-natural forest with the active involvement of the local community, rather than a simple tree planting operation.

PRATO URBAN JUNGLE

DESCRIPTION

Cities and urban communities face challenges related to poor air quality, the effects of heat islands, flood risks, social exclusion and degraded urban environments, which lead to health impacts, quality of life, well-being and safety of citizens of European cities, especially among the less privileged people. At the beginning of 2018, the Municipality of Prato adopted a new strategy for the urban forest, aimed at limiting land consumption by encouraging strategies for the recovery and reuse of existing areas and buildings. As part of this strategy, the Prato Urban Jungle (PUJ) project aims to renovate the districts of Prato in a sustainable and socially inclusive way by developing urban jungles. To this end, urban jungles will be developed in 4 specific areas of the city dealing with pollution, high traffic density, economic and/or social fragility, abandoned and former industrial areas.

The „urban jungles" are areas with a high density of green, immersed in the urban structure, which multiply the natural ability of plants to break down pollutants, restoring at the same time the soil and unused spaces, transforming marginal areas into active green hubs.

PUJ

Prato Urban Jungle

Green space management community-driven approach to design, develop and maintain urban jungles

City or municipality
Municipality of Prato

Location
4 pilots sites in Prato
- Soccorso District, Consiag- Estra private building
- San Giusto District, EPP (public) buildings, via Turchia
- Macrolotto Zero District, covered Market
- Commercial area, via delle Pleiadi

Project owner
Municipality of Prato

Time of implementation
Ongoing project

More information
Webpage of Prato Urban Jungle
Facebook page of Prato Urban Jungle

Contact person
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THE PUJ INCLUDES 4 PILOTS SITES IN PRATO AS FOLLOWS

Soccorso District, Estra building (private company) and its surroundings located in a complex urban area with the daily passage of 50,000 vehicles. The intervention focuses on green facades, the roof and the outdoor parking area, including the demineralization of the soil and the creation of parking spaces dedicated to sustainable mobility.

San Giusto District, EPP (public) buildings are located in an urban area with high population and large green areas characterized by the presence of social housing. The EPP complex includes 102 public housing units and the intervention aims to restore natural soils and public space to the community, including trees, plants and living nature, grafted onto existing buildings by reducing mineralized surfaces, absorbing numerous tons of CO2. For the buildings facades structures will be installed consisting of steel cables anchored to the blind elevations that allow the growth of climbing plants and the creation of innovative green sunscreem systems on the south-facing facades, capable of mitigating the temperature and cooling the surfaces of existing complexes. One of the objectives of the project is to irrigate the climbing species that will cover the facades mainly with recovered rainwater. The intervention also deals with the creation of common social spaces dedicated to collective and recreational activities. The parking area will be affected by a demineralization of the soils that will transform the pavement into a permeable surface.

Macrolotto Zero District: In the historic district characterized by underutilized spaces (former industrial area), a city market will be built with facades covered by plants and the air will be purified by the largest Air Factory ever built. It will be possible to consume local products and enjoy the benefits of a space regenerated by plants. These interventions will generate benefits in terms of environmental microclimate regulation, temperature mitigation, air quality, thermal and acoustic insulation and rainwater regulation.

Commercial area. This intervention is divided into several parts: a high-performance urban greenhouse for the production of plants at Km0, a refreshment area created with old industrial containers, an area dedicated to musical or cultural events.

The 4 pilot projects will adopt a community-driven approach to design, develop and maintain urban jungles, through the creation of Green Hubs or communities of stakeholders, citizens, businesses, civil society organizations etc. that will mobilize urban creativity to develop and replicate urban jungles. The urban jungles will be co-designed with the help of citizens, through shared urban planning facilitated by the use of digital platforms, which will open management to the community, increasing inclusion and promoting widespread sustainable development of the urban environment.

INNOVATIVE CHARACTER

Urban jungles go beyond common urban forest approaches by proposing the creation of areas with a high density of greenery through an innovative co-design path that improves the resilience of the city and creates sustainable urban landscapes. The project will provide a new strategic approach to urban planning which, by involving stakeholders through an innovative digital platform and governance model, will be able to support a more inclusive urban green development in cities.

The environmental monitoring activities, developed by the CNR (National Research Council), are focused on the development of tools and technologies to measure NBS interventions.
Through the installation of a series of control units (AIRQino), developed by CNR researchers, the state of the environment and the air quality will be monitored, before, during and after reforestation interventions, with an ex-ante ex -post able to quantify the benefits of the interventions. The AIRQino will provide data open and available to citizens, and will constitute a low-cost observational network model, which can also be replicated in other areas and contexts and can also be managed by the citizens themselves or by other associations in the area.

Through the development of a mathematical model in ‚digital twin' logic, i.e. a virtual twin of the portion of the urban fabric object of the interventions, a virtual environment will be created continuously connected to the real one through the networks of sensors, and able to simulate both the real context and virtual scenarios containing new ideas and new projects for future reforestation expansion. CNR will also develop technologies and targeted interventions on the soil matrix, capable of monitoring and restoring the levels of fertility and biodiversity of soils compromised by many years of impermeable flooring, which will be returned to a condition of natural contact with the atmosphere (through the de -sealing of parking areas for example).

SOCIAL IMPACT

Community-driven approach to design, develop and maintain urban jungles: in fact, urban jungles will be co-designed with the help of citizens, through shared urban planning facilitated by the use of digital platforms, which will open management to the community, increasing inclusion and promoting widespread sustainable development of the urban environment.

There are also training and awareness-raising activities addressed to the citizens.

CONCLUSIONS, RECOMMENDATIONS

The Prato Urban Jungle approach is integrated into the guidelines for European Cities for the implementation of urban forestry strategies and for the use of Nature Based Solutions and Plant Based Solutions in architecture. The NBS are increasingly seen as a solution to the challenges of land use in cities. NBS can foster sustainable urbanisations, restore degraded ecosystems, improve climate change adaptation and mitigation, and aid risk management and resilience. Furthermore, by reshaping the urban environment, NBS can improve inclusiveness, equity and livability, regenerating disadvantaged neighborhoods, improving citizens's mental and physical health and quality of life, reducing violence and social tensions through a better social cohesion, especially for the most vulnerable groups, i.e. children, elderly, and people with low socio-economic status.

RETE CLIMA FORESTAZIONE ITALIANA®

DESCRIPTION

Milan is the Italian economic capital. With its 1,5 million inhabitants, it's the second most populated city in Italy and the biggest metropolis in northern Italy. Due to this peculiarity, Milan's air is the most polluted in Europe, like the Ruhr basin in Germany.

Furthermore, the urban heat island is one of the biggest problems facing the city, and often the floods of the two rivers crossing the city, Seveso and Lambro, cause big damage.

To solve these problems, Urban Reforestation is the cheapest solution, particularly in the suburban areas and urban parks. Parco Nord Milano is one of them. With its more than 600 ha, especially about 100 ha of forests, is considered a "green lung" for the city of Milan.

Green space management

City or municipality
Milan

Location
Parco Nord Milano

Project Owner
Rete Clima - Parco Nord Milano Regional Park

Time of implementation
from 2015 - ongoing

More information
Webpage of the project owner
More information

Contact person
Pietro Acrami

Organization
Rete Clima

Email address
pietro.acrami@reteclima.it

Telephone
+39 3383404357

HISTORY, JUSTIFICATION

The development is economically justified by the company's donations, which subsequently communicate to the customers and the stakeholders the trees planting. The objectives of urban and peri-urban forestry are diverse and numerous, and respond to the need to protect non-urbanized spaces, preserving naturalistic and landscape values, and limiting land consumption.

IMPLEMENTATION

Rete Clima carries out new national urban forestry projects open to the financing of Companies, with compensatory and territorial renaturalization purposes, as a strategy for the concrete implementation of CSR and the environmental responsibility of the Companies. These forestry activities, which involve the laying and maintenance of trees in Italy, generate many benefits at an environmental, territorial, climatic level but also in raising the awareness of people and companies, whose employees and stakeholders can be concretely involved in forestry activities.

Rete Clima carried out an Forestazione Italiana Protocol (Italian Forestry Technical Protocol) providing:

-compliance with the requirements of good forestry techniques (such as correct forest planning, the construction of natural-shaped forest plants, the use of native and certified forest species, etc.),
-compliance with forestry and environmental regulations in force in the forestation site,
-compliance with any territorial and landscape constraints that may be present,
-the maintenance of the forest plants created, up to plant maturity,
-the direct participation of companies and the territory in forestry activities,
- involvement of the local horticultural supply chain, both for the supply of plants to be laid and for subsequent maintenance interventions,
in order to generate real, concrete and lasting benefits for the local community and its territory

This project is focused on certification and improvement of forests: thanks to the PEFC forest certification and the following management actions on the cork wood and on the surrounding forestry areas, new ecosystem services will be generated in favor of both local quality of territory and global climate mitigation.
The reforestation projects are made during the vegetative rest of the plants, in late winter or in the first days of the fall. The funds are provided by companies that want to cut their carbon dioxide emissions or communicate their sensibility for environment and climate change. The projects are implemented with the support of Parco Nord Milano technicians, and, except the first Italy's lockdown period, the plantings are participated by the companies employees and stakeholders.

INNOVATIVE CHARACTER

The measure is innovative because it's carried on a protocol, Forestazione Italiana® (literally: italian reforestation) based on native and forestal trees, not older than 1 or 2 years, on the maintenance of the plants, too often underestimated, that generate many benefits at an environmental and climatic level. The involvement of the community is carried on with the involvement of the employees and stakeholders of the companies that finance the project.

SWOT ANALYSIS

STRENGTHS
the Forestazione Italiana protocol focuses on the correct design and on the maintenance of the plants. Ensuring irrigation, replacement of dead plants and weed cutting for at least 5 years we can guarantee the engraftment of the plantation, the absorption of CO2 and the provisioning of the ecosystem services.

WEAKNESSES
The principal weakness in this protocol is the species selection. With the climate change, the indigenous species we are used to planting may not be the best for the future projects because they could suffer due to the increase in temperature and the lower frequency of the rain.

OPPORTUNITIES
The greater opportunity of the Forestazione Italiana protocol is its ease of replication. We can create a new forest in any space available, if it is large enough to justify the plantation costs.

THREATS
The principal threat is the climate change already mentioned, especially the moving of key pests' habitat. We'll have to fight new pests, probably harmful, that could cause serious damages to the plants.

SOCIAL IMPACT

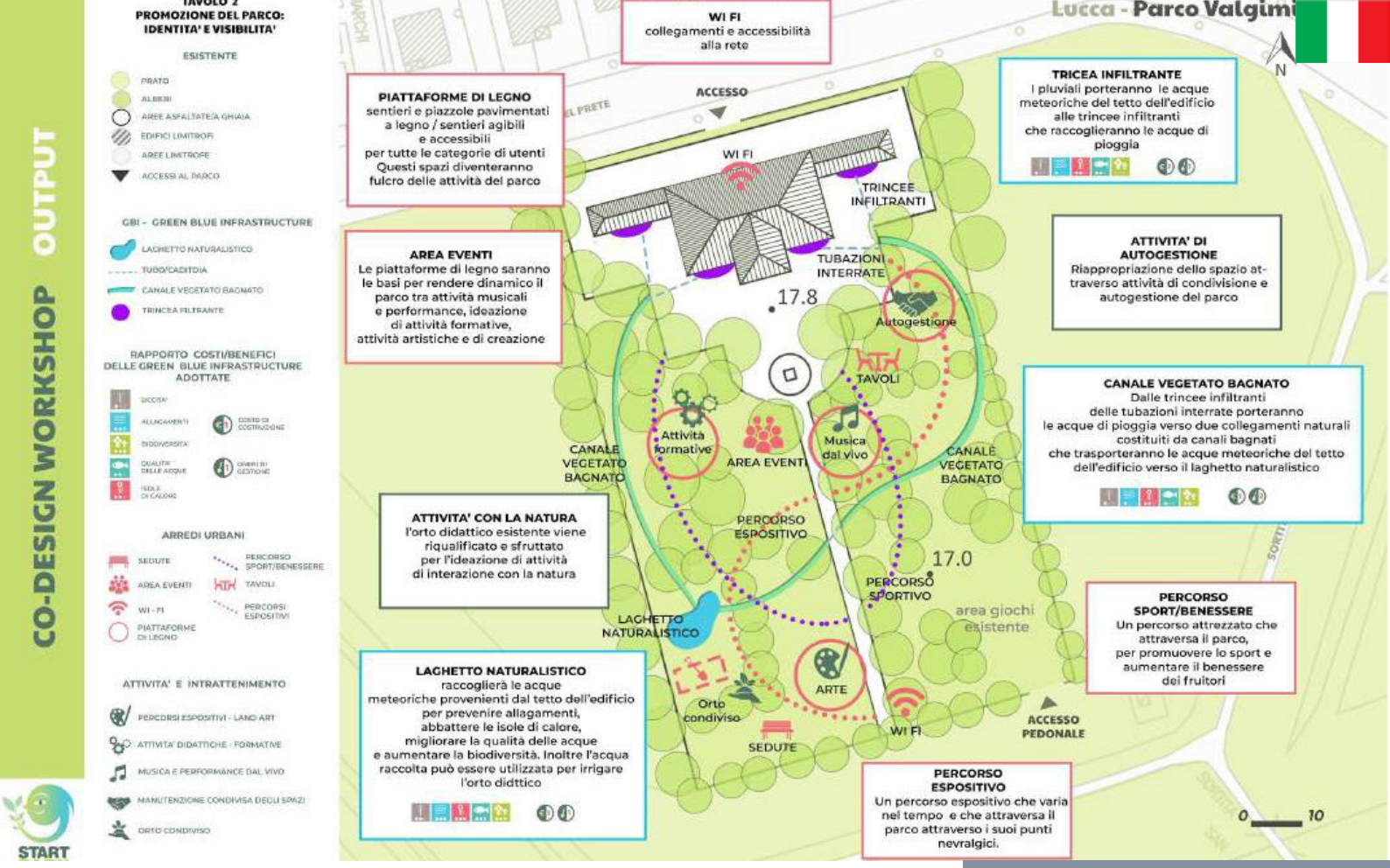
The financing companies' employees and stakeholders participate in the plantation, promoting green team building actions. Furthermore, with the forestation we are going to donate natural resources and woods to the citizens who live near the projects.

REPEATABILITY

The repeatability is one of the strengths of the Forestazione Italiana protocol: in fact, we can plant trees and bushes everywhere, as long as we're not subtracting land to the local farmers. To avoid this, we turn to the institution asking for land suitable for the reforestation.

CONCLUSIONS, RECOMMENDATIONS

The "Forestazione italiana" protocol is not always applicable in the same way: the most important recommendation that we feel we can make is to adapt the forest plant to the environmental conditions, to plant the right tree(s) in the right place(s) to create a truly resilient environment to climate change.



START PARK

DESCRIPTION

Public and private green areas are not designed to adapt to the impacts of climate change (CC) and with particular reference to the water cycle. Floods, droughts, and heat islands are the main threats in urban areas. Start Park faces the challenge of Climate Change (CC) through a service-process that revolves around three main aspects:

1- a co-design and gamification process focused on the active role of the entire community involved;

2- the measurement of socio-economic impact through the Start Park factor indicators;

3- Green-Blue Infrastructure (GBI) capable of providing multiple benefits to citizens and the entire ecosystem of the city.
Start Park is the co-design of green blue infrastructures in urban parks to make communities more resilient to climate change and extreme weather events. The Start Park project enhances outdated design and architecture of city greenspaces through the use of nature-based solutions.

Water management, Resilience & Water

City or municipality
Prato Municipality
Lucca Municipality

Location
Prato Municipality - Giardini di Prossimità, Via Nenni Pietro, 1, 59100 Prato
Lucca Municipality - Parco Valgimigli, 55100 Lucca

Project owner
Codesign Toscana e Iridra srl
Start Park Prato: Prato Municipality, CUT (Circuito Urbano Temporaneo), Riciclidea
Start Park Lucca: Lucca Municipality, ASP Carlo Del Prete

Time of implementation
2019 – ongoing

More information
Project webpage: www.startpark.org;
Project facebook page: https://www.facebook.com/startpark.project
Project twitter page: https://twitter.com/StartPark_
Project instagram page: https://www.instagram.com/startpark.project

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Organization
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DESCRIPTION

Start Park was born as a concept during the Climathon 2017 promoted by Climate-KIC and organized thanks to the collaboration between GreenApes, Codesign Toscana and Impact Hub Firenze. On that occasion multidisciplinary teams were challenged to come up, in 24 hours, with innovative solutions as responses for the mitigation of Climate Change effects and extreme weather events. In particular the design challenge, under the category "Resilience & Water" was "How might citizens and local actors contribute in raising the city's resilience to tackle the more and more frequent extreme climate events (from droughts' period to intense meteoric events)?". From this challenge the group came up with a systemic service that merged public/private interest and facilitated the growing of resilient urban parks and shared awareness about the climate crisis.

The project diffuses climate change awareness and design thinking to citizens and creates economic value for private and public stakeholders.

Subsequently, Start Park has been awarded with the winning of two Designscapes (Horizon 2020) | Design-enabled innovation in urban environments grants. Thanks to them, Start Park has been prototyped in the city of Prato involving both the local community and the Municipality and it is currently scaling in Lucca, again with the cooperation of the Municipality of the city and a group of local citizens.

Start Park offers to communities and municipalities a pre-feasibility study of the project, but is due to local administrations to complete and realise operas:

The commitment of the municipality is fundamental to guarantee the realization and sustainability of the project. Even if there are resources at the central government level, municipalities are not always willing to get involved.

INNOVATIVE CHARACTER

Start Park is the first project in Italy that combines community participation with a concrete co-design process. In fact Start Park follows the 5 points of co-design thinking (Empathy, Definition, Ideation, Prototyping, Testing) and it contributes to spreading awareness in the local communities about Climate changes, it gives experience of co-design and gamification. Last but not least, communities can rethink, through this process, their own environment, their own neighbourhood and they can concretely act to improve it.

Start Park focuses on the water cycle, and even the project itself is a cycle: in the first part local communities receive information that can raise their awareness on climate change and the impact of it on their own place, then they start to think about how to improve it. The municipality built the Start Park project and the community can perceive the result of their own commitment in their neighbourhood.

Furthermore, the repositioning and rethinking of the green areas, can have a strong impact on resilience to climate change and the Green-Blue Infrastructure (GBI) is capable of providing multiple benefits to citizens and the entire ecosystem of the city.

SOCIAL IMPACT

Another innovative aspect of Start Park is the measurement of socio-economic impact: in fact, the Start Park Factor is an indicator mixing empirical data and social, cultural, environmental impact, that can give real feedback about the project. Furthermore, mixing people together to think about how to improve their own environment can create a more strong sense of community.

REPEATABILITY

Yes, the entire project is online and open source. The Start Park team has a huge expertise about the project, but everyone can replicate it by himself with no need to involve the original team.
A Start Park prototype has been carried out in the city of Prato, Italy, involving both the local community and the municipality, and now it is scaling to the city of Lucca. The team is trying to replicate it to many other Italian municipalities.

CONCLUSIONS, RECOMMENDATIONS

StartPark is an ecosystem for the design of urban parks resilient to Climate Change thanks to Nature Based Solutions and the creation of active communities in the area. Research (feasibility studies) , Co-design, gamification (start Park cards) and community engagement and impact evaluation (social, cultural, environmental and economic) are the key elements of the Start Park process as well as the commitment of local Municipalities and stakeholders (public and private).

IULIUS PARK

DESCRIPTION

This western city in the region of Transylvania traces its origins back to the Dacian settlement of Napoca in the 2-nd century A.D. After the Roman take-over of Dacia, it was renamed Napoca and in 124 A.D., received the rank of „municipium". The city quickly advanced socially and economically and during Marcus Aurelius' reign Napoca received the title „colonia", the highest possible urban status in the Roman Empire.
The name Cluj comes from Castrum Clus, first used in the 12-th century as the name of the citadel surrounding the city. Clus means „closed" in Latin and refers to the hills that surround the city. German merchants, who arrived here in the 12th century, rebuilt the medieval earthen walls of Clus in stone after the Tartar invasion of 1241. Known as Klausenburg to the Germans* and Kolosvar to the Hungarians, Cluj became Cluj Napoca in the 1970s, when the communist regime added the name of the old Roman settlement to emphasize its Daco-Roman origin.
With one of the most vibrant economies in the country and a population of around 330,000, Cluj, is today a vibrant cultural and educational city. The six state and several private universities located here also make Cluj Napoca the city with the largest percentage of student population in Romania.

Storm water infrastructure

City or municipality
Cluj Napoca

Location of the measure
Cluj Napoca

Project owner
Julius Grup, City of Cluj Napoca

Time of implementation
2005, 2007

More information
Description about the Iulius Parc on Cluj webpage
Description about the project

Contact person
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Organization
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HISTORY, JUSTIFICATION

Iulius Group wants to offers to the people of Cluj a green space arranged according to modern standards, similar to those in the big European cities.
The city of Cluj know in our days a very dynamic development, being a second larger city, after Bucharest and being also the capital of Transylvania. But this intense development involve also costs by reducing the green spaces and by the intensification of the traffic.

On the western entry to the city exist a very intensive real estate development and from the 90`s in this part of the city was developed a big commercial complex.
The Iulius Group is part of this commercial complex and they intended to create an extra attraction for the customers by creating this recreational area. The conditions were suitable, existing the possibility to combine the green space with a water surface. By the end the idea to create a complex area for recreation and also for nature get a very favourable opinion from the population and was implemented by the Iulius Group.

IMPLEMENTATION

The creation of the park is largely due to the Julius Group and the Cluj Mayor's Office.
This project was a joint investment of the city and of the commercial group and was supported also by EU funds. Iulius Parc covers an area of three hectares and is an investment of over two million euros of Iulius Group, made for the Cluj community.

The realisation of the whole plan took 2.5 years to complete, between 2005 and 2007.
The value of the surrounding areas has doubled, people's well-being has improved a lot and it is perhaps one of the best examples at the Romanian level that they have achieved.
Iulius Parc green area is an oasis of relaxation in the city, so that all visitors can enjoy the most pleasant ways of recreation and disconnection in nature in an area with heavy traffic: 10,000 sqm of grass, pedestrian suspended above the lake, cycling and running track, alleys promenade and seating areas equipped with benches.

The redevelopment/rehabilitation works involved the regeneration of vegetation by planting over 18,000 trees and shrubs of various sizes and about 10,000 square meters of special lawn for traffic.

INNOVATIVE CHARACTER

This park was very much needed as the area was full of blocks, there were no green zones or parks, typical communist construction was present in the area.
When they started to build the mall, at the same time they started to build the park on the lake, so they started to build a mall at the same time, which became one of the most beautiful and modern parks in Romania.
The innovative character of this project for Romania is represented by the fact that it is the first combination between a commercial company and a natural area, and also it is innovative that the project is supported by the municipality.

SWOT ANALYSIS

Strengths:
- the well-being of the residents is increased
- air pollution has been greatly reduced,
- the summer average temperature also dropped a good few degrees
- plenty of bird species have migrated to the area, the lake is full of a living world of fish.

Weakness:
-there are very big traffic jams because everyone wants to get here to relax, either in the minor or in the park, especially in the summer.

Opportunities:
It’s an opportunity to increase the green surface

Treaths:
-the prices have risen sharply for real estate, rents

SOCIAL IMPACT

The social impact is very clear, the people who want to go shopping to the mall can spend some time in a natural environment, socialize and relax. Sometimes the children can stay better in the park as in the mall, and can get fresh air.

REPEATABILITY

The best practice can be repeated, but we don’t have information about it.

CONCLUSIONS, RECOMMENDATIONS

Remarks- we think this is one of if not the most beautiful modern parks in Romania that have been built in a big city in the last 20 years.
Other towns could take the example of Cluj that it is possible and necessary to create such parks, every single settlement deserves it.
It should be noted that in the last 15 years Cluj is the largest developing city in Romania, trying to catch up with the Western countries from any point of view.

WATER FOR PEOPLE AND FOR NATURE. MEANDER RESTORATION PROJECT IN GALESTI

DESCRIPTION

The territory of Găleşti commune is located on both banks of the middle course of the river Niraj and its valley, at a distance of approximately 24 km from the county seat Tîrgu Mures, with an average altitude of 345 m. It is neighbouring from west with Livezeni and Păsăreni, to the south with the commune of Fântânele and Sângeorgiu de Pădure, to the north with the town of Miercurea Nirajului. It is a more or less forested hilly area with the main meadow and the generally flat terraces of the river Niraj. It consists of seven villages, as follows: Găleşti (common residence), Troiţa, Bedeni, Sânvasii, Maiad, Adrianu Mic and Adrianu Mare.

The first reliable data on Gălești can be found in the 1567th register. The first data on the population, provided by the military census of the 1600s, show the free Szekler status of the village, as well as the fact that the wealthier families were the Ózdians and Szentivánians.

The history of the village is closely connected with the history of the Szentiván family. In the time of King Matthias, the ancestor of this family named George, he was a leader of Transylvania...

Storm water infrastructure

City or municipality
Gălești

Location
Gălești

Project owner
Halkan Sports Association,
Galesti Commune City Hall,
Focus Eco Center

Time of implementation
2010

More information
Description about Nyárádgálfalva on Wikipedia
Description about Nyárádgálfalva on Nyárádmente homepage

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DESCRIPTION

György's son, Zsigmond, built the Szentiváni mansion and the birthplace of the poet and politician Mihály Szentiváni in 1501 in Nyárádgálfalva.

There are 5 cultural homes in the commune (Gălești , Szentháromság, Nyomát, Bede, Nagyadorján) and a library in the village center. Old traditions are faithfully preserved, presented on various traditional holidays. Ancient Szekler folk costumes and folk dances are present at almost every event.
The commune now has problems with the water, the Niraj River was regularized in the 70th and the water scarcity is a general phenomena.

HISTORY, JUSTIFICATION

The lack of a local recreation area led to the above mentioned project. The aim of the project is to create conditions for the population of Galesti commune for sports and leisure activities, as well as the rehabilitation of the old course of the river Niraj. The project created two football fields, a building with locker rooms and a fishing lake. Currently, sports competitions, fishing competitions, exhibitions of traditional local products and crafts take place here.

On the other hand the lack of water became a big problem for the village as far the local population obtains the drinking water from drinking water wells, and these wells depend on the level of the groundwater. The level of ground water decreased in the last years due to the regularisation of the Niraj River which caused a decrease of the water level by 2-3 meters.

The rehabilitation of a meander and the surrounding area has the main goals: increasing the level of the groundwater, creation of the recreational area and rehabilitation of a natural area for the wildlife.

IMPLEMENTATION

The meander rehabilitation was realized in 2010 in Gălești for several reasons, one of was the water retention, catching rainwater, water for animals, creating a pleasant place of recreation for the people living there, and also used as a fisherman's lake for tourism.

The population welcomed the new realisation with great joy and there was great interest in it. The project was financed by a fund from the Ministry of Environment which was created with the goal to support the creation of green spaces in rural areas. The mayor of Galesti was dedicated to the water rehabilitation projects and he was supporting several projects in the village Adrianu Mare (part of the commune Galesti), so he and his team were involved in such projects and got some experience in this field. The theoretical support for the water restoration projects was ensured by a partnership with the environmental organization Focus Eco Center.

The main problem was that the meander was used as the waste dump of the village for several years, and all waste had to be cleaned up and transported to the official waste deposit.
After the transport of the waste the mud which was also polluted, was used for the football ground.

Another difficulty was that the Water Authority wasn't very cooperative, because their vision was different, they had a project of river regulation in the area which could be in contradiction with the wetland project.

In carrying it out, the whole village helped in which way they could.
Today we can talk about a well-functioning system, full of life, various birds and fish.

INNOVATIVE CHARACTER

In general the wetland rehabilitation and in special the meander rehabilitation in Romania is very rare. The Water Authority is focusing on water regulation, in order to drain the rainwater as quickly as possible, which practice was normal for the 60's water management, but for the actual conditions of the climate change this method is not at all recommended. Instead of this practice the water retention and wetland restoration is recommended, to ensure a buffer effect.

The project from Galesti is innovative because it is the first project in the area to restore a former meander which was cut during the water regulation works in 70s. The project is innovative also because it combines the wetland restoration with the recreational area, having a double effect. From first hand it is a nature restoration project and on the other hand it is a project which promotes the active recreation of the local people with the involvement of the local people. In this idea, they focused on simple solutions rather than very technical solutions, the works were realised by traditional methods.

SWOT ANALYSIS

Strengths:
This lake is very important to the locals and in such a small settlement it is a big investment. A relaxing place for local people, also a fishing opportunity for people
Rehabilitating the meander, it became a living water again with both birds and fish and other species of water snake.

Weakness:
Need for a continuously maintaining

Opportunities:
Local tourism has picked up
Its water retention strength is also very important during drought, this lake is very useful for either animal drinking or irrigation

Treats:
Increased number of mosquitoes which can be unpleasant for locals.
In times of great drought, the lake may even dry out.

SOCIAL IMPACT

The measure has a great social impact, because it offers the community a great recreational place. The area is suitable for different activities, like fitness, football, fishing, But the place also offers possibility for nature lovers, who just want to relax, or for small groups to have barbeque there. The restored wetland also increased the underground water level in this way ensuring the water in the neighbouring wells, having a good quality water for different uses including for human and animal use.

REPEATABILITY

The measure can be repeated everywhere, where meanders were cut due to the regularization works, in the vicinity of the localities, offering a complex area with possible complex use.
Till now we don't have information if the measure was implemented or not in another place.

CONCLUSIONS, RECOMMENDATIONS

This is a great project that could be an example for other villages as well.
The water retention systems should play a very important role for people, especially in places where there is water scarcity, but they can all be used for animals for watering and maintaining agricultural areas, in this situation it also promotes tourism.

It is a good example of complex use of an area after rehabilitation.