Nature-Based Solutions: A Smart Way to Improve Urban Resilience in the Face of Climate Change

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Abstract. This paper provides an overview of Nature-Based Solutions (NBS), a new emerging concept in climate change adaptation and mitigation strategies. It introduces a typology of NBS, from minimal intervention to the highest degree of engineering, and provides examples of each. It also provides an overview of the 'Life Metro Adapt' project, which focused on the climate problems of the Milan Metropolitan City and supported the development of climate change adaptation strategies through alternative, nature-based solutions. Finally, the paper stresses the need for increased awareness of environmental issues, in order to ensure that NBS become 'commonplace' today and can be perfected in the future.

1 Introduction

Nature-Based Solutions are increasingly sought after to guide the design of resilient landscapes and cities to enable them to achieve economic development goals with beneficial outcomes for both the environment and society. Nature-based solutions (NBS) are actions supported or copied from nature, with the aim of preserving the functionality of natural ecosystems or restoring it in human-modified ecosystems. The concept of NBS was born in the early 2000s as a tool to address the contemporary challenges and changes we are witnessing, largely caused by the development of civilization, which has gradually stopped progressing with nature, promoting actions contrary to the laws underlying natural balances. In this context, NBS are proposed as nature-based interventions that can address sustainability challenges such as: climate change, hydrogeological risk, environmental disasters, food security, water security, human health, resource scarcity, social and economic development, ecosystem, and landscape degradation caused by urbanization processes, and biodiversity restoration and enhancement [1].

The purpose of this paper is to provide an analysis of the type of Nature-Based Solutions already present today, seeking to understand how they came into being and highlighting the applications of NBS as "living" and adaptable tools to address today's

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critical environmental, economic, and social challenges. The paper concludes with a case study on the city of Milan. It will show how the project Life Metro Adapt focused on various climate problems faced in metropolitan areas, particularly heat waves, urban heat islands, and local flooding due to excessive spills, supporting the development of climate change adaptation strategies in metropolitan areas, with the intention of testing innovative approaches in the Milan Metropolitan Cities.

2 Nature-Based Solutions

2.1 Implementation process

Nature-based solutions use the features and processes of nature's system, with the aim of helping societies address environmental, social, and economic challenges, in sustainable ways [2]. This implies that the maintenance and enhancement of natural capital are critically important, as it forms the basis for these alternative intervention strategies. Ideally, such nature-based solutions are resilient to change as well as energy and resource-efficient. However, to be resilient, and therefore sustainable, NBSs must be implemented in a way that adapts to local conditions and supports biodiversity and people [3]. NBS encompasses a wide range of actions, including the protection and management of natural and semi-natural ecosystems, the integration of green and blue infrastructure in urban areas, and the application of ecosystem principles in agriculture. The concept is based on the understanding that healthy natural ecosystems produce a diverse range of services on which human well-being depends, from carbon storage to flood control, from coastal and slope stabilization to the provision of clean air and water, food, fuel, medicines, and genetic resources [4].

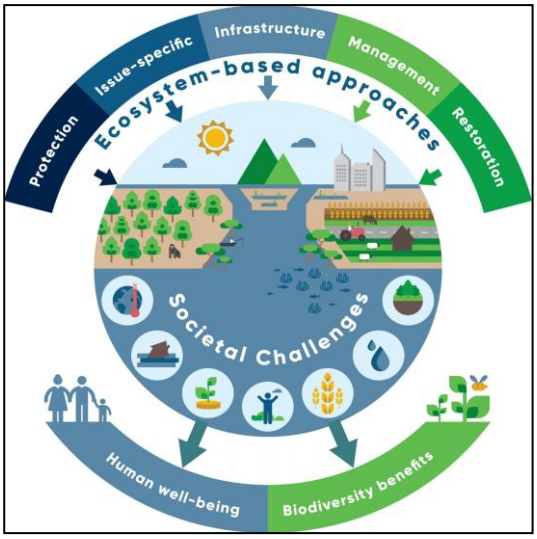

Fig. 1. Nature-Based Solutions.

Nature-based solutions can positively influence all three dimensions of socioeconomic vulnerability. Thus, three main areas on which they can act are codified:

1. Environmental dimension. In the presence of a strong ecosystem, services made available for living things are provided by the system itself. Optimizing the functionality of

the biosystem is achieved by reducing the negative impact of humans on the environment. In this regard, Herman Daly proposed three criteria for assessing ecological sustainability [5]:

- Renewable resources should provide a sustainable yield, so the harvest rate should be lower than the regeneration rate;
- Renewable reserves should have equivalent development for non-renewable resources;
- Waste generation should not exceed the environmental assimilation capacity;

So, the environmental sphere inherent in sustainability involves various areas, such as water resources, food resources, energy resources, and all the non-renewable sources from which we are drawing at the expense of renewable ones. In conclusion, the environmental dimension inherent in sustainability goes into a multitude of areas, including water resources, food, energy and all those non-renewable sources from which we are drawing at the expense of renewable ones.

2. Economic dimension. Sustainability and economics are closely linked in that economic growth has had repercussions on environmental degradation. Although economic and ecological analysis must consider social, cultural, health, and monetary aspects, the concept of sustainability goes beyond welfare and resource performance. For example, nowadays in developing countries, per capita consumption is sustainable, but the population requires to adapt to the standards of Western countries, which have a lifestyle based on greater consumerism. In contrast, in developed countries, population growth is more under control, but consumption levels are found to be unsustainable. The goal of sustainability is to balance this disparity by increasing the quality of life in developing countries and containing high consumption in already developed countries, not exceeding current resource use limits. In this regard, the concept of green economy has been introduced, characterized by the integration of "classical" market analysis and data under analysis regarding the effects of possible environmental damage that may occur during the commodity processing cycle.

3. Social dimension. It concerns areas inherent in the daily lifestyle with which one interfaces. It is therefore a matter of assessing and overseeing the big picture over time, since change is a lasting process and involves a multiplicity of areas, including urban planning, transportation, and human rights. Hence it is clear that the relationship between these rights and a global development must start with the individual who, having become aware of the environmental situation, should take responsibility in every small gesture and personal choice.

2.2 Typologies

The BiodivERsa ERA-NET, a network of national and regional funding organizations that supports research on biodiversity and ecosystem services, has identified three main types of Nature-based solutions [6]:

1. Type 1 NBS: consists of minimal or no interventions to maintain and enhance natural ecosystems. They provide for a high level of maximization of present ecosystem services and minimal use of engineering methods. This type of NBS is related to the concept of nature reserves, which include protected areas, buffer zones, and transition areas where people live and work sustainably. An example of the use of this type of intervention could be the protection of marine areas, aimed at preserving and restoring biodiversity, with the intention of increasing biomass in fisheries areas by more than 600 percent, organism size by 25 percent and species diversity by 20 percent, compared to the same unprotected areas

[7]. A second example is the preservation and management of mangroves in coastal areas, with the aim of limiting the risks associated with extreme weather conditions and providing benefits to local people by protecting them from storm surges and tsunami damage. Specifically, the presence of mangroves can reduce the magnitude of a tsunami by 5 to 30 percent in areas at risk [8]. In Indonesia, Sri Lanka, India, Thailand, and Malaysia, ecological restoration has taken place in the face of ecosystem degradation, aimed at restoring community-based coastal habitat.

2. Type 2 NBS: make use of solutions based on the development of protocols and procedures for the sustainable management of managed or restored ecosystems, involving moderate enhancement of ecosystem services and moderate engineering intervention. Examples include: enhancement of existing agricultural biodiversity to increase the resilience of forests to extreme events; innovative planning of agricultural landscapes to increase their multifunctionality. This type of intervention was implemented in Rajasthan, India, in 1985-1986, when an unusual period of low rainfall, combined with excessive logging, had led to a very severe drought condition. The non-governmental organization (NGO) Tarun Bharat Sangh supported the local people in the process of restoring the natural hydrological cycle and water reserves by building small reservoirs and redeveloping forests and soil to increase groundwater recharge. These interventions resulted in visible improvements, including the restoration of some rivers that usually ran dry after the monsoon period, the regeneration of fish fauna, increased groundwater levels, and the return of wild species such as antelope and leopards [9].

3. Type 3 NBS: consists of large-scale ecosystem management and artificial ecosystem creation, involving minimal improvement of ecosystem services and maximum degree of reliance on engineering to achieve them. This typology supports green and blue infrastructure concepts aimed at promoting environmental conservation, sustainable development and urban resilience through government policies that enable more resilient urbanization planning [10]. An early example of this innovative strategy is the use of green roofs and walls to contribute to urban cooling and mitigate polluted air levels in cities. In London, to combat climate change and improve human health by increasing biodiversity, the greening process was implemented for building roofs, based on the use of more green walls [11]. A second example lies in the construction of hybrid solutions, characterized by the synergy between natural elements and gray infrastructure. One hybrid solution is artificial wetlands, which are increasingly being used for stormwater treatment to enable a reduction in surface erosion caused by precipitation flows. Some intervention strategies included in this category are:

- Source control: allows the control of storm flows by dividing surface runoff into multiple pathways through the use of green roofs and walls, connected to a drainage network;
- Conveyance: allows stormwater to be collected in infiltration and detention basins through special channels;
- Filtration and infiltration: make use of drainage trenches, filters, wetlands and filter depuration basins;
- Storage: allows excess water to be collected in order to reuse it for individual and collective purposes.

2.3. Objectives

Increasing urbanization has led and still leads to the loss of green spaces in cities, with negative consequences for water, air, soil, biodiversity, human health, and climate. A sustainable future needs sustainable cities; this is where green infrastructure and nature-

based solutions can play a key role in restoring ecosystems and green elements in daily city life [12]. Four NBS goals have been identified [13]:

1. Promoting sustainable urbanization. Currently, 73% of Europe's population lives in cities and an increase to 82% of the population in urban areas is expected by 2050. The quality of urban environments is at risk and sustainable regeneration is needed in order to provide healthy and liveable conditions for citizens. Nature-based solutions for sustainable urbanization are based on restoring natural areas in and around cities to perform essential ecosystem services. First, NBSs support economic development in urban areas, which is highly dependent on the quantity and quality of available natural resources, such as water for sanitation and manufacturing and drinking water. Second, sustainable urban planning provides opportunities for adaptation to climate change by increasing urban resilience to hazards such as droughts, floods, and heat waves. Third, the availability of green space can increase people's happiness and overall health. In fact, having nearby green space appears to reduce the incidence of heart disease, obesity, and depression, as the presence of parks, urban farms, and community gardens represents provides opportunities for people to be physically active and meet others. So, moving nature-based solutions higher up the urban design and planning agenda represents an important opportunity to contribute to a city's resilience and economic growth and human well-being [14].
2. Restoring degraded ecosystems. Europe is home to many areas degraded by humans, due to activities such as agricultural intensification, expansion of gray infrastructure, pollution of brownfield sites, hydrological changes to water bodies, intensification of forestry practices, and climate change. Ecosystem restoration can play a key role in increasing resilience to environmental hazards and threats. For example, coastal restoration makes coastal communities more resilient to sea level rise and storms, while forest restoration protects against flooding and mitigates landslides and avalanches.
3. Develop climate change adaptation and mitigation. Addressing climate change is a global challenge, with impacts on the environment, economy and society. There are two strategies for coping with environmental change: adaptation, which aims to reduce impacts, and mitigation, which aims to mitigate CO2 emissions, moderate energy demand and increase carbon storage. So, it is important to develop nature-based solutions that address both adaptation and mitigation, and that can be applied in different sectors and challenges. An important strategic opportunity could be the integration of gray infrastructure with green and blue infrastructure, so that traditional methods, such as water management in urban areas, can be integrated with nature-based solutions. Similarly, zero-waste production deploys interventions to prevent waste, promote the recovery of goods destined to become waste, and activate distribution systems for recovered goods. Third, one strategy for adaptation and mitigation to climate change is floodplain restoration. For example, the Room for the River program involves the restoration of the Noordwaard polder plain, with the intention of providing flood protection for millions of inhabitants.
4. Improve risk management and resilience. Europe is exposed to multiple natural and technological hazards including droughts, extreme temperatures, floods, industrial and transportation accidents, landslides, avalanches, storms, volcanoes, and forest fires. Implementing nature-based solutions would reduce the frequency and intensity of various hazards through pollution reduction, carbon storage, biodiversity conservation, provision of recreation and economic opportunities. NBSs also offer synergies for reducing multiple hazards and meet the objectives of several European regulations, including the Flood Directive and the Water Framework Directive, as well as contributing to climate change adaptation and mitigation. Nature-based approaches include the integration of living systems with built systems through innovative combinations of soft and hard engineering.

For example, stress from high temperatures in cities can be addressed by increasing green spaces, with the intent of reducing temperatures and mitigating air pollution [15].

2.4 Urban resilience

The concept of resilience is defined as the ability of an ecosystem to maintain its structure and integrity following environmental disturbance. This principle is based on the need to learn and improve the management, in a sustainable way, of the interactions produced by anthropogenic systems, which continue to affect the existing natural system, and all those biological systems that are present instead [16]. According to the United Nations (UN) Habitat Program on Human Settlements, resilience refers to the ability of an urban system to maintain its structure in response to various environmental shocks and stresses, adapting and regenerating, while promoting positive and sustainable change. Therefore, a resilient city is one that assesses, plans and acts to prepare to respond to all hazards, foreseen or unforeseen, that may threaten the stability of the environmental, social and economic system. Strengthening resilience means, therefore, reducing risks, increasing capacities, decreasing fragilities, and improving responses developed according to a process of constructive awareness, aimed at seeking the improvement of the quality of life of individuals and communities in urban contexts. In addition, resilience promotes the concept of collective health and well-being, according to an approach also based on the economic and urban planning of territories, as we have learned over the past year, when the COVID-19 pandemic found us unprepared and dangerously fragile, challenging our normality [17]. Therefore, the resilience of an ecosystem and, consequently, of its sustainability, can be measured by combining the forces present in nature (water, atmosphere, soil, vegetation, biomass and solar energy) with the energies injected into the environment from disturbances [18]. Humans play an important role in this context: in fact, sustainability can be studied in a concrete way through the activities they produce and reintroduce into the ecosystem, replacing those that have been removed. In other words, when an ecosystem is affected by external disorder, the process that is triggered is one of adaptation, aimed at restoring the order and stability that external forces have previously compromised [19]. In 1987, Gro Harlem Brundtland, chairman of the World Commission on Environment and Development (WCED,) established in 1983, presented the report "Our Common Future," where he asserted that the critical points and global problems of the environment are mainly due to the great poverty of the South and the unsustainable production and consumption patterns of the North. Thus, the report highlighted the need to implement a strategy that can integrate the needs of development and the environment. For this, the concept of "sustainable development" was defined as "that development which enables the present generation to meet its needs without compromising the ability of future generations to meet their own needs". It is clear from this definition that the concept of sustainability addresses not only the environmental sphere but that of human well-being. The ethical aspect is thus touched upon, focusing on the responsibilities that must start with today's generations so that they can safeguard themselves and future generations. It is essential, then, to strike a balance between the available natural resources and preserve it over time. In September 2015, the governments of the 193 member countries of the UN signed the 2030 Agenda, which set out common and shared goals that affect all countries and individuals: no one is excluded, nor should anyone be left behind along the path to sustainability.

3 Practical applications and case study

3.1. Milan "Life Metro Adapt" case study

The Metro Adapt project, in full called "Metro Adapt: enhancing climate change adaptation strategies and measures in the Metropolitan City of Milan," began in September 2018 and ended in September 2021, funded by the European Commission-Executive Agency for Small and Medium-sized Enterprises (EASME) and co-funded by the European Union's LIFE program, with a total budget of €1,118,385. The Metro Adapt project supported the development of climate change adaptation strategies in metropolitan areas, with the intention of testing innovative approaches in the Milan Metropolitan Cities. This project focused on several climate issues faced in metropolitan areas, particularly heat waves, urban heat islands, and local flooding due to excessive spills. In particular, the effect of heat waves in the urban structure of a large territory such as the Milan Metropolitan Area is amplified in dense built-up areas (about 40.5% of the entire territory) by anthropogenic factors such as traffic and other human activities. In addition, the entire Milan Metropolitan Area is prone to flood risk due to the projected increase in the currents of the Olona and Seveso rivers and the spills generated by impermeable and compact urban structures. The ultimate goal was to promote the creation of sound governance related to climate change, which was common to all local authorities, and to produce tools that would enable them to implement efficient adaptation measures. The partners involved were the Metropolitan City of Milan (Italy), ALDA (European association for local democracy, France), Ambiente Italia SRL (Italy), CAP Holding SPA (Italy), e-GEOS SPA (Italy) and Legambiente Lombardia Onlus (Italy). The objectives were:

1. Finding climate change adaptation strategies and measures in the drafting processes of the CMM's Territorial Plans and in the construction and planning rules of the 134 municipalities that comprise it, through an innovative approach of identifying intermediate governance entities (the 7 CMM Homogeneous Areas);
2. Establish and promote Nature-Based Solutions that would integrate multiple objectives (flood risk and heat island reduction, along with regeneration of neglected urban spaces) and expand the mastery of technical skills needed for their development;
3. Promote bottom-up initiatives in order to raise awareness and increase public awareness, regarding climate change adaptation strategies;
4. Develop innovative weather satellite data and high-precision maps, supporting vulnerability analysis in detail (focusing particularly on heat islands and flooding) for each of the 7 Homogeneous Areas, while also ensuring the availability of disaggregated information at the municipal level for accessible, up-to-date, and possibly open data;
5. Develop a network of metropolitan areas, Italian and European, that would promote the integration of adaptation policies and measures and support the implementation of Nature Based Solutions.
6. Many European cities, particularly densely urbanized metropolitan areas, face climate challenges daily. Consequently, of paramount importance are adaptation strategies at the local level and well-structured common governance. This provides an opportunity for local authorities to tap the potential for cost-effective adaptation by shaping regional and national environmental policies according to the local context [20]. Local governments are in a unique position to engage citizens and design timely responses to local vulnerability and risks. As a result, the role of metropolitan authorities, such as the Metropolitan City of Milan (134 municipalities, including Milan), becomes critical to set a comprehensive strategy for the territory to improve the framework of adaptation measures at all local levels, and coordinate all operational and planning tools.

3.2 The project in brief

There are many climate challenges faced by European cities, and by densely urbanized metropolitan areas. For this reason, cities have been recognized as playing a key role in the adaptation process throughout the EU. Europe has been identified by the Intergovernmental Panel on Climate Change (IPCC) as one of the areas most exposed to climate change (IPCC, 2014). Southern Europe, and particularly the Mediterranean basin, will be the area most affected by global climate change. Lombardy, due to its geographical, spatial and socio-economic characteristics, has a great vulnerability to the effects of climate change. The region, with largely urbanized mountainous areas and river valleys, is, and will increasingly be, subjected to extreme weather conditions. In this scenario, the Milan Metropolitan Area is exposed to the risk of flooding, both because of the expected rise in the maximum flow of the Seveso, Lambro and Olona rivers, and because of the impermeability of urban soil. In order to gain a thorough understanding of the phenomenon and reduce its impact, the Metro Adapt project analyzed the hydraulic hazard of the area by taking into consideration the capacity of the soil to retain rainwater, based on soil and terrain characteristics. Life Metro Adapt had the overall goal of integrating climate change adaptation strategies in the Milan Metropolitan Area and fostering the creation of common governance through the development of tools to enable local authorities to implement strategies and policies to increase urban resilience, adapted to different spatial contexts. In order to make the Milan Metropolitan Area capable of effectively preventing and countering heat waves and hydrological risk, it was necessary to develop an integrated plan to support urban planners and policy makers in prioritizing climate change adaptation activities and implementing Nature Based Solutions. The first output of the project was the creation of urban heat island and vulnerability maps in socioeconomic and agricultural terms, together with the detailed definition of hazard maps. In parallel, Guidelines for climate analysis and risk assessment at the metropolitan scale were drafted to provide principles and useful references for the Metropolitan City of Milan, its municipalities and other metropolitan areas. These indications are the result of an initial analysis of the run-off phenomenon in urban areas, with the intention of identifying all the factors that contribute to the problematic nature of this complex phenomenon [21]. All these studies and maps are made freely available in an easily searchable form through the Metro Adapt Platform, published on the Milan Metropolitan City website. The Metro Adapt Platform is proposed as a dissemination tool, with the aim of providing a comprehensive overview of the main issues addressed by the project. In addition to general information on the objectives and results obtained, the Platform offers the possibility to have access to all the tools, analyses and data collected, in order to share with local governments and entities in the Milan metropolitan area, information on climate vulnerabilities affecting the territory. The Metro Adapt project proposes tools to support mitigation and adaptation criteria. Specifically, increasing temperatures, and a lower frequency of precipitation concentrated in shorter periods of time, and the concomitant increase in the intensity of these phenomena, are among the main effects attributable to climate change. One of the thermal anomalies to which the Milan metropolitan area is most prone is the Urban Heat Island (UHI) phenomenon. Climate change projections for the European continent, including the Po River Basin, agree that over the course of this century heat waves will become increasingly frequent, intense, and last longer, especially during the summer season. The effect of heat waves in the city is not homogeneous but is amplified by elements such as: the level of building, the size of streets, traffic, and the sealing of soil covered by concrete or asphalt. For example, tall buildings "capture" heat and reduce the cooling effect of winds and vegetation, especially at night. As a result, in areas of densely built-up cities, night-time

temperatures can remain warmer than in the suburbs, with peaks of up to 10°C exceeding temperatures measured in neighbouring rural areas [22]. The platform provides three constantly updated maps that illustrate valuable data on the urban heat island phenomenon:

1. Hazard map to urban heat island phenomenon: shows precisely the areas where the heat island phenomenon occurs, in order to provide with urgent interventions (e.g., distribution of water or relocation of vulnerable people to cooler areas) and urban planning measures, the adoption of climate adaptation tools, such as the installation of green and blue infrastructure.
2. Urban heat island vulnerability map: depicts the distribution over the territory of the vulnerable population (elderly over 70 and children under 10) by census section based on 2011 ISTAT population census data.
3. Urban heat island risk map: By integrating data on areas where heat island phenomenon occurs with data on the spatial distribution of the vulnerable population, this map shows the areas of the city with the highest density of population vulnerable to extreme temperatures.

3.3 NBS adaptation measures

One of the main strategies that a metropolitan area can implement to improve its ability to adapt to climate change is the design and development, on its territory, of so-called Nature-Based Solutions. These are intervention strategies inspired and supported by Nature, with the aim of ensuring environmental, social, and economic benefits, helping to improve adaptive capacity to the effects of climatic change and the resilience of urban areas. Green roofs and walls, urban forests, alternative stormwater management systems, and urban agriculture are just a few examples of solutions that can be implemented in urban and peri-urban areas. As part of the Metro Adapt project, 20 fact sheets were produced that illustrate the main naturalistic solutions that can be implemented in urban and peri-urban areas. Their scale of application is specified, describing the environmental and socio-economic benefits and drawbacks that can result, and providing examples of best practices. In addition, following extensive research and study of the best existing NBSs and the adaptive success of such interventions in the contexts in which they have been put into practice, engineering works, aimed at mitigating hydraulic risk in heavily urbanized territories, have been implemented as part of the Life Metro Adapt project.

3.4 Pilot interventions

Pilot interventions of the Metro Adapt project were implemented in Solaro and Masate, where Nature-based Solutions-based stormwater management strategies were put into practice as an adaptation to the foreseeable increase in extreme events. In Solaro, the municipal sports facilities located on Berlinguer Street are served by a large parking lot. In the beginning, rainwater from the parking lot discharged into the village's mixed sewer system. The project included the construction of a special drainage system in a public parking lot to reduce the overload of water collected in the sewer. In the southeastern portion of the parking lot, a bioretention area was built, with a total area of 135 m2 and connected by drainage pipes to 6 sumps with a depth of 3.5 m and an internal diameter of 2 m. In a second area, the existing manhole was planned to be intercepted and conveyed to a system consisting of 6 more leaking wells. The intervention presaged the complete disconnection from the mixed sewer of the drainage network serving the parking lot, and the delivery of stormwater to infiltration systems. Specifically, the objective was the implementation of a mixed SUDS system, comprising:

1. Two bioretention areas connected by drainage trench (138 sq. m.) in a marginal side of the parking lot for direct drainage of surface runoff water from part of the parking lot platform;
2. Two dispersal systems, each equipped with 6 leakage wells: one centrally located and one marginal adjacent to the bioretention area;
3. Four drainage beds (11 sq m each) at the accesses to the sports field, for direct drainage of surface runoff water. Also in Masate, the applied solutions aimed to disconnect rainwater, preventing it from discharging into the mixed sewer system, overloading the system itself and the sewage treatment plant that received the wastewater. The intervention involved a parking lot and a section of provincial road. The intervention carried out aimed to convey and dispose of stormwater from a public parking lot and a portion of the provincial road into a special retention system by installing a detention basin with a capacity of about 90 cubic meters, which would allow the water to be invaded during heavy rains. It was studied, therefore, that a work capable of reducing the dilution of water collected in the sewer system and the consequent impact on the sewage treatment plants during heavy rain events, coming to collect an estimated volume of rainfall of 3162 cubic meters per year, with a reduction in peak flow of 77 liters per second. The goal was for the water to be conveyed via PVC piping for about 100 meters to the retention basin having a capacity of 110 cubic meters, finally delivered to a watercourse after appropriate treatment for oil separation. In both cases, the inflow of water into the wells is preceded by a de-oiling system to prevent the infiltration of oils and hydrocarbons. Four draining beds (rain gardens) have also been constructed at the entrances to the sports field. The system covers a total stormwater collection area of about 5700 square meters, with an estimated annual rainfall volume of 6384 cubic meters, and will result in a peak flow reduction of about 73 liters per second.

3.5 Final considerations

It seems clear that NBS is still in the development stage, and the involvement of different agencies and individual citizens takes time so that everyone is synchronized on the different development plans. In a first analysis, practical cases of different matrixes (environmental, social and economic) were studied, but they always held a common thread from a procedural point of view. It is precisely for this reason that Città metropolitana di Milano, thanks to research work carried out within a number of nationally and European-funded projects, first and foremost the LIFE Metro Adapt project, has developed the one-stop shop for the resilient transition of territories, called "Resilient Territories". This one-stop-shop aims to provide everyone with the necessary knowledge about the phenomenon of climate change, and to support and incentivize the design and implementation of natural systems-based climate change mitigation and adaptation measures where they are most needed and effective. In conclusion, the Metropolitan City of Milan, for the first time in Italy, has studied and defined climate change adaptation and mitigation goals in its Metropolitan Territorial Plan, providing for adaptation actions based on natural systems and implementing pilot experiences with nature-based solutions in order to counteract the phenomena of climate change.

4 Conclusions

Nature-Based Solutions are gaining ground in international policy and business discourse, offering enormous potential for addressing both the causes and consequences of climate

change, while sustaining biodiversity and ensuring the flow of ecosystem services on which human well-being depends [23]. In particular, the full integration of NBS as solutions to the climate and biodiversity crises requires a new approach in economic thinking, moving from a focus on infinite economic growth to the recognition that the flows of energy and materials necessary for human well-being must remain within safe biophysical limits [24]. Nature-Based Solutions strategies can be integrated with smart city or smart service initiatives [25]. For example, cities can use green infrastructure such as urban forestry, green roofs, and living walls to reduce energy and water usage in buildings, improve air quality, and reduce urban heat islands. Cities can also deploy smart irrigation systems to improve water efficiency and the health of urban green spaces. Another example is the use of smart sensors and monitors to collect data to inform decisions about how to manage natural resources and green infrastructure in a city. In this sense, the paper brings to light innovative solutions that are practical, efficient, and relatively simple; reasons why NBSs are constantly growing, spreading, and being monitored so that they become "in common use" today and can be perfected in the future, with the goal of benefiting society and present and future generations.

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