# Chlorophyll City: Regenerative and Restorative Urban Planning for a Sustainable Future through Extensive and Branching Reforestation Initiatives

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**Abstract**
The problems arising from the expansion of cities are global challenges that require innovative and sustainable solutions. This paper explores the beneficial potential of urban forestation with regenerative and restorative urban planning. Focusing on the reuse of marginal, empty and abandoned areas, it proposes to transform them into smart parks to mend the green spots of cities and to reconnect the empty and degraded urban tissues, but would also offer tangible services and benefits to the local community. All connected through eco-human networks to make urban spaces relatable and give species the opportunity to move freely in uncontrolled cities. This integrated approach to urban planning could play a crucial role in shaping chlorophyll cities, sustainable for the future.

**Keywords:** Urban environmental sustainability, Restorative and Regeneration, Natural Based Solution, Cultural Based Solution, Eco-Human corridors.

## 1.1 Introduction

A great contemporary challenge and a problem now in extreme territorial growth is urban pollution, a cause of environmental and natural degradation, that pushes our cities, sources of a good part of these deprecated pollution and environmental disasters, to urgently reorganize given the speed of these changes, designating a turning point. Citing Richard Rogers (1998) *"The future of cities will be determined by its cities and cities"*.
Urban areas are vibrant and complex entities, comprising a heterogeneous blend of built environments, plants, animals, and habitats modified for human use.
A new planning and management of cities would report the creation of preventive and sustainable balances. The goal is to develop plans defined in advance and compatible with the environment itself, adopting a global vision that focuses on sustainable development and conservation of the territory. Spatial planning emerges as a key tool to address this challenge, offering the opportunity to study, design and achieve a harmonious balance between human pressures and available resources. This implies the need to balance human activities with the skills and needs of the territory, finding solutions that guarantee a basis for an ecological and social balance.
Unfortunately, over the last few years, many cities have experienced poor planning and management of the urban environment, compromising both the natural environment (water, atmosphere, green) and the socio-cultural part (urban landscape, cultural heritage, social cohesion)bringing increasingly pressing environmental and social challenges, including daily stress and lack of green spaces.
A large part of air pollutants is attributable to heating and urban traffic, while many of the water and soil pollution comes from solid and liquid waste in the city, because of an imbalance of settlements and an ineffective distribution of functions on the territory. At the moment global warming, the catastrophic consequence of these climate changes, is following an exponential trend whereby cities, for a matter of survival, must transform, change in values

and behavior to resist these variations. In the context just outlined, it is natural to consider technology as a possible response to this crisis. However, it is important to stress that it should not be seen as the only solution or as the only actor capable of solving environmental problems. Rather, technology can act as a support and complementary tool, intervening where resources require support to grow and become essential to the success of policies to promote a regenerative city. For example, innovative technology solutions could be used to monitor and manage water and energy resources, reducing waste and optimisting the use of available resources more efficiently. In addition, technology can play a key role in promoting more efficient and environmentally friendly public transport, thus helping to reduce air pollution and improve air quality in cities. However, it is important to remember that technology alone cannot solve environmental problems. It is necessary to adopt a holistic and multidisciplinary approach, involving a wide range of actors and interests, including governments, businesses, local communities and individuals.

**1.2 Theoretical framework**

Urbanization has been defined as the movement of population from rural areas where agriculture is the predominant economic activity to urban areas dominated by industry and services.[1]

With the demographic increase and urbanization that we are witnessing today, the number of people living in cities will continue to grow rapidly, predicting that by 2050, (70%) of the world's population will live in urban areas, putting increasing pressure on resources and the environment[2].

The continuous growth of urban population inevitably leads to the disorderly expansion of cities, which have long-standing habits of resource consumption and waste disposal. Consequently, a series of complex issues have emerged, such as environmental degradation, biodiversity loss, social dysfunction, scarcity of natural resources, and the increasing anthropogenic climate change[3]. As our societies become more complex and the urban environment deteriorates, the built environment upon which we rely will become increasingly unsustainable.

Despite occupying only (1.6%) of the earth's surface, cities produce a disproportionate amount of waste and harmful emissions. This tiny fraction of territory could be compared to a stone on the Praia do Cassino Beach in Brazil, one of the longest beaches in the world. This comparison helps us to visualize the enormity of environmental challenges: despite the limited extent of cities, which, although occupying only a tiny portion of the planet, have become places of environmental aggression, with devastating consequences for biodiversity and the quality of human life. This parallel "urban stone" generates a disproportionate amount of waste, carbon dioxide and harmful emissions, about the (80%) of the total environmental load, making the most of the resources available on our planet. The final price of this overproduction should be defined by a rebalancing of resources: everything that is taken away from the Earth, should be returned, a sort of virtuous cycle that maintains the natural balance. Reflecting on this comparison, one can realize that life on Earth is concentrated in a thin layer, just 20 kilometers high, known as the biosphere, extending 10 kilometers below sea level and 10 kilometers above. Of all this living, only the (0.3%) represents animal life, the total weight on the whole planet, of which only the (0.01%) belongs to human beings. And the remaining (89.7%) to whom does it belong? About (1.2%) it belongs to fungi and microorganisms, but

[1] He, Reith, (2022)
[2] (CORDIS, 2019)
[3] He, Reith, (2022)

the remaining (87%) of the biomass weight is made up of plants[4]. This percentage may surprise, as it indicates that the predominant weight of life on Earth is represented precisely by plants. However, the question arises as to how it is possible that, despite the domination of plant-related biomass, our planet is facing unprecedented rapid climate change.

In the course of 2020, a surprising fact was recorded: the material produced by man exceeded the weight of life itself on Earth. This comparison becomes even more significant if we relate it to the situation of just a hundred years ago: in 1900, the anthropogenic mass was almost negligible. It is incredible how in a century things have changed so radically, highlighting a devastating impact of human activity on the environment and a concomitant reduction in life as a whole.

In 2021, for example, China produced the same amount of cement that the United States used over a century. This extraordinary volume was consumed in just twelve months.

Speaking of cities, we talk about urban metabolism, which is like exploring the meanders of a living organism, a sort of pulsating entity that swallows and transforms the resources it receives. It is an intriguing concept, which drives us to consider cities not only as agglomerates of cement and asphalt, but as complex organisms able to interact with the surrounding environment in surprising ways. This analogy leads us to reflect on the similarities between the functioning of a city and that of a biological organism. At the heart of this notion is the concept of the circular economy, a principle that recalls the life cycle of nature itself. Imagine a constant flow of resources entering a city, like the blood flowing into the veins of an organism. But what really makes urban metabolism fascinating is its ability to transform these resources into something new, regenerated, just like the cells of the human body that transform food into vital energy. However, this change is not always as efficient as it should be. Unlike plants that exploit photosynthesis to maximize resource utilization, cities often operate with dysfunctional metabolism. Many resources enter, but too often excess waste is produced, generating an ecological footprint disproportionate to the size of the city itself.

The ecological footprint, in this context, reminds us that every human action has an impact on the surrounding environment. Measure the area of land needed to support a specific lifestyle and dispose of the waste produced. It is a powerful indicator that drives us to reflect on our habits and how we interact with the world around us.

One of the main problems facing European cities today is urban organisation, which manifests itself in the conflict between two objectives, both crucial for urban policy. On the one hand, the need to ensure high access to high-level urban services that define the very essence of a modern city, an aspect that no citizen is willing to give up, on the other hand, the challenge of preventing the concentration of such services from leading to an overload that threatens environmental and social sustainability, making the city unlivable.

Reflecting on this dynamic, it emerges clearly that large cities are in a situation of overcrowding compared to the available territorial resources and the degree of concentration. This uncontrolled expansion, which also extends beyond the historic center, has serious consequences: the loss of human sociality (sociality), the decrease in the sense of belonging and identity (identity), and the compromise of environmental sustainability (sustainability)[5].

The fundamental question is therefore: how to decentralise urban functions to reduce congestion and relieve the pressure on the historic centre, without compromising the quality of life?

This tendency for citizens to concentrate in or near urban areas is fueled by the search for advanced urban services. However, it seemed that the advent of modern telematic

[4] (Stefano Mancuso, 2023)
[5] (Franco Archibugi, 2002)

technologies had offered a solution to this phenomenon, reducing the need for spatial concentration: with access to the same services without the constraint of physical presence, The city could no longer be conceived as a collection of physical distances, but as a network of abstract communications. Unfortunately, the intrinsic attractiveness of cities cannot be completely replaced by the convenience of digital technologies as cities continue to offer a variety of social opportunities, cultural and economic that attract people not only for the services available, but also for the energy and diversity that characterize urban life. The vision of a clean and ecological city, regenerative, is what should be investigated, where technology acts as a stimulating and educational element for a better quality of life and a sustainable urban environment. But how can we keep the soul of cities alive in a digital age? How can we ensure that everyone has access to the opportunities that cities offer, regardless of their physical location? In this new world, the very concept of the city is constantly evolving, so we must have the ability to adapt to these sudden changes that will determine our urban destiny. We must recognise that we face a great challenge, not only in terms of adapting and mitigating climate change, but also in terms of restoring the balance between man and the natural environment. And this challenge begins right in our cities.

**1.3 Research methodology**

Looking at cities, we see that urban forestation plays a crucial role in rethinking and redesigning our urban landscape. It is necessary to go beyond aesthetics, considering urban forestation and its methodologies as a fundamental strategy to address environmental challenges and improve the quality of urban life, to restore the lost balance, especially in urban suburbs and in those urban places of environmental and social degradation.
We need to broaden our concept of the urban landscape, considering it not only as a collection of buildings and streets, but as a living organism. This means recognizing the interconnectedness between the natural and artificial elements of our urban environment and adopting a holistic approach to city design and management.
The concept of urban forestation has its roots in the United States, thanks to Frederick Law Olmsted, who adopted an interdisciplinary approach, combining the natural sciences, humanities and landscape design, to develop a new vision of the relationship between man and environment.
The development of effective urban forestry plans requires a collective commitment and an integrated vision, taking into account the environmental, social and economic needs of urban communities.
A significant example is the *"five-finger"* plan of Copenhagen, a 1947 urban plan that included an urban forestation strategy along the *"fingers"* of urban design. The "fingers" represented the backbone of the metropolitan urban railway network, while the interstitial spaces between them were left as green areas, including urban forests, wetlands and agricultural areas. These ecological corridors, in addition to their function of preserving biodiversity, also had to promote creativity and interaction among the inhabitants of the city. In this way, urban forestry is not just a matter of green belts, but a complex system of ecological connections that define and enrich the urban environment.
Recently, there was talk of *"Greening Green Belt"*, an approach that aims to strengthen the existing green belts. This is particularly important in view of the increasingly serious and evident effects of climate change, providing a unique opportunity to redevelop degraded urban areas, including derelict industrial areas and abandoned sites, contributing to urban regeneration and the creation of green spaces vital to the community.
A fascinating example is the landscape plan developed by Ian McHarg, who in the 1960s was commissioned to conduct a study for the city of Philadelphia, which at the time faced serious

pollution problems, especially in the city centre. McHarg, in his book "Design with Nature", highlighted the need to reduce pollution sources to solve the problem and through investigations, McHarg developed indicators based on wind direction and thermal inversion, which revealed how during the winter months, with poor air circulation, the pollutants remained trapped in the atmosphere. Using this data, McHarg identified the so-called *"wind pools"*, or areas crossed by prevailing winds, and established that along these corridors should not be built industrial polluting complexes, but suggested to strengthen urban forestry to improve air quality. These concepts demonstrate the ability to recognize the importance of nature and its integration in urban planning and it is surprising to note that these principles are still current and relevant, also in Italy, where we have only recently begun to consider in more depth the importance of urban forestation and landscape planning to address environmental challenges.

In 2020, in the capitals of the Italian region, the average annual temperature showed an anomaly of (+1.2)°C against thirty years 1971-2000. At the same time, there was a fall in rainfall of (-91) mm on average[6]. Cities have become places of increasing vulnerability to climate change, called hot spots, due to the high population concentration and density of infrastructure. At the same time, however, they present great opportunities for climate adaptation/mitigation actions. 2020 is the least rainy year of the last ten, together with 2011, with a total annual precipitation of 661 mm, reporting, as in 2020, in the capitals of the region, a quantity of water that could meet the needs of about 10 million people was lost daily. The greatest difficulties have been found in the southern regions: in more than one capital out of three there have been total losses percentages above (45%)[7]. In Southern Italy, it was even necessary to take rationing measures in the distribution of water to end users, through the reduction or suspension of the supply.

Due to the concentration of paved and built surfaces, interspersed with a few green spaces, as well as the presence of diffuse thermal sources, such as vehicular traffic, heating or cooling systems, large cities suffer the effect "Urban Heat Island" (UHI).

The term indicates the presence of a warmer microclimate in the city areas than in the surrounding peripheral areas, with average annual temperatures of 1-3°C higher than in the surroundings.

A possible solution to this problem, which is recognized as a valid tool, both of mitigation and adaptation by scientists of the IPCC and is provided for in European (Green Deal) and national (PNRR) plans, is precisely urban and periurban forestation. The vegetation is able to refresh the urbanized areas thanks to the shading and the evotranspiration process.

In addition, the urban greenery performs climate mitigation actions, capturing the CO2 present in the air and absorbs and reduces some air pollutants, making the soil more permeable, thus containing the impact of violent rains, and last but not least, makes our cities more pleasant, liveable and welcoming.

*"The protection and promotion of urban greenery is a natural solution that, by increasing the resilience of cities, can play an important role in climate change strategies and, more generally, in improving the sustainability of urban systems and the quality of life of citizens"* (Elisa Terenghi, 2022).

An excellent news is given precisely with regard to the urban green area where the total area of urban green areas is constantly increasing: in the last decade there has been an increase of green (15%) thanks to urban and suburban forestry works[8]. The distribution of these green lungs is far from uniform in the Italian peninsula, with maximum availability in the capitals of

[6] (Elisa Terenghi, 2022)
[7] (Terenghi, 2022)
[8] (Terenghi, 2022)

the Northeast and minimal in those of the South. This should give us an awareness of how urban forestry is an excellent path to pursue in spatial planning.

**1.4 Case study**

The challenges of demographic, energy and climate change need to be tackled rigorously, innovatively and in research, pluri- and inter-to formulate design responses that will promote sustainable development in the years to come. To re-establish a more direct and lasting relationship with the soil while waiting for a reinterpretation and a wise re-functionalization, in relation to the territorial urban location. There is no more space available to build something new, but we must work in the intermediate bands of different densities, on the brittle margins, on the edges of scattered and weak spaces that require care and maintenance[9]. Therefore a project fot the recovery and regeneration of what remains is urgent: degraded and forgotten enclosed spaces, the post-industrial decommissioning, the areas flattened by the heat islands, the cutouts between the motorway junctions, the illegal construction of buildings, the fallow countryside, all those residues of margin, surrounded by buildings mostly "disinterested" and consisting of spaces without relations and resonances, still free, available for transformation.
How can the architectural and urban project intervene for the requalification of degraded contexts? Is it possible that through waste, you create urbanity and quality landscape, able to regenerate the city and the contemporary territory?
We need a practice of defense, recovery and redevelopment of the interstice, which can become a park, open space, landscape, path and place of exchange to restore a balance between man and nature. Nature and culture can resume a dialogue, trying to relate the signs of the landscape (often anthropic and ideally wild and natural) and even dense artificial presences (built, infrastructure, etc.).
The concept and practice of sustainability are progressively evolving towards a design approach that not only seeks to avoid further damage to the status quo but rather aims to remedy the harm caused by previous practices through a reparative and regenerative approach. The term 'regenerative' denotes a process that repairs, recreates, or revitalizes energy sources, air, water, or other resources. Furthermore, regenerative urban design is seen as a process to replace the current linear system with a cyclical one, aspiring to regenerate life itself and thus offering prospects of hope for the future[10]. Similarly, restoration implies correcting damages resulting from human activities and returning the environment to its original state through deliberate development. The intermediate areas, marginal, of environmental and social degradation, would become compensations that go to rebalance what has torn, injured, saturated and polluted our cities and their surroundings out of control. Spaces that are designed for the community, starting from considerations on the nature of their limits and the most degraded portions, putting them in reciprocal dialogue with the external context, from the scale of the city to the territory itself, in a vital osmotic exchange.
Gilles Clément, landscape gardener, in his Manifesto of the Third Landscape said that the waste is a constituent material of the Third Landscape, a scenario located on the urban edges, uncertain and changeable, place of abandonment and neglect that defines and gathers the whole of abandoned spaces, pockets of acceptance of diversity. The Third Landscape includes all the territory left free, rural and urban, degraded or excellent: the edges of roads and plots of land, the margins of industrial areas, nature reserves.

[9] (Anna Arioli, 2012)
[10] He, Reith, (2022)

*"It is the space of indecision and the living beings who occupy it act in freedom. Consider in the third landscape a biological need, which affects the future of living beings, changes the reading of the territory and enhances places usually neglected"* (Gilles Clément, 2015). The project is called into question for an integrated and multi-scale intervention with particular attention to the naturalistic dimension and the design of the connections (paths, accesses).

Considering urban forestry plans and supporting the related ideologies, such as the creation of green belts and ecological networks, is a method of rebalancing the urban ecosystem. This implies the integration of green areas with spaces dedicated to services and cultural, physical, work, social, connected by a minor network, light and slow, of discontinuity in full, but also of continuity within areas that are polluted, fragmented and isolated. The landscape enters the city, the open space designed and recomposed, no longer residual, discarded, becomes a place of propulsion of relationships and energies[11].

Indicators related to space and infrastructure are crucial in sustainability-oriented urban design. While some findings regarding infrastructure suggest a return to human-centric design, physical proximity does not always imply a significant connection between spaces[12]. Hence, it is essential to create a "network of places" to foster deeper connectivity and better integration among urban areas. Regenerative urban design tackles urban challenges from an integrated perspective of economy, society, and environment, not only seeking to increase conventional indicators such as employment and biodiversity but also restoring and establishing adaptive capacity. Additionally, reparative urban design not only restores polluted and damaged ecosystems to a healthy state but also integrates nature into daily life through appropriate design models, while promoting interaction and contact with nature to enhance the physical and mental well-being of inhabitants. Regenerative urban design goes beyond conventional indicators to include those emphasizing nature as a form of self-regeneration, such as solid waste reuse, renewable energy, and the development of a sense of place. Physical connectivity does not erase boundaries between various spaces, as people tend to mentally separate these elements[13]. However, the geometric relationship between places influences the type of feeling a place conveys to individuals. Here is how eco-human paths, where species can wander without the constraints of suspension, sudden or gradual, which can occur in an urban or non-urban setting, represent new strategies for eliminating boundaries. Chlorophyll connections provide the possibility of a continuum, a transition from one space to another, immersed in the well-being gifted by greenery. A design that we can define as "biophilic urban planning" that aims to mend the dynamics of marginal landscapes, degradation, abandonment, and the city with its anthropic behaviors, rendered polluted and uncontrolled in its social and geographical growth.

Eco-human paths in which species can walk without conditions of suspension, sudden or gradual, that can occur in an urban or non-urban path, chlorophyll connections that give the possibility of a continuum, a transition from one space to another, immersed in the wellness given by the green. New strategies that go to mend the dynamics of the landscape of margin, of degradation, of abandonment and the city with its anthropogenic behavior, made polluted and uncontrolled in its social and geographical growth.

Through the vegetation it’s possible, not only to absorb carbon dioxide and release oxygen, helping to reduce the greenhouse effect and alleviate the negative effects of air pollution, such as reducing urban temperature, mitigate the effects of heat islands, but these realities also offer a regenerating space for citizens, promoting well-being and reducing stress, helping to create a more comfortable climate in the cities. These urban forestry initiatives and the creation of green rings transform the forgotten areas of the city into more sustainable and

[11] (Anna Arioli, 2012)
[12] He, Reith, (2022)
[13] He, Reith, (2022)

welcoming places for their inhabitants, re-educating and transmitting all those environmental and social benefits that are now lacking in the territories of dispersion of the saturated city and its very margins, building new centralities open to the landscape, to put into system redeveloped complex spaces, disoriented inhabitants, energies and structuring dynamics. Making those forgotten, empty places become protagonists and material of composition to give a new structure to those fragments of a degraded city. The residues, the free portions of space, emptied but almost never empty, constitute the weak and yet fertile framework on which to fix new reference points[14].

Imagine a city where nature and urbanization are not in conflict but harmoniously integrate to create a healthier, more sustainable, and welcoming urban environment for all its inhabitants. This is the vision of a reparative city, one that utilizes afforestation and ecology to regenerate its abandoned spaces into oases of life and well-being. Urban afforestation is not merely an aesthetic concern; it is an intelligent strategy to address multiple urban challenges. However, this process is not without its challenges. We must carefully consider crucial issues such as accessibility, safety, sustainability, and social inclusion. How to address the practical challenges related to transforming abandoned urban spaces into green areas, such as accessibility and safety? In the context of urban repair, one of the fundamental questions is how to design and plan a safe city through forestation and the creation of intelligent urban parks. The presence of trees and green spaces is essential to improve urban life quality and promote citizen well-being, but it also presents practical and safety challenges that must be carefully addressed. One critical aspect, for instance, concerns the access of emergency vehicles to various points in the city, including fire trucks, ambulances, and law enforcement, to operate effectively. However, the presence of obstacles such as trees and dense vegetation along streets and in parks could compromise their proper positioning and swift access in case of emergencies. This challenge raises significant urban planning and design issues, particularly concerning public space planning and the arrangement of green elements in cities. It is essential to provide dedicated areas for emergency vehicle transit and ensure the presence of escape routes with alternative access in case of emergencies. To address this challenge more broadly, it is important to consider the safety of the cities from various aspects, such as crime prevention, traffic management, protection from extreme weather events, and more. Solutions could include the integration of surveillance and lighting systems in urban green areas, the design of safe roads and sidewalks for pedestrians, and the implementation of traffic management policies that promote safe and sustainable mobility. Addressing the issue of safety in cities in urbanized contexts with a strong presence of trees and vegetation requires an integrated and collaborative approach that takes into account safety needs, environmental sustainability, and community involvement.

In the context of the urgent need to address contemporary urban challenges related to climate change and quality of life, the innovative perspective of using artificial intelligence (AI) emerges and advanced technologies to drive urban regeneration through forestation.

Within these parks, a network of biological sensors would be installed to monitor the health of urban ecosystems in real time, to detect changes in air, soil, water and biodiversity, providing detailed and predictive environmental health data.

In parallel, the system could include a community engagement component, through the implementation of digital platforms and mobile apps that allow residents to actively participate in the planning and management of urban forests. This platform could facilitate communication and collaboration between residents, local organizations and public authorities for the management and animation of green spaces. Users could share ideas, projects, and initiatives to enhance and enrich the city's green spaces, thus promoting greater

[14] (Arioli, 2012)

community involvement, aware of which aspects of their cultural heritage need to be protected and preserved. All of this can lead to educating and raising awareness within the community about the importance of urban green spaces for health, well-being, and the environment. The shared information becomes educational resources and success stories to inspire greater appreciation and use of green spaces. An innovative way to promote environmental sustainability, improve urban quality of life, and encourage greater community involvement in the management of urban green spaces.
In the digital age in which we live, we must rethink art as a tool and support to improve urban quality, no longer confined to the walls of galleries or museums, but spread among urban contexts, interacting with our daily environment in innovative and exciting ways. The installation of digital art and immersive arts in eco-human paths is a powerful tool to raise awareness of environmental and climate issues that we face today.
These works of art not only decorate public spaces, but also serve as a vehicle to convey important messages about the environmental crisis we are experiencing. Using advanced digital technologies, such as lights, colors and projections, artists can represent in a tangible way the climate changes and environmental pollution that directly affect our lives and our habitat. A tangible example of this approach is the integration of sensory elements into digital artworks, which allow environmental data such as air pollution or temperature to be detected and displayed in real time. In this way, citizens who go through these eco-human paths can immediately understand the impact of their actions on the surrounding environment.
In addition, 3D installations representing models of facilities and services in the area add an additional layer of interactivity and information. These representations can be enriched with additional data, such as statistics on energy consumption or emissions produced, to educate the public on sustainable practices and innovative solutions available. In summary, the use of digital technologies in urban art not only enriches the aesthetic experience of citizens, but also promotes awareness and action towards the preservation of our planet. This form of artistic expression is thus an essential bridge between human creativity and the global challenge of environmental sustainability. It becomes crucial to consider the crucial role of education and awareness in promoting sustainable practices and encouraging the adoption of eco-responsible behaviour. Educational programmes and awareness-raising initiatives in the form of digital art would help actively involve citizens in the care and enhancement of urban green spaces, transforming them into places of learning and personal growth. Through environmental education and the promotion of sustainable lifestyles, we can create a more conscious and committed urban culture in protecting our environment and future generations.

**1.5 Conclusion**

This approach aims to create sustainable and resilient cities that grow together and with green photosynthesis, can address the environmental and social challenges of the 21st century in an effective and collaborative way. New urban parks, "Intelligent Urban Ecosystems" (IUE), inserted in those marginal realities of degradation and pollution, restoring a new identity, reversing the approach, so as to redevelop the city itself that tried to destroy them, making them empty spaces. These places will not become static green parks, but real dynamic ecosystems and interconnected by eco-human networks, managed through the use of artificial intelligence and emerging technology: a regenerative break and synthetic photo for the entire city and its territory. Within these reforested spaces or parks, we could find functions and services suitable for the city, where citizens can identify their activities.
Any buildings and infrastructure within these parks would be designed with an *"intelligent green"* approach, including plant facades integrated with irrigation and self-powering systems, green roofs equipped with photovoltaic technology and rain water collection facilities. Roads

and pavements made of permeable materials that allow water to infiltrate the ground, reducing the risk of flooding and recovering water that would otherwise be discarded.
Design with a focus on resilience to climate change, integrating infrastructure and adaptation practices that protect the city from the effects of extreme events, such as floods, drought and heat waves. An urban planning project that addresses the environmental, social and economic challenges faced by modern cities, integrating innovative and sustainable solutions to create more prosperous and resilient urban environments.
The landscapes of the peri-urban countryside connote memories and call for redevelopment to bring benefits and values to the city, which has grown away from the countryside, placing it on the margins of an increasingly rampant expansion. Today, urban agriculture is gaining popularity: from hydroponic crops on roofs to vertical gardens on the walls of buildings, becoming real centers of local food production. These initiatives not only provide fresh and healthy food to urban residents, but also reduce dependence on long-distance transport and promote environmental sustainability. Urban gardens are not only places of food production, but also community meeting points. People come together to cultivate, share knowledge, and socialize, creating stronger bonds between residents and fostering a sense of community. These spaces foster cultural exchange and social cohesion, helping to create more livable and resilient cities. Traditional coworking spaces are evolving to include elements of biophilic design in green design, with a focus on the psycho-physical well-being of individuals[15]. The goal is to (re)create a powerful connection between urban spaces and nature, making our habitat greener through osmosis between design, architecture, and natural elements, symbolizing vitality par excellence. Plants, in fact, not only improve air quality and reduce stress but also create a more stimulating and creative work environment.These hybrid spaces integrate digital connectivity with the sensory experience of nature, offering a green haven for urban professionals.
We must also imagine the cities of chlorophyll as a hub for the circular economy and sustainability: catalysts for a more sustainable approach to the use of natural and renewable resources, collected within the parks, such as solar energy through photovoltaic panels and rainwater collection through drainage and filtering systems, exploited to feed local production processes. In this context, innovative solutions for waste management, such as organic composting and the production of biogas from food waste, could be implemented to create a virtuous cycle of recycling and reuse of resources within the urban community. The adoption of circular economy practices would reduce the consumption of finite resources and the environmental impact associated with the production and disposal of materials, while promoting greater resilience and local self-sufficiency.
In some chlorophyll parks space will be given to living laboratories for the research and development of innovative technologies and business models oriented towards sustainability. Through collaboration between public authorities, research institutes, businesses and local communities, initiatives are promoted to stimulate innovation and the adoption of sustainable solutions in key sectors such as energy, mobility, construction and urban agriculture. These projects promote social inclusion, offering spaces for meeting and public use for people of all ages and socio-cultural backgrounds, becoming a reality to improve the physical environment of cities and a driver of growth and social cohesion.
Ultimately, these smart parks and eco-human networks would represent not only an opportunity to strengthen the connection between man and nature in regenerative cities, but also an engine of transformation towards a more sustainable and resilient future.

[15] Braga, (2020)

In chlorophyll networks, space is given to intelligent mobility, addressing current challenges related to pollution and traffic congestion, promoting a more balanced and harmonious urban environment.
Integrating eco-human corridors and linear parks along transport infrastructure such as cycle paths, sidewalks and roads can create ecological corridors that allow plants and animals to move freely within the urban environment. These infrastructures not only improve the air quality and aesthetic appearance of the city, but also promote biodiversity by offering natural habitats and corridors for urban wildlife.
The integration of electric vehicles with sharing systems would reduce the total number of vehicles in circulation, freeing space for the creation of green zones to preserve the urban landscape. Parks, public gardens and green corridors provide vital habitats for plants and animals, increasing the quality of life for urban dwellers and promoting nature conservation even in urban areas.
Urban regeneration through forestation and the creation of eco-human corridors offers an innovative solution to environmental and social challenges. With smart urban parks equipped with biological sensors and green networks that aggregate services to the community, we create intelligent and resilient ecosystems, actively involving the community, trying to reduce the growing crowding in the cities and bringing people back to live even in peri-urban areas, dark and forgotten. These parks not only improve air quality and biodiversity, but also become vital centers, with a cutting-edge approach to a more sustainable city, connecting through more ecological culture, art and services, a city that grows thanks to chlorophyll and its photosynthesis.
To conclude, urban regeneration through forestation and the creation of intelligent urban parks offers an innovative and vital solution to the environmental and social challenges of our time. This approach not only improves air quality and promotes biodiversity, but also transforms urban spaces into vital hubs of connection and resilience. By actively involving the community in this process, these parks, reachable and connected through eco-human corridors, become places of encounter, learning and collaboration, creating a more sustainable and supportive urban fabric. Through chlorophyll and its photosynthesis, we guide the growth and the journey towards a city that embraces nature and culture as fundamental pillars of its development. It is smart urban parks, equipped with biological sensors and integrated green networks, that offer us a brighter future, where connectivity, ecology and community well-being are at the heart of urban design. In this context, the city is not only a place of residence, but becomes a dynamic and interconnected ecosystem, able to adapt and thrive in the face of the challenges of climate change and urban growth.
Reparative and regenerative urban design is closely related to the goals of sustainable development, mitigating and minimizing the negative impacts of design and development on natural systems, while also using the built environment to promote a closer relationship between humans and nature. Urban development must go beyond simply maintaining sustainability; urban design thinking must transcend the dialectic of coexistence between humans and nature, pursuing the logic of coevolution between humans and nature.
Chlorophyll thus becomes our ally, guiding us towards a greener, regenerative city in harmony with our planet.

**Reference**

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