Research Paper

Urban Green Space Planning Based on the Aniene River Heritage Corridor

Biodiversity Conservation and Sustainable Urban Design

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Abstract

With the momentum of urbanization, present places face challenges such as ecosystem degradation, tight geographic tools, and declining environmental quality. By incorporating the cultural and natural heritage of the Aniene River, this research explores a complete industrial green space planning method to advertise biodiversity conservation and sustainable development of places. In an era of rapid industrial expansion, this integration highlights the value of using historical and ecological narratives to enhance urban landscapes.

This paper uses green design principles to produce sustainable and resilient industrial environments in response to the Aniene River Heritage Corridor's recommendations for industrial green space planning. The purpose of the paper is to show how corporate urban planning can promote synergies between urban development and environmental conservation.

By preserving crucial environments and developing ecological corridors, which are essential for maintaining industrial diversity, the study successfully maintained and enhanced wildlife.

Importantly important in nearby communities, widespread and keystone types received special attention. implemented functional green space plans in densely populated areas

industrial ecology is protected while accommodating pleasure needs in densely populated areas. This included designing areas that serve multiple features, such as entertainment, flood mitigation, and biodiversity delivery. In order to improve the state's ability to adapt to climate change, the city should emphasize the importance of managing water resources, green infrastructure, and energy-efficient architectural design. As essential elements of sustainable urban design, innovative solutions like rain gardens, permeable pavements, and natural roofs were highlighted. A useful model for optimizing industrial environments was developed using the Aniene River Heritage Corridor for industrial green space planning, which incorporated biodiversity conservation, green design, and population needs. As a major reference point for global cities, this organizing strategy enhanced both the ecological resilience of places and the people ' quality of life. The project demonstrates how intelligent use of green infrastructure and landscape design can transform urban spaces into attractive, good, and sustainable environments.

Keywords

Biodiversity Conservation, Sustainable Urban Design, Ecological Corridors，Green Infrastructure

1. Introduction

Cities are confronted with numerous environmental and social issues as global urbanization progresses. Urban expansion is required to provide growing groups and more economic activity. But, natural communities are frequently harmed by this expansion. Humanity's endurance is weakened by the loss of biodiversity and the loss of natural communities. Additionally, it lowers the standard of living in urban

places. It is crucial for urban planning to balance development needs with the protection and restoration of natural environments (Piracha & Chaudhary, 2022, Daz et al., 2006, Tzoulas et al., 2007). Problems like air pollution, urban heat islands, and flooding get worse. With its abundant historical past and distinctive natural environment, Rome must balance marketing sustainable urban development with protecting cultural heritage. The Aniene River Heritage Corridor's development as a unit for urban green spaces is the focus of this study. This type of planning may aid in the protection of diversity and enhance city residents ' quality of life.

2. Urban Green Space Planning in Rapid Urbanization

Urbanization has accelerated to a level never before seen in the 21st century. Normal ecosystems are frequently hampered by this rapid industrial growth. It leads to scattered environments, higher levels of pollutants, and the loss of normal areas that are essential for supporting wildlife and ecosystem services. For instance, urban green spaces are crucial for maintaining biodiversity and supporting species diversity (Goddard et al., 2010; Aronson et al., 2014; Beninde et al., 2015). These issues are particularly significant in Rome. Urbanization makes it harder to preserve Rome's historical and cultural heritage in addition to affecting healthy situations.

Rome is currently experiencing quick urbanization. The growth of residential areas and significant infrastructure upgrades contribute to this. This industrial expansion is fueled by population shifts away from the city centre to the suburbs, leading to more residential and commercial development. In order to meet the needs of its expanding community, the town is also upgrading its transport, energy, and communication techniques. Rome's hospitality sector, which contributes significantly to the country's economy, has grown even faster with system projects. This is especially evident in the traditional centre, where there is a lot of industrial development. These urbanization initiatives, but, present challenges, particularly for the preservation of Rome's wealthy historical and natural heritage. As seen with the Metro C range, construction projects frequently experience difficulties caused by historic discoveries. Also, fragmentation and uneven economic policies, which prevent them from addressing issues like waste and habitat loss, make efforts to expand natural spaces difficult. The city must strike a balance between modernization and the preservation of its distinctive historical and ecological resources (DeRobertis & Tira, 2016; Capotorti et al., 2013).

In reducing urbanization's adverse effects, urban green spaces are important. They provide important ecosystem services, like climate rules, temperature regulation, and rainwater control, which are essential for reducing places ' environmental impact. Green spaces also offer recreational and cultural activities for residents, helping to strengthen social bonds and improve public health (Ahern et al., 2014, Haase et al., 2014, Sandifer et al., 2015, Chiesura, 2004).

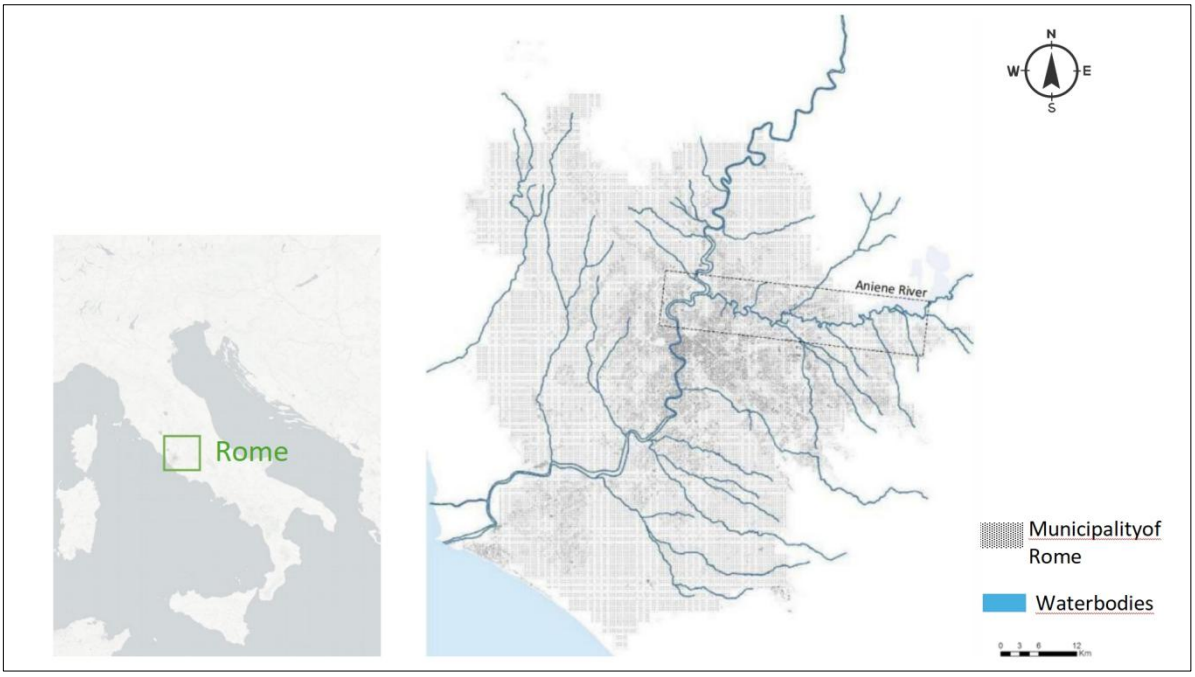


Fig.1 The Aniene River has a very important place in Rome

Source: Own design based on Urban Atlas (EU Copernicus Programme, 2012).

3. The Importance of the Aniene River Heritage Corridor

The more well-known Tiber River has long overshadowed the extra lake in Rome, the Aniene River. The Aniene's healthy ecosystems have experienced increased damage, serious waste, and a lack of effective habitat planning as urbanization has progressed. The Aniene River Heritage Corridor task demonstrates how urban green spaces can help address the challenges posed by swift urbanization. Cities can build systems that support diversity while enhancing the quality of life of people by incorporating natural spaces into the urban environment.

3.1. Historical Significance and Decline

The Aniene River Valley, a significant source of water for the metropolis, was a significant source of water in ancient Rome. The river supported crops, which was crucial to Rome's wealth, as well as providing having water. Some popular aqueducts, such as the Aqua Anio Novus and Aqua Anio Vetus, were constructed to take fluids from the Aniene River to Rome, revealing the engineering skill of the Roman Empire. These aqueducts now serve as historical landmarks, highlighting the significance of the valley in the city's growth and development.

Moreover, Roman nobility favored a retreat at the Aniene River Valley. In the area, numerous aristocrats constructed villas and enjoyed the tranquillity of the natural setting for leisure and recreation (DeRobertis & Tira, 2016).

However, the Aniene River Valley started to suffer carelessness as Rome evolved. Rapid urbanization caused environmental degradation, like water pollution and wildlife separation. The river has been severely impacted by the pressures of urban growth despite after being a significant agricultural and natural area. In an effort to preserve the area's historical and ecological significance, the authorities and

environmental agencies have made efforts to restore it and promote sustainable development in recent years, development that seeks to stabilize the valley's historical value with its natural importance.

3.2. Protecting core ecological habitats

The Aniene River is a significant natural hall that supports a variety of types and ecosystems. Rome's wildlife is greatly increased by the Aniene River Valley's approximately 500 shrub species and more than 100 bird species. A wide range of plants and animals can be found in the Aniene River Valley Nature Reserve. Papyrus, retina, and blackberry are typical vegetation in this stockpile, along with many other water plants that grow in wetland habitats. Brown trout, crabs, frogs, and some invasive species like the American crayfish are also found in the Aniene River (Wikipedia, 2024).

3.3. Social and Cultural Significance of the Aniene River Heritage Corridor

Critical social and cultural significance surrounds the Aniene River Heritage Corridor. Designers can incorporate cultural heritage with natural recovery by protecting and displaying old aqueducts, historic sites, and cultural landmarks along the creek. This strategy helps both Rome's residents and visitors have a richer experience while maintaining its historic significance. A living example of Rome's history can be found in the river hall. Additionally, it opens up fresh opportunities for educational and cultural pursuits.

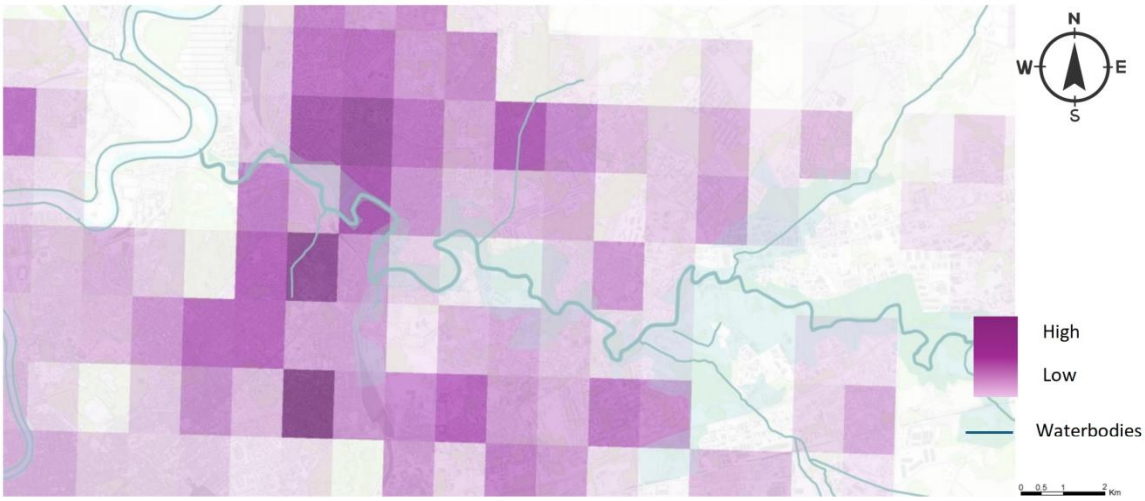


Fig.2 Population Density（https://www.worldpop.org/methods/populations/）

4. Content formattingPlanning

4.1. Project Focus

The Aniene River Heritage Corridor style aims to bring together industrial planning's historical and natural elements. This strategy promotes a town that is more tenacious, more sustainable, and sustainable. Critical cultural landmarks like old Roman aqueducts and historic ruins, which depict Rome's traditional development, are preserved while also being preserved. The design incorporates cultural heritage into industrial green space planning, providing both economic and historic knowledge and enriching experiences for both residents and visitors.

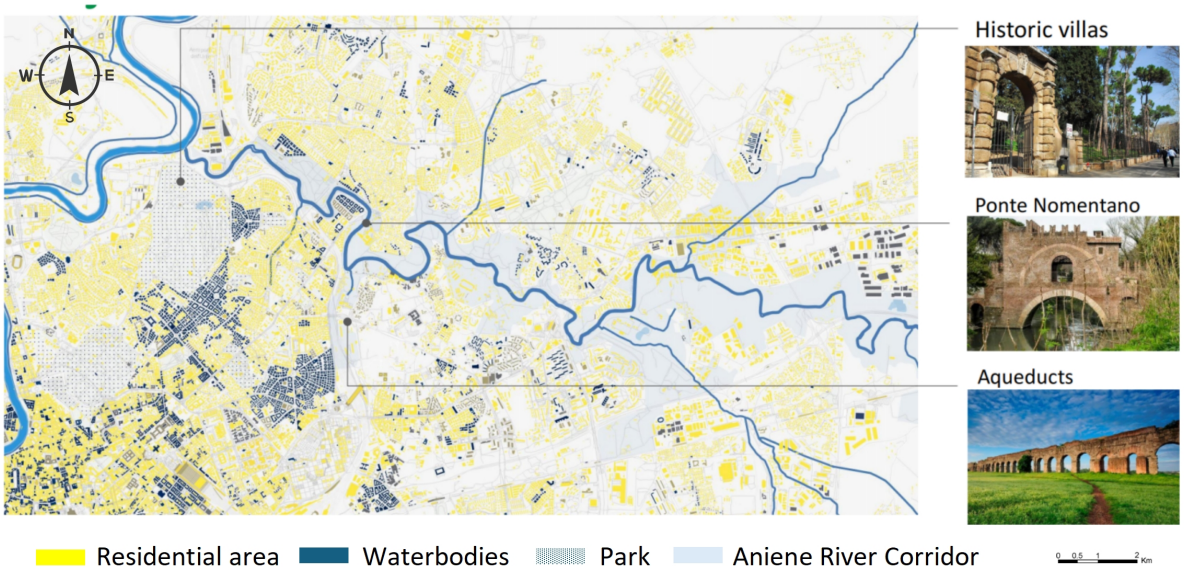


Fig.3 Aniene River Heritage Corridor historic site

Source: Open Street Map database (http://download.geofabrik.de/, accessed on 23 March 2024).

4.2. Identifying key ecological areas and corridors

Land use drawings from OpenMap were used in this investigation to transform land use data into linear pictures using ArcGIS software. A value of 1 was given to areas impacted by human actions, such as farmland, building land, and non-construction area. A benefit of 2 was given to natural resources like forests, grasslands, and water systems. In a linear TIF format, this categorisation created a foreground and background isolation. The review then used GuidosToolbox software to perform MSPA analysis.

Understanding the spatial arrangement of green spaces and their ecological roles can be learned using Morphological Spatial Pattern Analysis (MsPA). In industrial communities, MsPA has played a significant role in identifying critical environments and ecological corridors. These" core areas" and" corridors" are crucial because they promote biodiversity and promote ecosystem health (Prevedello & Vieira, 2010; Hansen & Pauleit, 2014; Opdam & et al., 2006). This approach improves the design of green infrastructure in response to needs (Williams & Winfree, 2013, Forman, 2014).

The Aniene River Heritage Corridor is divided into three main components using the Morphological Spatial Pattern Analysis (MsPA) technique. The population density and historic sites of the area are taken into account in this sector. The MsPA actions are explained in simple terms in this example:

Core Competencies

The core areas are identified as the primary biological areas on both flanks of the Aniene River Heritage Corridor. These locations are crucial for conserving wildlife and sustaining local varieties. Traditional sites, like old Roman aqueducts and cultural landmarks, are also preserved in these core areas. This enables the fusion of biological significance and historic significance.

Edges and Corridors

Hallways and sides are marked to maintain solid natural connections between core areas. These hallways are essential for promoting species activity, particularly in urban environments where movement is frequently constrained. The sides reduce the impact of local industrial actions by serving as buffer areas for core areas and hallways. To prevent conflicts between human actions and biodiversity, population density information is also used to prepare these corridors.

Landscape Fragmentation

Finding and evaluating isolated areas in the Aniene River Heritage Corridor, like as trees and little green islands, is a top priority for landscape separation analysis. This analysis helps to understand how dispersed the place is, as well as develop plans for reconnecting these dispersed regions. Additionally, it makes for a more constant and related wildlife. A particular emphasis is placed on reducing the effects of industrial equipment fragmentation. To join these remote areas, alternative roads or links are suggested.
In order to maintain wildlife, increase wildlife value, and increase accessibility in the Aniene River Heritage Corridor, planners can combine natural, historical, and industrial factors using this approach.

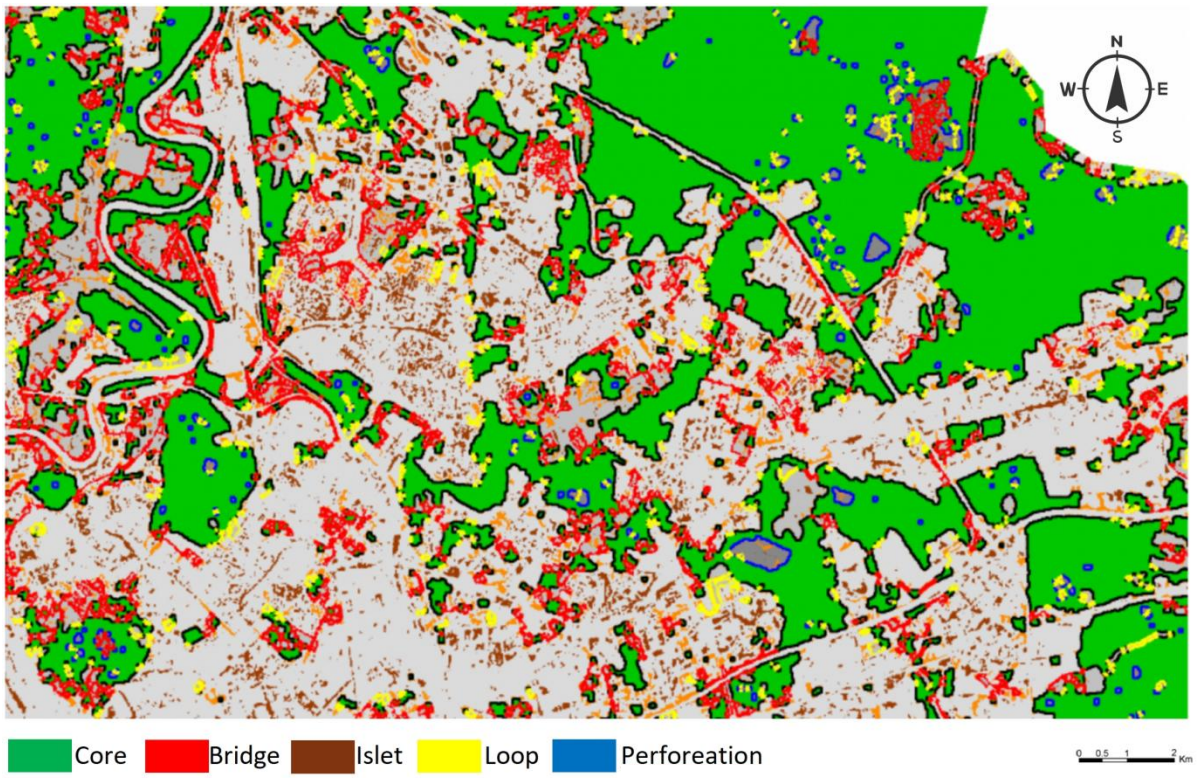


Fig.4 The MSPA landscape classification

Source: Open Street Map database (http://download.geofabrik.de/, accessed on 23 March 2024).

4.3. Strategies for planning and protecting biodiversity

The classification of ecological corridors in the Aniene River Heritage Corridor is following the tiered natural hall system described above, adjusted to fit the town's unique natural and cultural features. We can maintain a healthy balance between natural security, industrial power, and residents ' needs by creating various types and functions of ecological corridors. Below is an analysis of the categorization of ecological

corridors in the Aniene River Heritage Corridor:



Fig.5 The extraction map of network center and Ecological corridor construction

Primary Ecological Corridors: Important channels connect big nature reserves to urban green spaces, known as primary ecological corridors. These interactions aid in the protection of wildlife and the movements of varieties. These corridors enable animals and plants to shift between secluded habitats in order to maintain natural contacts. These hallways connect urban parks and green spaces, stretching from the city's borders to the city's borders. This facilitates the integration of more extensive natural networks between metropolitan areas.

These key corridors improve the conservation of town ecosystems as well as promoting wildlife movement and genetic variety. They offer people important ecosystem services like regulating temperatures, cleansing the air and water, and providing them with recreation areas. These corridors aid in maintaining healthy processes, reducing biodiversity fragmentation, and protecting biodiversity within the city by connecting outer nature reserves with inner-city natural spaces. In order to promote a more harmonious interaction between character and industrial areas, they serve as protective barriers to the stresses of urban development.



Fig.6 Primary Ecological Corridor

Secondary Ecological Corridors: Urban gardens and river systems are connected by secondary ecological corridors, creating entertainment areas that balance human and natural needs. These hallways serve as important links between urban areas and natural settings, which promote biodiversity and enhance residents ' quality of life. These passageways give people a chance to enjoy and enjoy the natural environment without having to travel a long way from home because they give them access to nature within the area.

These corridors serve both natural purposes as well as areas to unwind and unwind. They promote lasting urban growth while allowing people to take advantage of nature's advantages.



Fig.7 Secondary Ecological Corridor

Tertiary Ecological Corridors: Greenways along smaller creeks and roads are used by Tertiary Ecological Corridors to reduce urban natural separation. These passageways facilitate simple access to clean locations for entertainment and exercise and strengthen connections between little ecosystems. These corridors offer crucial outdoor spaces for walking, running, biking, and other exercise activities in densely populated areas where large parks are frequently absent.

These corridors promote the city's natural health as well as promote the real well-being of the residents by blending nature and urban facilities. People have a better chance of connecting with nature and staying engaged yet in highly developed regions.



Fig.8 Tertiary Ecological Corridor

5. Future Development

The Aniene River Corridor's potential growth will concentrate on strengthening natural contacts throughout Rome and expanding its green storage system. In order to increase biodiversity, main efforts will be made to restore damaged habitats, improve water quality, and introduce native plant species (Tzoulas et al., 2007, Sandifer et al., 2015, Hansen & Pauleit, 2014, Alberti, 2005). Modern green infrastructure techniques, such as urban wetlands, rain gardens, and permeable pavements, will also be applied to help minimize flooding and power urban heat island results (MEA, 2005, Haines- Young & Potschin, 2010, Benedict & McMahon, 2006).

For the program's success in the future, community involvement is also crucial. According to research, including local residents in the planning and maintenance of green spaces can promote environmental responsibility and enhance city quality (Haase et al., 2014; Ahern et al., 2014; Dearborn & Kark & Kark, 2010, Ryan, 2005). The Aniene River Corridor project (Colding & Barthel, 2013) aims to foster community involvement by fostering a strong commitment to the long-term preservation and enhancement of urban green spaces (Colding & Barthel, 2013).

6. Conclusion

The Aniene River Heritage Corridor task shows how natural protection, cultural heritage, and green urban planning is all exist together in places. By using Morphological Spatial Pattern Analysis (MsPA), the project found key ecological areas, ecological corridors, and how urban growth affects biodiversity. This data assisted managers in developing a robust, multipurpose clean space system that benefits both Rome's citizens and its natural environment.

The initiative also demonstrates how cultural heritage can be preserved and included in urban development without compromising sustainability, such as traditional villas, aqueducts, and historical sites. The success of these initiatives depends largely on community involvement. The project promotes environmental responsibility and fosters interpersonal relationships by including local residents in the planning, construction, and maintenance of these places.

7. Acknowledgements

This project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.4 - Call for tender No. 3138 of 16 December 2021, rectified by Decree n.3175 of 18 December 2021 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU;Award Number: Project code CN_00000033, Concession Decree No. 1034 of 17 June 2022 adopted by the Italian Ministry of University and Research, CUP B83C22002950007, Project title “National Biodiversity Future Center - NBFC” .

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