

Reflections on the Path of Landscape Heritage Reuse and Urban Ecological Restoration under the Resilience Concept

Bohan Li

MSc in Sustainable Architecture and Landscape Design (SALD) of Politecnico di Milano, Piacenza, 29122, Italy

Abstract: How to guide landscape heritage reuse and urban ecological restoration with the concept of resilience: A study. Instead of providing new empirical data, it collects existing research on socioecological resilience, historic urban landscapes, green infrastructure and circular regeneration to propose a conceptual system for heritage-led ecological restoration. First, resilience thinking and its application to cities as complex social-ecological-technical systems are introduced; then, how international instruments such as the UNESCO Recommendation on the Historic Urban Landscape and culture-based urban resilience agendas have redefined landscape heritage as a dynamic resource is explored. Based on landscape ecology and the concept of the circular economy, this paper studies how adaptive reuse of landscape heritage sites, such as old parks and cultural routes, as well as industrial and rural heritage areas, can promote biodiversity, connectivity, ecosystem services and community identity. Resilience-oriented reuse should be achieved through integrated planning of heritage conservation, ecological restoration and urban development, and nature-based and hybrid infrastructure solutions are practically feasible, reducing excessive reliance on heritage as a single remedy. The paper concludes by putting forward governance and design rules that can support careful, context-sensitive reuse of landscape heritage in the context of urban ecological restoration.

Keywords: Resilience; landscape heritage; adaptive reuse; urban ecological restoration; green infrastructure; historic urban landscape.

1. Introduction

Cities are now large-scale socio-ecological-technical systems that face problems such as climate change, biodiversity loss, social division and infrastructure vulnerability. Therefore, resilience thinking has gradually emerged as a guiding idea in urban planning and design to shift the focus from narrow stability to adaptability, transformability and learning.

At the same time, landscape heritage, which includes old parks, cultural routes, industrial areas and rural landscapes in urban areas, has also been designated as a resource for sustainable and resilient development. The international system now believes that heritage should be used in modern city life in a living way, rather than being kept as a museum piece.

This paper studies paths for landscape heritage reuse and urban ecological restoration in light of the resilience concept. It develops a conceptual argument based on existing literature rather than new empirical data, and aims to connect resilience theory, landscape heritage policies and ecological restoration practices in an integrated way for heritage-led urban repair.

2. Resilience Thinking and Urban Social-Ecological Systems

Holling was the first to propose that the strength of a disturbance-response ability for an ecological system is its capacity to adapt to change under disturbance by retaining basic functions, structure and feedback mechanisms [1]. Later research on panarchy and adaptive cycles extended this idea to interconnected human-nature systems and focused on cross-scale interactions and changes [2]. As shown in the above results, resilience is not the absence of fear but the

ability to adapt and recover from difficulties.

Resilience thinking has been used in infrastructure, climate adaptation and disaster risk reduction for urban areas, and more recently, at the socio-ecological level, community identity and ecosystem services have also been applied [3-4, 8]. Landscape ecologists and urban designers believe that cities can be regarded as mosaics of patches and networks that support or restrict ecological processes, and that resilience depends on the arrangement and management of these patterns [4, 7].

Ahern proposes moving from a fail-safe approach to a safe-to-fail strategy, and advocates designing for uncertainty by distributing risk through redundancy, multifunctionality and connectivity [3]. The above ideas will directly guide the planning of landscapes as operational systems that can absorb shocks, redistribute flows and support recovery. Resilience thinking for landscape heritage reuse advocates viewing historic sites as nodes in a larger social-ecological network, and thereby enhancing the adaptive capacity of the network.

3. Historic Urban Landscape Approaches and Heritage-Based Urban Resilience

The policy for international heritage is increasingly resilient-oriented. In accordance with the UNESCO Recommendation on the Historic Urban Landscape (HUL), historic urban areas are evolving landscapes resulting from the cumulative influence of cultural, natural and socio-economic forces over time [5]. It calls on the Member States to give back to the heritage protection of their cities and areas in an orderly manner [5].

The HUL approach proposes a landscape view that considers multiple levels of urban heritage, such as

monuments, ordinary fabric, water bodies, green areas, agricultural land, topography and intangible practices [5]. All of the above are in line with resilience thinking; urban heritage helps promote social cohesion, identity and ecological continuity, thereby strengthening the resilience of communities to environmental and economic changes [6, 11].

UNESCO's Culture: Urban Future report has put forward culture-based responses to urban resilience and recommended that local authorities integrate heritage and traditional knowledge into plans for addressing environmental problems and climate change risks [6]. Recently, studies on historic urban landscapes and heritage systems have proposed that heritage assets can promote place-based innovation, adaptive reuse, circular economy strategies and ecological benefits such as the conservation of traditional landscapes and practices [10-11]. The above developments show that landscape heritage can be used to promote resilient urban regeneration, but only when it is included in an all-encompassing planning system and not handled in isolation.

4. Landscape Heritage Reuse under the Resilience Concept

Adaptive reuse of landscape heritage refers to using old sites, parks and cultural landscapes for new social and environmental purposes while keeping their multiple values. In the context of resilience, reuse refers to a way of maintaining the continuity of place identity and ecological function while enabling new uses and performances [10-11].

Research on heritage-based urban recovery has shown that adaptive reuse can promote social cohesion, economic development and environmental protection by using heritage resources as the foundation for urban renewal [10-11]. Case studies of industrial and rural heritage landscapes show how thematic cultural routes, public spaces and multifunctional green areas can be created by reusing strategies that combine physical restoration with community participation and smart heritage technologies [10-11].

Resilience-oriented reuse also stresses the need for flexible, reversible and context-sensitive interventions. Rather than fixed programs, designers and planners are now encouraged to explore hybrid uses that can be adapted over time for various community needs and incorporate ecological restoration. Therefore, the evaluation of heritage reuse should also consider how well it supports the adaptive capacity, redundancy and connectivity of the urban system [3, 8, 11], in addition to the results of conservation.

5. Urban Ecological Restoration and Green Infrastructure Pathways

Urban ecological restoration seeks to restore degraded ecosystems in cities, promote biodiversity protection, and improve ecosystem services. Landscape ecologists believe that the strategies for building urban resilience include increasing biodiversity, building ecological networks and adaptive design to maintain essential functions under stress [7]. Green infrastructure refers to a network of green and blue spaces and nature-based solutions, and it has gradually been used to promote ecological restoration in urban planning [9].

Research on the benefits of green infrastructure for urban resilience includes reducing flood damage, lowering the urban heat island effect, improving air quality, promoting biodiversity conservation and strengthening social cohesion [9]. Staddon and others believe that green infrastructure can

combine nature and engineering to increase the resilience of cities [9]. These measures use soil, plants and water-management processes to absorb and regulate stormwater, sequester carbon and provide recreational areas.

Nature-based solutions for urban sustainability also propose that, by adding ecological processes to infrastructure systems, flexibility and co-benefits can be achieved that are not available in traditional grey infrastructure. The framework of urban green infrastructure is based on the concepts of multifunctionality, connectivity, diversity and accessibility, and it is proposed that resilient ecological restoration requires networks of various habitats and interventions at different scales [7][9]. For the reuse of landscape heritage, this means that the historic landscape and its corridors can be used as necessary nodes in the green infrastructure plan to promote ecological and cultural connectivity.

6. Linking Landscape Heritage Reuse and Urban Ecological Restoration

Resilience thinking can be used to connect landscape heritage reuse and urban ecological restoration as mutually reinforcing processes. Historic Parks, cultural routes, waterfronts and rural heritage sites often have residual ecosystems, microclimates and spatial structures that can support ecological restoration under good management [7-11]. At the same time, ecological restoration can add an experience and symbolism to the heritage landscape to draw more public attention and participation.

Research on the sustainability and resilience of urban landscapes shows that ecological integration in planning and design can be achieved by using heritage landscapes as ecological infrastructure to promote biodiversity, connectivity and ecosystem services [7]. For example, the old canal corridor can be restored as a riparian habitat and an active mobility route, and the former industrial area can be converted into a multi-functional park with successional vegetation and community gardens [9-10]. The above modifications demonstrate that adaptive reuse can align with the goals of restoration.

Circular Economy and Resilience Thinking for Historic Urban Landscape Regeneration focus on using landscape heritage as part of a circular strategy to maximise value, reduce waste, and promote social, economic and environmental synergy [10]. Indices of Resilience Performance for Historic Urban Landscapes include Landscape Quality, Security and Resource Management, and Cultural Identity; all of these can be improved through restoration-oriented reuse [10]. Set the goal of ecological restoration for heritage reuse, and thus create a path that promotes both resilience and sustainability without being solely based on heritage.

Linking heritage reuse and ecological restoration in practice requires an all-around assessment of the physical, ecological and social environment. Map the heritage layers and ecological potentials, involve communities in a co-design process, and establish governance arrangements that coordinate heritage, environment and urban development agencies [5-6, 11].

6.1. Industrial Heritage Parks as Resilient Landscape Nodes

Industrial heritage parks are typical cases of how adaptive reuse and ecological restoration can be combined under the

concept of resilience. The former factory site, warehouse and rail yard have all been turned into public green spaces that provide cultural ecosystem services, such as recreation, aesthetic experience, heritage learning and a new sense of place. At the same time, plants can be added to improve the quality of the habitat, regulate the microclimate and enhance hydrological function; thus, the former sealed industrial surface will be turned into a permeable, life-supporting landscape [7][9][10].

Case study analysis of an industrial site converted into an urban park shows that multifunctionality and connectivity are required to improve resilience. Reclaimed industrial corridors can be developed as linear greenways to connect fragmented habitats and neighbourhoods, and park designs that support flexible use, such as events, quiet contemplation and community gardening, create redundancy in social and spatial functions [7,9]. By adding heritage buildings, such as preserved facades, machinery and rail lines, to the new ecological and recreational areas, industrial heritage parks can present a "safe-to-fail" design concept; they are able to absorb shocks, host various activities and evolve over time without losing their original charm. The above cases show that landscape heritage reuse can serve as an operational component of green infrastructure, provided that the goals of ecological restoration and community needs are clearly incorporated into the design and management plans.

6.2. Canal-oriented Riverfront Regeneration as Everyday Heritage Corridors

Historic canals and riverfronts are also kinds of landscape heritage that can support urban ecological restoration after being revitalised as daily life heritage corridors. Canal-oriented waterfront projects have shown how industrial and transport infrastructure can be redesigned as continuous pedestrian and cycling networks, linear parks and accessible public spaces along the water [7][9]. Ecological interventions include bank re-naturalisation, riparian planting, wetlands and bio-retention areas to improve water quality, restore habitats, reduce flood risk and turn engineered edges into hybrid green-blue infrastructure.

Canal and riverfront regeneration can help maintain the ecological and social continuity of resilience. Restored hydrological connectivity and diversified riparian habitats to enhance the capacity of urban water systems for absorbing extreme weather events, while carefully preserving bridges, quays and canal structures to maintain historical legibility and support cultural memory [5][10][11]. Walking or cycling to work, attending casual gatherings, and so on, all take place in these corridors, fostering a strong sense of place and belonging among the residents. By combining landscape heritage reuse with nature-based solutions for waterfronts, canal-oriented regeneration has shown that resilient cities can be built without relying solely on large-scale, technocratic construction through the integration of heritage, ecology and mobility.

7. Governance, Design Principles and Limits of Resilience-Oriented Reuse

Resilience-oriented Pathways for Landscape Heritage Reuse and Urban Ecological Restoration are based on governance and design principles that consider both opportunities and constraints. Urban resilience literature indicates that resilience is not an absolute good, and poorly

designed resilience policies may favour certain groups or maintain undesirable situations [8]. Therefore, the design of heritage and green infrastructure strategies should consider equity, participation and long-term learning.

Historic urban landscape approaches promote inclusive and participatory decision-making, map and inventory heritage values, and provide integrated planning tools for governance [5-6]. Research on heritage-based resilience suggests that adaptive reuse should be implemented with an open-minded assessment system for physical, social and cultural changes to prevent damage to the multifaceted value of heritage sites [10-11].

Design ideas based on resilience thinking, such as redundancy, multifunctionality, connectivity and adaptability, can be applied to landscape heritage protection and ecological restoration to create flexible systems that are suitable for future changes [3-4, 7]. Resilience-oriented reuse should not be realised as an all-new system for the city, reducing resource consumption, addressing social disparities and changing mobility patterns, etc. Nature-based and heritage-led solutions should be considered as components of the overall plan, not as all-encompassing remedies for all urban problems [8-9].

Considering the above deficiencies, we should not present the role of heritage reuse and ecological restoration in building urban resilience as particularly prominent. It motivates planners and designers to introduce such interventions in an iterative, adaptive way, and continuously monitors, evaluates and adjusts based on new knowledge and changing circumstances.

8. Summary

In light of the concept of resilience, landscape heritage reuse and urban ecological restoration can be viewed as two paths to enhance the adaptability of cities. Resilience thinking is about adapting to change rather than maintaining a fixed state, and now it focuses on networks, multifunctional infrastructure, and socio-ecological continuity.

The international system of the Historic Urban Landscape Recommendation and culture-based urban resilience agendas has redefined landscape heritage as a dynamic resource capable of supporting social cohesion, ecological functions and place-based innovation when reused in a context-sensitive manner. Green infrastructure and nature-based solutions offer operating strategies for incorporating ecological restoration into urban planning, and heritage landscapes serve as the core nodes of these networks.

This paper has put forward a conceptual system that links resilience theory, heritage policies and ecological restoration, but has not carried out new empirical studies. In the future, this system will be applied to specific cases to investigate how heritage-reuse projects promote biodiversity, ecosystem services and community resilience. The first problem for practitioners is that, although careful, integrated and participatory methods for using landscape heritage can help achieve urban ecological restoration and resilience, they should not be viewed as independent paths to address large-scale structural problems but as supporting measures.

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