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Abstract

According to the United Nations declarations in 2019, cities, as humanity's primary living habitat, will accommodate 68% of the world's population by 2050. The more people settle in urban centres, the more severe the impacts are on ecosystems and the climate. Due to rapid urbanisation, the number of unused and under-managed urban spaces or "Urban voids" is rising. However, regenerative approaches can turn urban voids into assets to combat climate change and environmental issues. The regenerative design promotes ecological systems to regrow by allowing every urban component, like houses, workplaces, and neighbourhoods, to flourish ecologically. This research starts with reviewing related terms for urban voids beside a fundamental approach towards utilising them, "Interim re-use." With these in hand, the research's methodology mapped 577 urban voids in its "Balat and Fener" case study, two juxtaposing historical districts in Istanbul, Turkey. The study goes on to classify the mapped urban voids into six distinctive types. The classification of urban voids is done using a decision tree model with five features that are assigned binary values. The features are as follows: "Ownership," "Debris," "Economic activity," "Seal," and "Leisure facilities." The next phase evaluates each parcel based on ecological criteria; each void is rated through a Likert scale in terms of "Vegetation," "Permeability," "Ruggedness," and "Enclosure," and thence, receives an ecological identity. After each parcel is classified and assigned its ecological identity, a two-phased treatment approach composed of twelve solutions is applied. Suppose the subject lacks the fundamental prerequisites, such as a permeable surface. In that case, proper land preparation solutions will be applied, and based on their ecological identity, they then receive the second phase's applications. In conclusion, following the guidelines proposed in this paper, the decision-makers can treat urban voids to become more ecologically thriving and enhance their ecological performance.

Keywords: urban voids, interim reuse, climate change, regenerative design, ecological performance

1. Introduction

According to the United Nations declarations in 2019, cities will accommodate 68% of the world's population by 2050 as humankind's primary living habitat (United Nations et al., 2019). The more people settle in urban centres, the more severe the impacts are on ecosystems, mainly caused by rapid urbanisation. As human survival depends highly on ecosystem services, numerous negative impacts befall biodiversity, ecological processes, natural resources, and the health of

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ecosystems (Alberti, 2005; Blanco et al., 2021). The situation can be exacerbated even further if human decisions continue challenging nature. However, some countermeasures have been taken (Naboni et al., 2019). As the first initiated action, sustainability sought to limit environmental destruction by mitigating these impacts (Kadar & Kadar, 2020). The built environment, unfortunately, cannot endure further damage and requires immediate action (M. Brown, 2016). According to Wahl (2019), sustainability and restorative design could reduce the severity of the ecological and climatic crisis and even stop it (Wahl, 2019). Unlike sustainability, regenerative design (RD) tries to execute net-positive actions to restore what is lost by reversing the course of climate change and environmental degradation (Craft et al., 2021; Reed, 2007). Sustainability targets aim to minimise the environmental impacts of newly designed and constructed projects. However, RD helps cities to evolve in an ecological sense and to be "a part of nature rather than apart from nature" (Naboni et al., 2019). RD promotes ecological systems' regrowth by allowing every urban component, like houses, workplaces, and neighbourhoods, to thrive ecologically (Brown et al., 2018). Among them, neighbourhoods have proven to be essential assets for tackling climate change and ecological crises as they immensely affect the urban ecosystem (Alberti, 2005; Pickett et al., 2013). However, attaining RD and sustainable urban development demands more than simply creating homes and areas that are ecologically friendly. Reimagining the areas between buildings is also necessary since these areas are essential but sometimes ignored parts of urban ecosystems. Rapid urbanisation has formed a particular type of space within neighbourhoods that are in-between or unused (Carmona, 2010; De Girolamo, 2013). These spaces, known as "Urban voids" (UVs), are unoccupied, neglected, or abandoned in a city. Despite their negative connotations, UVs can be changed into areas that support ecological restoration and community growth. This research will examine the potential of UVs and how they might support sustainable urban planning and RD.

2. Literature Review

2.1. Urban Voids

Undermanaged urban spaces have been referred to by many names since Trancik (1986) highlighted their importance. These include "lost spaces" (Trancik, 1986), as well as loose, liminal, vacant, in-between, transitional, indeterminate, free, and neglected (De Girolamo, 2013). Some of these spaces are referred to as "vacant land," a term introduced by Pagano and Bowman (2000) to describe land that is unused or abandoned for the longer term (Németh & Langhorst, 2014). Vacant land does not necessarily mean damaged land and can refer to underused or unused land (Pagano & Bowman, 2000). Lopez-Pineiro (2020) suggests that all undermanaged, unused urban spaces can be called "urban voids" because they serve little or no benefit to their surroundings. This research will use the term "urban voids" to refer to such spaces with the potential to serve urban environments ecologically.

Urban Voids (UVs) are sometimes viewed negatively as underutilised or "left-over" spaces that can decrease land value and community sense. However, if repurposed correctly, they can also be valuable future investments (Goldstein et al., 2001; Lopez-Pineiro, 2020; Mhatre, 2007). For instance, UVs can provide new habitats for wildlife and urban ecological ecosystems (Kim et al., 2015). They were once treated as a problem to be fixed but are now viewed as a resource for community gardens, small-scale urban agriculture projects, or adaptive reuse of buildings and lots for business ventures (Németh & Langhorst, 2014). Ecologically, UVs can also provide benefits such as stormwater infiltration and mitigation of urban heat islands through vegetation growth (Kim et al., 2015; Németh & Langhorst, 2014).

2.2. Temporariness and Interim Reuse

Temporariness refers to a finite period with a defined beginning and end (De Girolamo, 2013). It is not based on the nature of the use, rent payment, formality, scale, or longevity but instead on the intention of the user, planner, or developer. Temporariness can be categorised into three groups: culture and counter-culture, where creative use leads to regeneration; activism and community use, where local organisations and citizens reuse urban voids; and disorder and unrest, where squatting plays a central role in temporary reuse (De Girolamo, 2013). Temporary use is explicitly and intentionally time-limited and considered a stand-in substitute for a preferred permanent option (Németh & Langhorst, 2014). Interim reuse refers to the time-limited adaptive reuse of abandoned urban spaces or vacant lands. It initially appeared as an informal expression but is now a deliberate post-recession tactical urbanism tool used by planners, politicians, and urbanists. Interim reuse describes the use of abandoned spaces between prior discontinued use and future use by activities that may be temporary or permanent but are not definitive (Costa et al., 2021). The interim use of urban voids highlights the positive aspect of temporariness by increasing public accessibility and bringing people together with a shared purpose (Costa et al., 2021). The term "Zwischennutzung" or "In-between use" refers to the use of a location in the gap between formal and planned uses (Louekari, 2006). Some scholars prefer to underline the space aspect as every activity happens there (Bosetti & Colthorpe, 2018). K.E. Till's (2011) concept of the Interim space fuses the duality of space and time with the activities happening there to capture the dynamic and open-ended sense of in-betweenness, interventions, and unexpected possibilities (Till, 2011, p. 103).

3. Methodology

3.1. A Brief History of the Case Study

Istanbul's Golden Horn has been a significant part of the city's history as a seaport, residential area, and religious centre. In the late 1940s, industries moved into the area, attracting immigrant workers and causing pollution and decay (Deneç, 2016). In the 1980s, Turkey's government focused on privatisation and free trade, and Istanbul's leaders worked on projects to make the city more attractive to investors and tourists. One project sought to revitalise the Golden Horn by moving factories out and clearing land for future development (Bezmez, 2007). The neighbourhoods of Fener and Balat were part of this effort. However, the massive migration of non-Muslim groups from Istanbul during the transition from the Ottoman Empire to the Turkish Republic resulted in their decline. Rural migrants from Anatolia occupied outdated structures left vacant by non-Muslims, increasing social unrest, poverty, and unemployment. In the mid-1990s, a new wave of Kurdish migrants arrived in Fener and Balat (Bezmez, 2007). To address problems such as inadequate healthcare facilities, unhygienic environments, subpar heating, and a lack of basic plumbing in Fener and Balat, the Fener and Balat Rehabilitation Project (Keyder, 2005). Despite many projects to rehabilitate the district, neglected spaces continued to exist and increase. UVs abound the most among these spaces, highlighting their importance and the need for regenerative actions.

3.2. Urban Void Identification

This study proposes a methodology for classifying UVs into distinct categories by defining what constitutes a UV and establishing criteria for its identification. Roger Trancik investigated "lost spaces" in modern cities and developed theories of "Figure-ground," "Linkage," and "Place" to analyse the spatial organisation of an urban area and identify lost spaces (Trancik, 1986). The figure-ground theory examines the distribution of solids (buildings) and voids (open spaces) in an urban region. Linkage theory inspects the roadway network and pedestrian routes to find places that need better connection to the rest of the neighbourhood. Place theory focuses on the social and cultural aspects of metropolitan areas to spot underutilised or ignored places. This research aimed to propose a guideline for making the case study more resilient and greener by targeting "lost spaces" that fail to contribute positively to combating climate change through carbon sequestration (AR6 Synthesis Report, n.d.; Milnar & Ramaswami, 2020). UVs are identified using Trancik's three analyses: Figure-ground theory, where the space is disconnected, poorly defined, and underutilised; Linkage theory, where the space is poorly connected and difficult to access; and Place theory, where the space is neglected, not valued by the local community, and lacks a strong sense of identity or character (Trancik, 1986).

3.3. Classification Criteria

This research classifies its mapped 577 UVs of the case study into six distinct classes: Inert, Institutional, Greensward, Residual, In-between, and Blocked. The classification uses a decision tree with five features: Ownership, Debris, Economic activity, Seal, and Leisure facilities. These features are obtained based on a thorough literature review and given names by the authors. Each UV receives a binary value of either zero or one for the existence or absence of each feature. Ownership refers to the legal right to a place. However, it can also extend to shared urban areas that belong to the entire community (Hashem et al., 2022). This affects the possible applications for UVs, with publicly held land being easier to access for community usage and development. Debris refers to the physical state of a UV, including litter and garbage, which can adversely affect the surrounding community and environment (Gardiner et al., 2013; López et al., 2021; Nassauer & Raskin, 2014). Economic activity refers to the potential for UVs to generate economic and fiscal benefits for the local community through business growth, job creation, and neighbourhood improvement (Hashem et al., 2022; Hwang & Lee, 2020). Seal refers to the extent to which an urban void (UV) is physically accessible or open to the public (Elbeah et al., 2022; Khalid et al., 2018). Open UVs are easily accessible and can be freely entered, while closed UVs are not easily accessible or are physically blocked. The accessibility of UVs can have significant implications for their utilisation and potential for community engagement. Leisure facilities refer to recreational amenities and services available within or near UVs. The ones with leisure facilities may appeal more to the public by offering opportunities for social interaction, relaxation, and physical activity. However, UVs needing more leisure facilities may be perceived as less desirable or inviting. Table 1 shows the features and classification of UVs.

Table 1. UV Classification features (Authors)

UV Type	Ownership	Debris	Economic Activity	Seal	Leisure Facilities	UV Count Over Total
Inert	0	0	0	0	0	138
Institutional	1	0	0	0	0	51
Residual	0	1	0	0	0	87
In-Between	1	0	1	0	0	36
Blocked	1	0	0	1	0	231
Greensward	0	0	0	0	1	34

3.4. Evaluation of Urban Voids Based on Ecological Criteria

After mapping and classifying the UVs in Balat and Fener, each UV was evaluated based on four ecological criteria: Vegetation, Permeability, Ruggedness, and Enclosure. Accordingly, Vegetation refers to the presence and abundance of plant life in a UV. It can provide significant ecological benefits, such as supporting biodiversity, improving air and water quality, and reducing urban heat island effects (Kim, 2016; Kim et al., 2015). Permeability refers to the ability of an urban void to facilitate the flow of water and nutrients through its soil. Permeable surfaces, such as unpaved or permeable paving, can help reduce stormwater runoff and improve groundwater recharge (Liu et al., 2020; Walsh et al., 2012). Ruggedness refers to the physical complexity and variability of an urban void's terrain. Ruggedness can provide essential habitats for wildlife and support a diverse range of plant and animal species (McKinney, 2008; Wimberly et al., 2020). Enclosure refers to the degree to which buildings or other physical barriers surround a UV. The enclosure can affect the microclimate of an urban void, as well as its accessibility and visibility (Tao et al., 2022).

With all these in hand, each UV received a numerical value between 1 and 5 for each factor, with the combination of these values representing its ecological identity. The values for each UV were recorded in a spreadsheet containing a list of all UVs and their numerical values for each of the four ecological criteria. Combining these four factors provided important information about the ecological characteristics of each UV. For example, a high value for vegetation and permeability might indicate that a UV supports a diverse range of plant and animal life and facilitates water flow and nutrient cycling. In contrast, a low value for ruggedness and enclosure might suggest that a UV is more exposed to human activities and urbanisation, impacting its ecological function. To increase the generalizability and credibility of the proposed method, each was broken down into sub-factors and assigned binary values based on the presence or absence of each subfactor.

Table 2. Ecological Identity (Authors)

	Vegetation (V)	Permeability (P)	Ruggedness (R)	Enclosure (E)
Assigned value: 1	zero vegetation	Structure	Full structure or a building	Fully closed
Assigned value: 2	Only grass	Asphalt and/or concrete	Slope	One side open
Assigned value: 3	Low laying vegetation like shrubs	Gravel and/or stone	Debris or ruin	Two sides open
Assigned value: 4	Trees	Muddy	Only vegetation	Three sides open
Assigned value: 5	Rich vegetation including grass, shrub, and trees	Green	Flat and Vacant	Fully open

4. Results

In this study, we classified 577 mapped urban voids (UVs) in the Balat and Fener districts of Istanbul, Turkey, into six distinct classes: Inert, Institutional, Greensward, Residual, In-between, and Blocked. The decision tree utilises five features: Ownership, Debris, Economic activity, Seal, and Leisure facilities. Each UV was assigned a binary value of either zero or one for the existence or absence of each feature.

After classifying the UVs, we evaluated each based on four ecological criteria: Vegetation, Permeability, Ruggedness, and Enclosure. Each UV received a numerical value between 1 and 5 for each criterion, with the combination of these values representing its ecological identity. For instance, a Blocked-V1P1R1E1 refers to a sealed and privately-owned UV with the least values for all the criteria, which is translated to an enclosed UV lacking any vegetation and permeability due to the existence of a structure or a building. As shown in Figure 1, the mean analysis of the UV types revealed that the vegetation level of the Greensward UV class was the highest. In contrast, the In-between UV class had the lowest vegetation level.

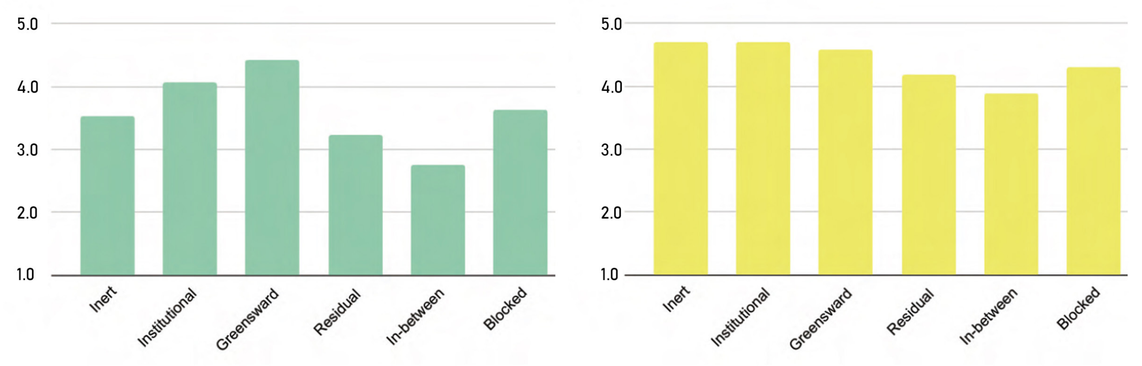

Figure 1. UV Class Mean Values for the Vegetation (left chart) and Permeability (right chart)

Table 3. Statistical Analysis for Ecological Criteria (Authors)

Variable set	Sample size	Pearson's r	p-value
V and P	577	0.6024	0.0000
V and R	577	0.1761	0.0000
V and E	577	0.2277	0.0096

The Statistical analysis of the ecological criteria revealed that vegetation and permeability are highly correlated, achieved with a Pearson correlation in Table 3. Vegetation and permeability correlation was investigated for each UV type, as shown in Table 4. Accordingly, the correlation was the highest in the Institutional UV type, followed by the Blocked void type.

Table 4. Pearson Correlation Analysis for Vegetation and Permeability (Authors)

UV Type	Sample size	Pearson's r	p-value
Inert	138	0.4875	0.0000
Institutional	51	0.7504	0.0000
Residual	87	0.3368	0.0079
In-Between	36	0.4290	0.0114
Blocked	231	0.6643	0.0000
Greensward	34	0.4378	0.0096

Considering the results of the analysis of the UVs investigated, this study proposes a two-stage treatment guideline for enhancing the vegetation of each UV. Realising the importance of permeability in a given UV, preparing each UV for further regenerative approach is of the greatest priority. Figure 2 shows the illustrated version of the proposed ecological treatment guideline.

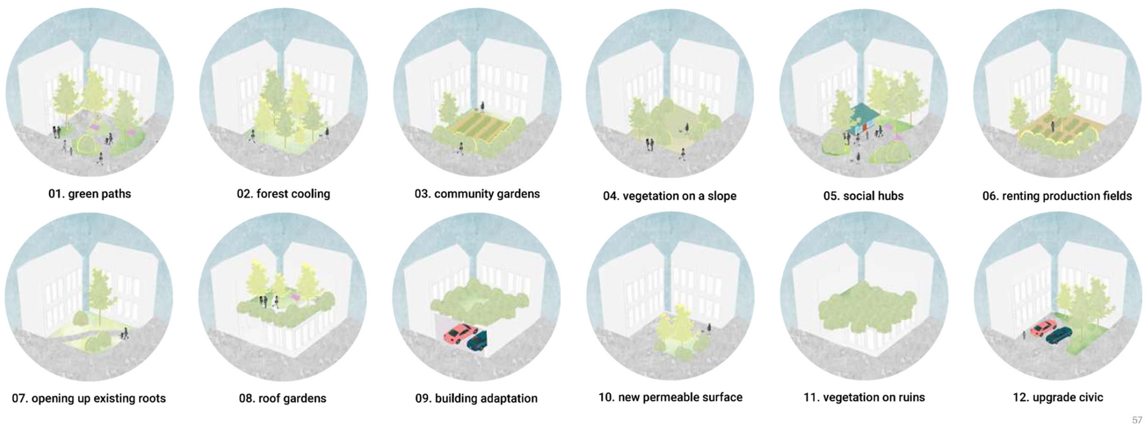

Figure 2. Ecological Treatment Guideline (Authors)

5. Conclusion

In conclusion, this research provides a comprehensive approach to understanding and addressing the issue of urban voids in the Balat and Fener districts of Istanbul. By mapping and classifying 577 urban voids into six distinct types using a decision tree model with five binary features, this study offers valuable insights into the characteristics of these spaces. Evaluating each urban void based on four ecological criteria - Vegetation, Permeability, Ruggedness, and Enclosure - further enhances our understanding of their ecological potential. The proposed two-stage treatment guideline, which focuses on improving permeability as a prerequisite for enhancing vegetation, provides a practical framework for transforming urban voids into ecologically thriving spaces. By following these guidelines, decision-makers can take concrete steps toward creating more sustainable and resilient urban environments.

Conflict of Interests

The author declares no potential conflict of interest was reported by the author.

Endnotes

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