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Research paper

MULTIFUNCTIONAL SOLUTIONS FOR RECLAIMING PUBLIC OPEN SPACES IN MULTI-FAMILY HOUSING: GELLERUP NATURE PARK

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Abstract

Multifunctional solutions (MFS) are increasingly taking a central role in contemporary urban planning as a response to the challenges of sustainable development. The idea that multifunctional public open spaces (POS) can contribute to sustainable urban development is based on the assumption that they bring a broader range of ecological, social, and economic benefits to urban area, and as such their application is of particular significance for multi-family housing regeneration. This is especially important in the context of climate change and the growing developmental challenges, where POS are expected to simultaneously provide benefits for both people and nature.

Based on the theoretical framework that recognizes the space, time, use and service dimensions of urban open space multifunctionality, this paper presents the case study of Gellerup Nature Park in Aarhus, Denmark as an outstanding example of the revitalization of neglected public open spaces through a multifunctional approach that simultaneously addressed the ecological, socio-cultural, and economic aspects of sustainability. The implemented solutions were developed through participatory process and involved a multilayered approach in which ecological and social interventions were interconnected. The aim of the paper is to explore the context, process and modalities of MFS application in Gellerup multi-family housing estate and to highlight environmental and social benefits that this approach may bring to multi-family residential areas.

Key words: *Public open space, multifunctional solutions, multi-family housing, sustainable development, citizen participation*

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1. INTRODUCTION

The idea that *multifunctional open spaces* may support sustainable urban development is based on the assumption that they bring a wider spectrum of environmental, social and economic benefits to urban areas [1, 2]. The application of this concept is especially important in residential public open spaces (POS) that are nowadays expected to provide a variety of benefits for both people and nature [3].

This issue is additionally relevant today, when vast underused, neglected, and unsafe public green open spaces of modernist multi-family housing represent a systemic problem faced by cities worldwide [4,5]. Although they may be beneficial to nature, if they do not have value and meaning to residents, they usually enter into a negative loop of negligence, thus contributing to the overall environmental and social decline of the area. To convert this negative process, there is a need for a complex, democratic, and multi-scale view of how POS may be used and perceived, that takes into account the variety of needs, interests, and meanings that people contribute to the place [3]. In this respect, a multifunctional approach and deriving solutions open new possibilities to reclaim POS in multifamily housing areas. In addition, current climate change debates recognize that POS have the potential to offset the impacts of climate change, and suggest integration of this new climate function into their planning and regeneration. In this regard, large green areas typical for inherited modernist residential complexes offer a great potential to make this possible [6,7].

In order to explore *how the revitalization of the neglected public open spaces in modernist housing area can be achieved and their potential activated through implementation of multifunctional solutions (MFS)*, the Gellerup Nature Park in Aarhus, Denmark, was chosen as an officially recognized example of good practice. Learning from this case may bring valuable insights to how multifunctional approach to POS planning and design may contribute to urban sustainability and regeneration. After introducing the theoretical framework on *multiple dimensions of POS multifunctionality* that was previously developed by authors [3], this paper uses case-study methodology to explore the context, process and modalities of MFS application in Gellerup multi-family housing estate in order to highlight environmental and social benefits that this approach may bring to multi-family residential areas.

2. THEORETICAL FRAMEWORK: UNDERSTANDING THE MULTIFUNCTIONALITY OF PUBLIC OPEN SPACES

Urban open spaces are physically un-built areas within a city's territory and integral parts of the urban structure [8]. Well-planned, designed, and maintained, they contribute to urban life through various functions, such as movement, recreation, gathering, and water management, alongside "non-urban" activities like agriculture, forestry, and nature conservation. In the pursuit of sustainable urban development, creating multifunctional public open spaces (POS) is highly promoted, assuming they simultaneously bring a wider range of benefits. This is especially relevant in residential areas, where sustainability depends on how people perceive and value these

spaces.However, the interpretation and application of multifunctionality in urban planning and design can vary.

Here we present a theoretical framework on POS multifunctionality, previously developed by the authors [3], which addresses different dimensions of this concept. Within this framework, multifunctionality is understood as a spatial feature that helps solve multiple problems and achieve diverse benefits, linking it directly to sustainable development. To harmonize the ecological, socio-cultural, and economic aspects of sustainability, we propose a multidimensional conceptualization. Based on theoretical analysis, we recognize key dimensions that link multifunctionality to space, time, use, and land services, and elaborate on how each contributes to sustainability.

The SPACE dimension refers to how different functions are distributed horizontally and vertically, determining the spatial scale of multifunctionality (from the city-wide level to specific locations). Diversifying the range of activities attracts more people, fostering sociability and social sustainability. Concurrently, enhancing an area's appeal boosts local economies, investments, and property values in surrounding neighborhoods. The level of sociability depends on the spatial configuration of the POS (dispersed or concentrated) and how individual spaces are linked. Furthermore, the ecological value of green POS can be protected by showcasing their natural beauty, enabling their active use, and integrating them into the daily lives of residents.

The TIME dimension refers to the temporal distribution of functions, which can be synchronic or diachronic: Diachronic multifunctionality involves the scheduling of different functions across different times. This supports the continuity of socialization for various user groups throughout the day or seasons, contributing to social sustainability. Synchronic multifunctionality refers to the co-occurrence of different functions at a single moment. This makes a place highly attractive to diverse users simultaneously, concentrating people and increasing opportunities for social interaction and communication. Both modalities provide direct and indirect economic benefits by making the space more vibrant and appealing.

The USE dimension focuses on providing possibilities for both people and other living beings to use space in different ways, which is heavily shaped by urban design. Social benefits are generated by diversifying activities; as more users are attracted, the chances for social interaction rise. While adding new uses to green public spaces helps residents connect with and appreciate nature, planners must note that intensifying use can either enhance or compromise the ecological value of a POS.

The SERVICE dimension refers to the capacity of natural or built land to provide tangible and intangible goods, services, and amenities to people and nature. Multiplying land functions and services helps reveal the diverse values of nature, supporting the protection of natural features in urban environments. At the same time, improving environmental comfort and aesthetics through ecosystem services increases the use and sociability of space, helping construct a positive identity for the area.

How all these dimensions of multifunctionality can be achieved in practice will further be explored through the case study of Gellerup Nature Park in Aarhus, Denmark.

3. METHODOLOGY

To investigate how multifunctional solutions (MFS) can be deployed to reclaim neglected public open spaces (POS) within modernist housing estates this study adopts a qualitative, exploratory single-case study research design. The case study method is particularly suited for this inquiry as it allows for an in-depth, contextual investigation of a contemporary phenomenon within its real-world setting, where the boundaries between the phenomenon and the context are highly integrated. The case (Gellerup Nature Park) was selected as an exemplary case of strategic urban regeneration using purposive sampling based on the following criteria: a) Typological relevance (modernist housing estate), b) Multifunctional POS development for sustainability; c) Institutional recognition (validated as an international benchmark, nominations and awards).

Data were gathered from multiple sources, facilitating data triangulation: a) Project and design documentation (EFFEKT and SLA); b) Policy and strategic regeneration frameworks (issued by the Aarhus Municipality and Brabrand Boligforening), c) Peer-reviewed journal articles analyzing impacts of the Gellerup regeneration project. The collected qualitative and spatial data were analyzed using deductive thematic analysis, in which the thematic coding was structured around the four dimensions of POS multifunctionality established in the authors' previous theoretical framework.

4. CASE STUDY OF MULTIFUNCTIONAL GELLERUP NATURE PARK DEVELOPMENT

Gellerup Nature Park in Aarhus, Denmark was selected as a good practice case of reclaiming POS in multifamily housing areas by applying multifunctional solutions in all dimensions: through the USE of SPACE in different ways and scales, simultaneously or during a certain period of TIME, as well as through providing landscape SERVICES. The result is a new urban space that by activating and linking the existing green areas, reconnects residents, thus creating a new positive image of the area.

4.1. Urban brief

Gellerup Nature Park was developed between 2014 and 2021, through a public-private partnership, aiming to bring „new life“ to modernist social housing blocks with large neglected and underused public spaces. The project was commissioned by Brabrand Boligforening, the Municipality of Aarhus, and Realdania, and designed by EFFEKT and the landscape architecture office SLA. Built in 1960’the Gellerup neighbourhood is one of the largest social housing projects (13ha) with more than 10 000 residents [9, 10]. The proposed park serves as a prototype for transforming similar residential estates, guiding their transition from modernist 'machines for living' into humane, nature-based communities[11].The project aimed at increasing social cohesion and biodiversity, addressing climate issues and economic factors, and at improving the well-being of the residents of the surrounding blocks. The park’s planning and design prioritized enhancing safety, promoting diverse activities, and fostering sociability through cross-cultural exchange [11](Fig. 1).

4.2. Issues detected

The construction of this social housing settlement was initiated in 1960' by the state of Denmark. Over time, it became a symbol of the fragmentation of both urban space and society. The neighborhood faced social and ecological challenges, resulting in the need for sustainable urban regeneration and revitalization of its public spaces. The neighborhood suffered an increased rate of crime, poverty, and unemployment. In addition to social problems, the neighborhood faced environmental problems. The original urban design of the area, with cascading courtyards, made green spaces inaccessible, underused, and neglected (Fig.2). Before the implementation of the new project, a limited variety of plant species had been recorded, indicating a significantly reduced biodiversity in the area [11]. The need for nature-based solutions was recognized, and the Gellerup Nature Park project became the answer to the question of how to integrate nature into the urban environment to provide multifunctional use and landscape services, thus harmonizing ecological, social, and economic aspects of sustainability.

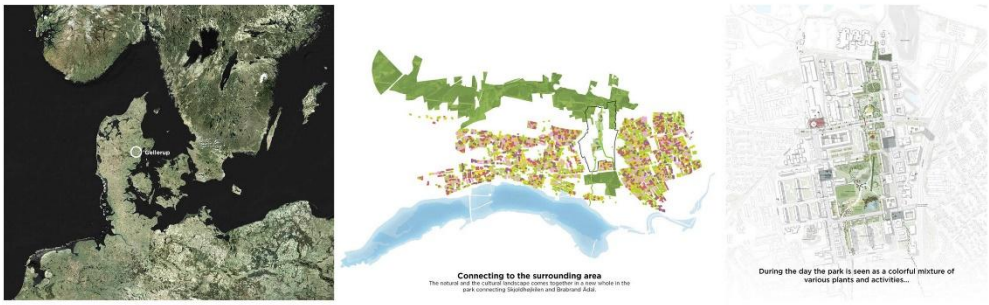


Figure 1. Gellerup Nature Park, a) Gellerup location, b) Gellerup Park connecting the city, c) Site plan. Source: https://www.effekt.dk/gelleruppark



Figure 2. Social housing from the 60s, a) Modernist blocks before the Gellerup Park intervention. Source: https://www.effekt.dk/gelleruppark

4.3. Multifunctional solutions implemented

The competition for the Gellerup Nature park was announced in 2014, and the first prize was awarded to EFFEKT architects + SLA landscape firm. Their concept was based on the multi-scale „return to the natural environment", by imitating the natural terrain that existed in this area before the modernist interventions (landscape cascades) and by introducing multifunctional use of both built and green spaces. [9]

Developed under a broad regeneration program by Brabrand Boligforening and Aarhus Municipality, the park's plan brought together experts in architecture, urban planning, sociology, and social development [11]. The 2018 "Bootcamp Gellerup 2.0" engaged experts and researchers to establish core values for the Gellerup-Toveshøj neighborhoods [12], while JAJA Architects and WE Architecture managed the wider urban redesign. Essential to this process was citizen participation, giving residents a platform to debate and propose ideas for the park's design and functions. The project was developed through three phases: 1) an extensive participatory process with the local community; 2) an architectural and landscape design phase; and 3) Implementation of the new natural environment together with citizens, gardeners, and biologists.

Design for projects' multifunctionality was developed by addressing two main issues: a) Ecology and climate, and b) Social cohesion and wellbeing.

Design for Multifunctionality: Ecology and Climate.

The ecological and climate interventions of the project refer to the design of a new landscape, featuring gentle and natural slopes, suitable for walking. The new terrain brings the feeling of being in a real natural environment [9]. The design also introduced water streams and lakes, which, apart from their aesthetic contribution, collect excess rainwater as a landscape SERVICE.



Figure 3. Ecology and nature in Gellerup, a) Landscape - from modernist cascades to natural slopes b) Natural-ecological multifunctional POS c) Ladscape before and after d) Meadows and hills, biodiversity. Source: https://www.effekt.dk/gelleruppark

Part of the water pools are in the form of cascades, taking on the possibility of height differences inherited from the previous modernist landscape design. The gradation in the "naturalness" exists: while some water reservoirs are implemented as natural lakes, others are shallower and in the form of water mirrors, providing a place

for rest, play and education. Moreover, to enhance biodiversity, over 160 new plant species were planted, including more than 2000 trees. This led to the appearance of over 23 new animal species that have found their living space in this park, including rabbits, foxes, squirrels, and wild bees [11]. Significant microclimate optimization was also a by-product of this form of park's multifunctionality.

The new natural environment offers the possibility of play, rest, walking, and educating the youngest, in addition to mitigating climate change related disasters, such as heavy rainfall and floods. The park functions as a dynamic location that attracts visitors and contributes to the development of local businesses (Fig. 3)

Design for Multifunctionality: Social cohesion and wellbeing.

To improve social cohesion, the park integrates playgrounds, sports courts, outdoor gyms, gardens, and cultural facilities, creating a "social nature" that enhances neighborhood quality of life [13]. The new Gellerup Park offers the possibility of partaking in a wide variety of activities, planned for a variety of users. Multifunctionality of SPACE is achieved at both area and location level. Although various activity areas are dispersed in space and can be alternatively used over TIME, every part of this park is multifunctional; regardless it is a green or paved area, a path or a field. Symbolic entrance portals foster a sense of belonging, while new, deliberately curved paths connect the park with the surrounding areas, providing better accessibility and enabling a greater degree of USE. The green areas are equipped with places for sitting, picnicking, and socializing with neighbors. Built structures are also multifunctional in their form: for example, the concrete benches along the walking paths “emerge” out of the terrain, which makes them suitable for skates or children to play.

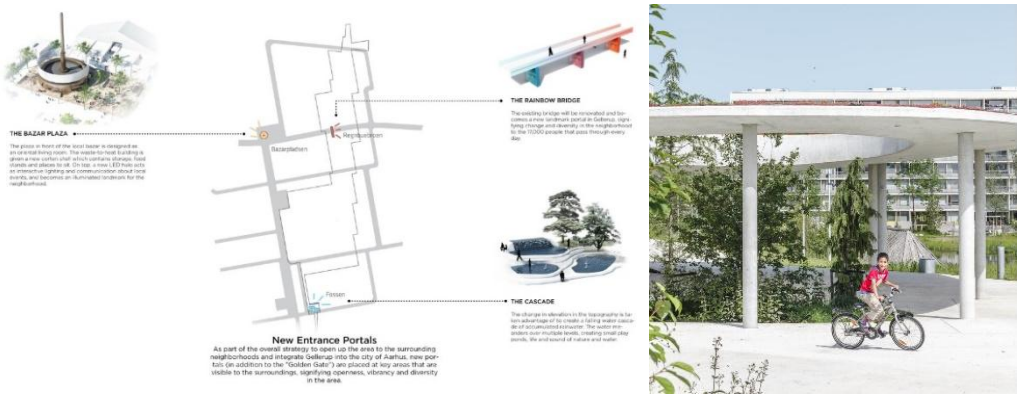


Figure 4. Design for social wellbeing in Gellerup: a)Spatial diagram – Bazar Plaza, New Entrance Portals, The Cascade, The Rainbow Brigde, b)Pavillions.Source: https://www.effekt.dk/gelleruppark

The space is decorated with murals, and the existing “Rainbow Bridge” was also restored as a local symbol. The new multifunctional pavilions provide gathering places, and "Bazarpladsen" - Bazar Plaza is equipped with food stands and space for sitting and socializing, while at the same time serves as storage and offers possibility of converting waste into energy. The entire space can be used even at night because it is lit by a circular LED "halo" (Fig. 4). Citizens actively support livability of the Park by organizing various temporary activities, cultural events, and happenings (Fig. 5). Consequently, the

increase of feeling of belonging and pride of being part of the Gellerup community was detected after implementation [11].



Figure 5. Gellerup Park summer neighbourhood activities, Source: https://skraeppebladet.dk/2024/7/sommersjov-i-gellerup-gratis-glaede-for-hele-familien/[n] , https://skraeppebladet.dk/blad/2024-04/gellerup-nu/paa-udkig-i-byparken-efter-sommerfugle-og-insekter/[n]

4.4. Benefits and recognition

Gellerup Park is globally recognized as an exemplary model of residential urban regeneration. Its innovative nature-based design and participatory process earned a nomination for the EUmies Awards 2022 [14] and a feature in the Simon Architecture Prize 2022 [15] for measurably improving safety and social cohesion. Additionally, the project won the European Garden Award 2019/2020 [16] and was nominated for the Green Cities Europe Award 2022 [11] for its climate adaptation. Multiple academic studies [5,17,18] further validate these substantial social and ecological benefits, confirming its success.

Key ecological and socio-cultural benefits achieved through different dimensions of Gellerup park multifunctionality are summarised below:

Table 1. Benefits of Developing Different Dimensions of Multifunctionality in Gellerup Park

		BENEFITS	
		Ecological	**Socio-cultural**
DIMENSIONS OF MULTIFUNCTIONALITY	**Space**	The project integrates nature into the urban area through a new landscape, featuring gentle and natural slopes, water streams and lakes, meadows and hills, making natural elements accessible, while supporting biodiversity.	Benefits are achieved at both area and location level by providing places for people to meet and interact. New paths connect the park with the surrounding areas providing better accessibility .
	Time	Areas of the park are planned as multifunctional, regardless of whether they are green or paved, supporting different activities over time while preserving the ecological value of the space.	Citizens are involved in the life of the park and organize various temporary activities, meetings and cultural events. This diachronic increase of the use of space supports continuity of socialisation.
	Use	The new landscape, with water bodies and gentle and natural slopes suitable for walking, offers opportunities for play, rest, and education for the youngest and reveals natures beauty and value.	The park offers playgrounds, courts, outdoor exercise areas, gardens and greenhouses, and meeting points that attract different users. Sitting, picnicking, and socializing with neighbors is encouraged.
	Service	Water streams and lakes support collecting excess rainwater as a landscape service, while also mitigating the effects of climate disasters, such as heavy rainfall and floods, and enabling significant microclimate optimization.	The project activated and linked the existing green areas, reconnecting residents and creating a new positive image of the area, inducing a greater degree of feeling of belonging .

5. DISCUSSION AND CONCLUSION

Implementing multifunctional solutions through public open space planning and design may bring *multiple benefits to both people and nature*, which is of special importance for reclaiming public open spaces in multi-family housing areas. Diversification of activities enhances attractiveness, use and sociability of POS, while the multiplication of land functions reveals values of Nature, thus supporting the protection of natural elements in the city. When delivered through the engagement of residents, these solutions contribute to building social capital in the neighbourhood.

The Gellerup Park case study serves as an outstanding example of how multifunctional solutions can revitalize neglected public open spaces in modernist urban fabrics, unlocking their potential for climate adaptation while enhancing both the neighborhood environment and residents' well-being. Our research reveals several key insights that form the basis for this contribution. First, the case study demonstrates that when dealing with the vast amounts of underused green open spaces typical of modern urbanism, alongside the urgent need for climate adaptation, all four dimensions of multifunctionality—*time, space, use, and service*—should be integrated into POS development. This approach better connects people with nature and helps harmonize the ecological, social, and economic aspects of sustainability, allowing natural elements and processes to be revealed, appreciated, and utilized for a variety of purposes.

The research also shows that multifunctional solutions can be applied *at different spatial scales and in different types of public spaces*. They are relevant for courtyards, parks, plazas, and communication paths, in which proposed uses and services can be combined for different activities, such as recreation, play, movement, community gathering, wildlife habitat setting, landscaping, and climate adaptation functions. The study reveals that, while multifunctional solutions can be implemented at a single POS location level, the best results are achieved when a systemic view is applied and when they form a part of strategic urban regeneration interventions, aiming to address and harmonize complex environmental and social goals.

Finally, this case highlights the importance of *good communication and collaboration* between public, private, and third sector, including local residents, in all phases of planning, design, delivery and management of multifunctional POS. Through mixed public-private collaborations and extensive participatory process with the local community, the new design of the park was proposed and delivered to enable new uses provided on a permanent and temporary basis, as well as new landscape services aimed to manage water, reconnect people with nature and attract diverse users, thus creating situations in which urban life may flourish.

Taking all this into account, it can be concluded that a multifunctional approach to public open space revitalisation yields diverse environmental and social benefits conducive to multi-family housing regeneration. Understanding POS multifunctionality through a multidimensional lens—incorporating time, space, use, and service dimensions—is essential for its successful application in specific urban scenarios. Future research should investigate the pathways and factors that shape how these multifunctional solutions are implemented across varied urban contexts.

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