Sustainability Assessment of Urban Open Public Spaces (OPSs) in the City of Munich, Germany

Master‘s Thesis of Sonali Abeysinghe

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Motivation / Background

Rapid global urbanization and climate change intensify pressures on cities [1]. Open Public Spaces (OPSs) are critical urban assets, offering vital environmental, social, and economic benefits [2]. This study addresses the urgent need for comprehensive sustainability assessments of these spaces. Focusing on central Munich, a high-density city facing continuous expansion, this research utilizes a unique dataset of mobility behaviors and user demographics as illustrated in ***Fig. 1***. It evaluates OPSs to understand how human interaction and spatial characteristics influence their long-term environmental, social, and economic sustainability. The findings provide a data-driven basis for resilient urban planning, ensuring OPSs remain vital for livable and sustainable cities.

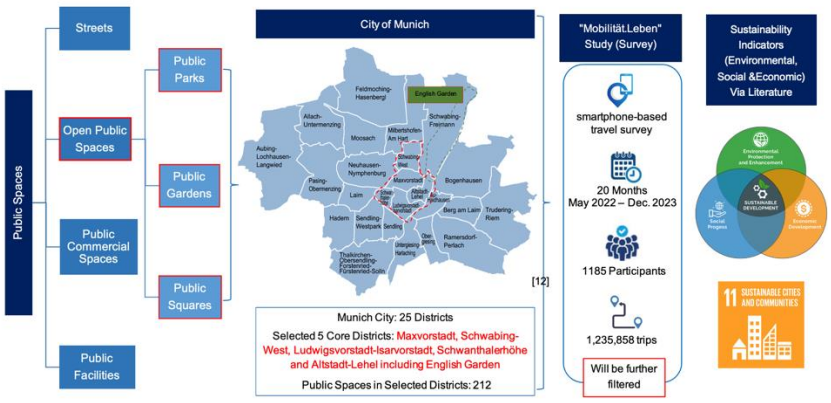

***Fig. 1**: Scope of the Research study*

Objectives of the Study

- To analyze existing OPS characteristics, mobility patterns, and user demographics of OPSs in Munich.
- To assess the environmental, social, and economic sustainability of OPSs using a data-driven approach.
- To develop a Composite Sustainability Index (CSI) and rank the most sustainable OPSs in Munich’s city center.
- To propose actionable recommendations to enhance the long-term sustainability and functionality of OPSs.

Methodology

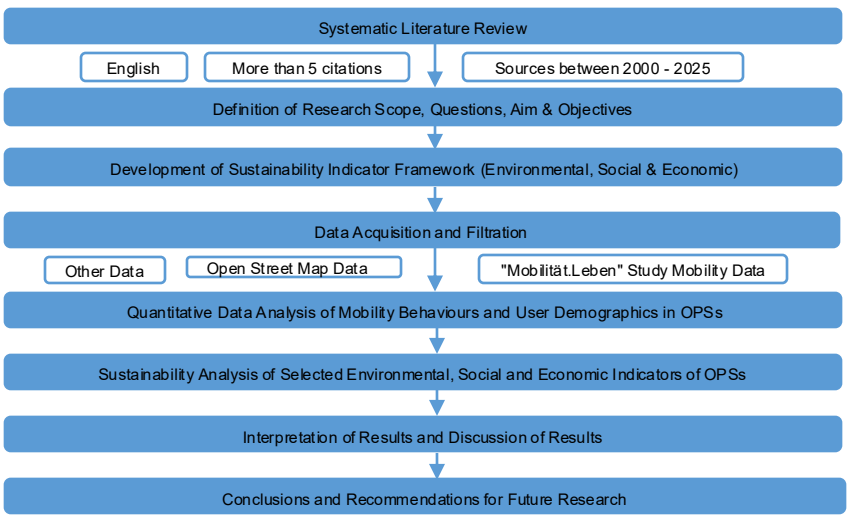

***Fig. 2**: Methodology of the Research study*

References

[1] UN-Habitat, World Cities Report 2022, [Online]. Available: https://unhabitat.org/world-cities-report-2022

[2] Kabisch, N., Haase, D., 2014. Green justice or just green? Provision of urban green spaces in Berlin, Germany. Landscape and Urban Planning 122, 129–139.

Results

Mobility Behaviors and User Demographics of OPS

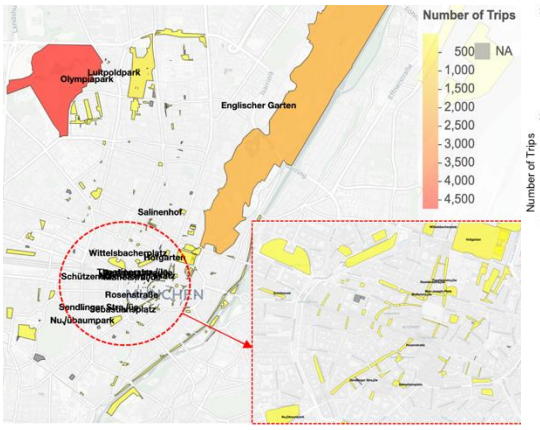

***Fig. 3**: Heatmap of the trip concentrations in OPSs in central Munich*

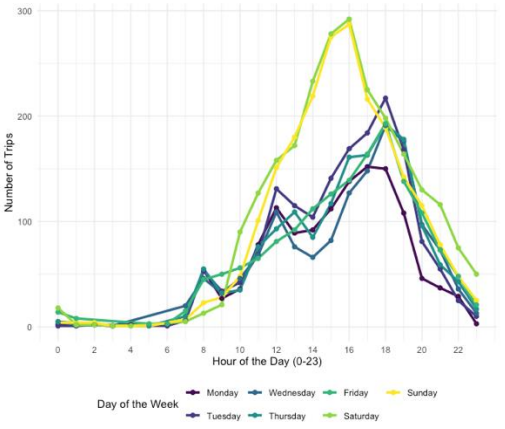

***Fig. 4**: Total daily & hourly trip generation in OPSs in central Munich*

OPS usage in central Munich shows strong spatial centralization, with major parks attracting high trip volumes while smaller squares exhibit high trip densities per square meter. ‘Olympiapark’ ranks top with 4724 trips followed by ‘Englisher Garten’. Trips are predominantly for leisure, with most visits lasting 12-72 minutes. Usage peaks in summer and on weekends, with daily activity concentrated between 4 to 6 PM. Active transport modes dominate, with 69.6% walking & 14.4% cycling, indicating sustainable access. Demographically, users are mainly young to middle-aged adults (20-39 age group), with a balanced gender distribution, but a notable concentration from higher-income and university-educated groups suggests potential equity concerns yet can be also attributed to uneven distribution of survey users of ‘Mobilitäat.Leben’ study.

Sustainability analysis of OPS

A Composite Sustainability Index (CSI), integrating 10 indicators across environmental, social, and economic pillars, revealed significant performance disparities among OPSs.

Large parks like 'Englischer Garten' excelled environmentally and socially, while central squares like 'Sendlinger Straße' showed strong economic vibrancy. However, trade-offs were evident: large parks often lacked economic integration, and central squares suffered from poor environmental quality. The most sustainable OPSs achieved a balance across all dimensions, as confirmed by a sensitivity analysis which showed rankings shift based on prioritizing social or environmental outcomes.

***Tab. 1**: C-SI of top 15 OPS of Munich*

Open Public Space (OPS)	E-SI	S-SI	Ec-SI	C-SI	Sustainability Ranking
Englischer Garten	0,86	0,58	0,61	0,68	1
Hofgarten	0,78	0,55	0,50	0,61	2
Luitpoldpark	0,91	0,56	0,27	0,58	3
Olympiapark	0,72	0,74	0,19	0,55	4
Salinenhof	0,87	0,23	0,49	0,53	5
Marienplatz	0,26	0,57	0,63	0,49	6
Sendlinger Straße	0,24	0,44	0,73	0,47	7
Residenzstraße	0,26	0,54	0,53	0,44	8
Maffeistraße	0,25	0,46	0,55	0,42	9
Theatinerstraße	0,17	0,53	0,53	0,41	10
Wittelsbacherplatz	0,17	0,51	0,54	0,41	11
Max-Joseph-Platz	0,11	0,46	0,58	0,38	12
Sebastiansplatz	0,33	0,26	0,46	0,35	13
Nußbaumpark	0,26	0,15	0,56	0,32	14
Schützenstr	0,25	0,26	0,40	0,30	15

Conclusions and Recommendations

Munich's OPS usage is spatially centralized, dominated by active transport, and highly seasonal, yet reveals demographic inequities, particularly among older and lower-income groups. A 10-indicator CSI showed significant performance disparities: large parks excelled environmentally and socially, while central squares were economically vibrant, highlighting inherent trade-offs. Sensitivity analysis confirmed that OPS value is deeply linked to underlying policy priorities, emphasizing that true sustainability requires a balanced integration.

To enhance OPS sustainability, prioritize integrated design by strengthening underperforming dimensions in each space, such as retrofitting central squares with greenery and improving accessibility to peripheral parks. Future research should incorporate qualitative indicators like perceived safety and management quality and ensure more inclusive demographic representation in mobility studies to guide equitable and effective urban planning.