1. Introduction

Urban green spaces are important for people's well-being in cities. Parks and other Publicly Accessible Outdoor Areas (PAOA) contribute to improving urban living quality by providing recreational opportunities and ecosystem services that support a healthier lifestyle and better quality of life for urban residents.

Accessibility to these spaces is a key factor in ensuring their effective use. Research has shown that factors such as distance, travel time, and the quality of pedestrian infrastructure significantly influence how people interact with urban green spaces. Ensuring that these areas are easily accessible and well-connected to residential areas is crucial for maximizing their benefits for urban communities.

Bikeability, a concept that combines cycling accessibility and comfort, has gained attention as a tool for assessing how well a city supports active transportation. Studies have shown that factors like bicycle infrastructure, traffic conditions, and the presence of green spaces along cycling routes can significantly influence the overall bikeability of a city. This study aims to explore the relationship between bikeability and the accessibility of PAOA in three European cities: Amsterdam, Münster, and Utrecht. By analyzing the bikeability of residential areas and their proximity to PAOA, we aim to provide insights into how these factors interact and how they can be optimized to promote sustainable and healthy urban mobility.

Research Questions:

- How does bicycle accessibility to PAOA vary across residential areas in Amsterdam, Münster, and Utrecht?
- To what extent do residential areas with higher bikeability also have better access to PAOA?
- Are there significant differences in the relationship between bikeability and PAOA accessibility across the three cities, and what factors might contribute to these differences?

Hypothesis:

We hypothesize that residential areas with higher bikeability will generally have better access to PAOA, as cities that prioritize cycling infrastructure are likely to also invest in the development and accessibility of green spaces. However, we expect that the strength of this relationship may vary between the three cities, reflecting different urban planning priorities and the existing infrastructure for both cycling and green space accessibility.

Methodology Overview:

1. Data Collection: We will gather data on residential areas, PAOA, and bicycle infrastructure in Amsterdam, Münster, and Utrecht.
2. Bikeability Assessment: We will calculate bikeability scores for residential areas using factors such as bicycle infrastructure, traffic conditions, and topography.
3. Accessibility Analysis: We will assess the accessibility of PAOA from residential areas, considering both distance and travel time.
4. Comparative Analysis: We will compare the relationship between bikeability and PAOA accessibility across the three cities, identifying patterns and potential factors influencing these relationships.

2. Indicators

The Bikeability index is composed of the indicators:

- Bicycle infrastructure
- Traffic conditions
- Topography
- Green spaces along cycling routes
- Residential density

Each of these indicators plays a crucial role in assessing the bikeability of a city. For example, the presence of dedicated bicycle infrastructure, such as bike lanes and bicycle paths, can significantly enhance the safety and comfort of cyclists, encouraging more people to choose cycling as a mode of transport. Traffic conditions, including the volume of vehicles and the presence of traffic calming measures, can also impact the perceived safety and stress levels of cyclists, influencing their willingness to cycle. The topography of a city, including the presence of hills and other terrain features, can also affect the ease and speed of cycling, with flatter areas generally more conducive to bicycle travel. Green spaces along cycling routes can enhance the overall cycling experience, providing a more pleasant and scenic environment for cyclists. Residential density can also be a factor, as areas with higher residential density may have more cyclists and more demand for cycling infrastructure.

By combining these indicators, we can create a comprehensive bikeability index that takes into account the various factors that contribute to the cycling experience. This index will provide a valuable tool for urban planners and policymakers to assess the bikeability of different areas within a city and to prioritize interventions to improve cycling infrastructure and promote cycling as a sustainable mode of transport.

3. Preparing

Import and define all the libraries required and the research AOI's and CRS for all the data: osmnx, geopandas, pandas, shapely, numpy, matplotlib, folium, contextily, sklearn, scipy, seaborn, scikit-learn, requests, urllib3, zipfile, os, io, time, warnings, gzip, shutil, pathlib, datetime, sys, subprocess, glob, os.path, collections, itertools, math, statistics, concurrent.futures, io, zipfile, tempfile, requests, urllib3, os, sys, subprocess, pathlib, shutil, time, warnings, gzip, io, os, os.path, glob, pathlib, shutil