

MULTI-SCALE ANALYSIS OF ACCESSIBILITY TO SHOPS, SERVICES AND GREEN SPACES IN THE RABAT-SALÉ CONURBATION IN MOROCCO

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1. Introduction

This study is part of two doctoral research projects: on the one hand, on planning through accessibility, to increase proximity to amenities and reduce the car's share of daily mobility, and on the other, on the daily travel experience of public transport users. This paper presents the results of a multi-scale analysis of accessibility in the Rabat-Salé area of Morocco. Several theoretical and methodological issues justify the choice of this study area and place it in the context of broader academic and operational research programmes. Firstly, this study draws on the concepts of the '15-minute City' and 'walkability' [1]. These approaches are still relatively unexplored in the context of Moroccan cities, and more broadly in that of North African cities. In many respects, urban planning in the Rabat-Salé conurbation is representative of the main cities in this geographical area: combating heat islands, managing dense informal housing, developing new towns on the outskirts, balancing the distribution of urban facilities in a context of strong urban and demographic growth, improving public transport infrastructure and promoting active modes of transport. Against this backdrop, the conurbation has embarked on drawing up a Sustainable Urban Mobility Plan (PMUD) to plan its mobility system for 2040 [2]. The core of the region's public transport offering is the tramway network, which has been in service since 2011. Two lines currently link the cities of Rabat and Salé, serving the main districts at the heart of the conurbation, and are set to be significantly extended to serve outlying areas by 2030. Our study therefore takes place in a context of major planning challenges, requiring a multi-scale approach due to the diversity of the urban areas concerned and the issues addressed. For this reason, a significant methodological contribution of our study lies in the use of Fractalopolis analysis software, currently under development. This software, based on the principles of fractal geometry, enables us to measure the accessibility of an area's amenities by taking into account the hierarchical and complementary organisation of its various centres [3]. While several studies have already been carried out using Fractalopolis on French and European cities, this is the first time the software's accessibility model has been applied in a non-European context. This study gives concrete expression to our thoughts on the software's adaptability to other cultural and socio-spatial contexts. The reproducibility of the methodology for the Rabat-Salé area has also been made possible by the emergence of global databases. Through this contribution, we hope to present a set of open data that will facilitate research into urban mobility and spatial planning for a wide range of areas.

2. Materials and methods

2.1. Methods

The study is based on two main stages of analysis, representing the multi-scale nature of our approach. The first stage involves an overall measurement of accessibility to amenities in the Rabat-Salé area, based on the organisation of its urban and commercial framework. The second stage is based on a more detailed understanding of accessibility indicators in the districts served by the tramway.

2.1.1. Global scale

Using the Fractalopolis methodology, we carry out an initial phase of diagnosing the area by measuring accessibility to amenities according to the organisation of the various urban centres. The first step is to understand the polycentric nature of the area and the spatial hierarchy that exists between the different polarities. Using the urban system we have constructed, we can identify the main areas of the conurbation from which we will measure levels of accessibility. This measure of accessibility is based on various indicators: the selection and classification of the different types of points of interest (POIs) used for the study, the choice of preferred access distances according to the type of POI and the frequency of use by the population. The POIs considered for this study are shops (grocery shops, supermarkets, coffee shops, pharmacies, etc.), services (nurseries, schools, sports facilities, health services, etc.) and green and leisure areas (parks, forests, beaches, etc.). With around thirty types of POI selected and geolocated in the form of points, the database used is particularly rich for this study area.

2.1.2. Local scale

As part of the preparation of the PMUD, we wanted to expand on existing knowledge of the urban characteristics of the areas served by the tramway and their integration with the rest of the Rabat-Salé conurbation. By focusing on the neighbourhoods around the tramway stations, the aim was to assess the level of walkability of these areas and their interactions with the public transport network. Our analysis therefore focused on a detailed analysis of accessibility to the POIs around the stations and in the rest of the city. We also focused on a number of indicators associated with the territorial design of these spaces (jobs, land use, pedestrian network, etc.). To calculate multimodal accessibility combining walking and trams, we used the open source tools OpenTripPlanner [4] and r5r [5], via the R environment. These tools can be used to calculate journey times and estimate accessibility to POIs via different types of location-based measures. This methodology required the use of GTFS (General Transit Feed Specification) data from the Rabat-Salé tramway network, which cross-references itineraries (organisation of routes and location of stops) and vehicle timetables.

2.2. Materials

The main GIS data used and their sources are shown in Table 1. The use of open and recent data has been favoured wherever possible, to facilitate the reproducibility of the methodology. Similarly, the preference for global spatial data may favour applications over a wide variety of territories. QGIS Desktop 3.32 software was used for GIS processing.

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TYPE OF DATA	SOURCE	PERIOD
Building footprint	Google-Microsoft Open Buildings	2023
Building height	Global Human Settlement Layer - GHS-BUILT-HR2023A	2023
Population / Number of households	Population census (RGPH)	2014
Number of jobs	<i>Rabat Région Mobilité</i>	2022
Land Use	OpenStreetMap / geoportal of the Rabat Salé Urban Agency	2024
Shops and services	Google maps / geoportal of the Rabat Salé Urban Agency	2024
Green and leisure areas	OpenStreetMap	2024
Tram lines and stations	OpenStreetMap	2024
GTFS tramway	<i>Rabat Région Mobilité</i>	2022

Table 1. Principal data used in the study

3. Results

The first contribution of this study is the formalisation of Rabat-Salé's 'urban system', reflecting the multi-scale organisation of its urban and commercial frameworks. Accessibility levels to shops, services and green spaces were estimated and indexed according to the different urban polarities identified. There is a disparity in scores between neighbourhoods, particularly between the heart of the conurbation and non-regulated built areas. It is therefore possible to identify areas that are suitable for future development, taking into account these assessments and the PMUD's recommendations. A detailed analysis of the areas served by the tramway provides a precise diagnosis of the nature of urban development and the potential for walkability and multimodal accessibility in these areas. This paves the way for more in-depth studies on the relationship between urban planning and transport in the Rabat-Salé conurbation, particularly with regard to the future development of its mobility system.

4. Conclusions

The contributions of this study are important in several respects, both in terms of improving specific knowledges of the study area and in the wider development of new theoretical and methodological thinking on the measurement of urban accessibility. This is an interesting contribution to the application of the '15-minute City' concept in the urban and socio-cultural contexts of a North African metropolis. This application of Fractalopolis is also an important step in developing the

operationality of the software and the reproducibility of its methodology. Finally, we hope to contribute to the dissemination of the latest innovations in the field of existing open geographic data on a global scale.

Acknowledgements

We would like to thank *Rabat Région Mobilité* for its support in sharing the data required for this study, in particular the GTFS files for the tramway and the job and population data.

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