

## Summary

The main objective of this study is to evaluate, analyze and visualize potential alternative scenarios for urban development of Monastir until 2050. Thus, the study uses local quantitative and qualitative knowledge to give a spatial and temporal assessment for different urban expansion pathways of the city. Finally, the attained results with the collaboration of the municipality would potentially contribute in improving local policies and in enhancing further informed-decisions.

# Simulating urban growth scenarios in the context of city development: findings from Monastir, Tunisia

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## ABSTRACT

The city of Monastir in Tunisia has witnessed relatively rapid urban expansion of near 200% since 1975, which had significant effects in degrading both the environmental conditions and the living quality services.

The approach presented in this study is hybrid and integrates local knowledge in the form of story lines of potential urban development scenarios with data-driven Urban Growth Model (UGM of SLEUTH) to simulate alternative development states of the city. Therefore, the approach progresses from a set of narratives that are verbal descriptions of the development to an operational application that simulates quantitatively different scenarios of future urban development. The methodology includes consecutive focus group discussions with local stakeholders to: (1) define the main sectors that shape the development of the city (e.g. industrial, housing, agriculture, etc.), (2) frame the development in a two-dimensional scenario space along two major axes that were defined by local stakeholders (here: strong vs weak economic growth and strong vs weak law enforcement). Each quadrant in the scenario space denotes a family of scenarios, where ‘scenario’ in this context is a description of a future possible state as an alternative image of how the future can unfold, (3) design a plausible typical scenario of each family which considers the spatial impact of future changes in the city for the determined time. In addition to the four alternative scenarios, a business-as-usual scenario is used to predict the future growth of the city based on the historical trend. Twelve Landsat images for the period 1975 to 2017 were used to delineate changes in urban land cover for Monastir following the European Urban Atlas Guide, which served as the main input for the UGM.

The accuracy of the calibration process of SLEUTH was conducted using the “Lee-Sallee shape index” which measures the spatial conformity between the model's simulated growth and the actual urban growth in the archived data. The model performance for the case study was reflected in the high attained Lee-Sallee value, 0.61, for Monastir which is acceptable when compared with related studies. The urban DNA of Monastir was captured through the standard set of SLEUTH coefficients for diffusion, breed, spread, slope, and road gravity, revealing that particularly edge and road gravity growth are prominent in Monastir. Moreover, the results showed that the policies of the two strong law enforcement scenarios were beneficial in reducing the consumption of land by 30 % and in enhancing the compact growth of the city. On the other hand, the two strong law enforcement scenarios showed much faster depletion of cultivated land with a potential reduction in the quality of public services due to the stress on the infrastructure created by the uncontrolled and unplanned growth. The ‘business as usual’ scenario revealed that ~ 25 % of the arable land will be lost in favor of urban expansion by 2050 and that the city, with over 70 % probability, will grow up to 28.5 %.

The conducted scenario analysis on the urban development, was an opportunity for testing and visualizing the impact of various city plans, which would guide towards more managed and consequently more sustainable development. Thus, a strategic intervention from the municipality is crucial to test and propose long term policies and solutions, which would help to contain the recent growth and manage the future urban development. In conclusion, our approach would enable the planners to have a structured process to think about longer-term future and understand better the implications of the current and the future strategies.