

# URBAN GROWTH SIMULATION IN GALICIA USING CELLULAR AUTOMATA: A STUDY CASE OF RIBADEO URBAN CORE.

## ABSTRACT

The greatest growth of Galician urban areas has taken place in the last 30 years, due to the socioeconomic development experienced in the region. The fast urban growth, its disperse nature and the lack of tools to regulate it, produced a series of problems such as the increase of private car ridership which fostered pollution and congestion problems, the increase of infrastructure costs, fiscal problems derived from commuting or jurisdictional problems due to the fact that new metropolitan areas exceed their original administrative limits. This leads to the need of studying and analyzing urban land use expansion in Galicia, so as to try to tackle the generated problems with suitable planning policies.

The study of urban problems, have been tackled using urban growth models since the 50's decade. Among these models cellular automata are one of the most outstanding due to their capability to reproduce with simple rules at local scale, complex emergent dynamics such as those of urban growth processes. The simplicity of cellular automata rules, among other issues, makes the analysis of the processes simulated easier, because they simplify the interpretation of the results. Bearing this in mind, in the present work, several conducted studies are presented in order to implement an urban cellular automata model, adapted to the simulation of urban growth processes in Galicia.

This model may be used as a valuable decision support system in Galician urban planning. Most of the existing urban cellular automata were designed to simulate big cities. Nevertheless, the application of these models to small urban areas, such as those characteristic of the region of Galicia, is very scarce. This is the reason why Ribadeo municipality has been chosen as the study area. Ribadeo is a middle-sized village which acts as the capital of a district. This characteristic makes this urban center a representative example of most of Galician villages.

In order to reach the proposed target, firstly, those urban cellular automata which have been implemented so far were studied to elaborate a classification which could make the selection of the best model for a specific situation easier, in this case, for the simulation of small urban areas such as Ribadeo. The next step was to study the processes to be simulated by analyzing Ribadeo urban growth patterns using spatial metrics and identifying their drivers through logistic regression techniques. The results of these analyses allowed studying the different urban growth dynamics which were present in the municipality using cluster analysis techniques to identify areas with uniform growth patterns. The drivers of the growth patterns within each area were studied using logistic regressions.

Then it was needed to analyze the behavior of one of the components of cellular automata which showed to exert a greater influence in the results; the stochastic component. For this, a sensitivity analysis of the main methods used to consider randomness in the models was conducted. The following study involved the simulation of urban growth in the study area using some of the main models identified in the bibliographic review. The obtained results allowed the assessment of advantages and drawbacks of each model and to test their accuracy in the simulation of Galician urban areas. The knowledge acquired in this study was applied to the design and calibration of a model, adapted to the characteristics of Galician urban areas. The main aim of this new model is to make the calibration process simpler by reducing the number of coefficients to be calibrated. To this end, suitability maps were obtained with logistic regressions and the weights of the neighborhood were simplified representing the distance decay influence of each land use in the central cell using two lines.