## 8. Determination of the explanatory factors of urban growth, storyline of future scenarios of urban growth, and estimation of future land demands

This stage try to determine the **driving factors of the urban growth** (in terms of increase of urban land use) in the two areas under study between 1990 and 2000 through statistical techniques. Information was gathered about more than 30 socioeconomic and bio-physical variables. Faced with the diversity of potential factors and the different spatial units for aggregating that information (pixel and municipality), up to five different statistical methods were used to check whether the results could differ considerably (multiple linear regression, logistic regression, partial least squares regression, multilevel models and geographically weighted regression). An added value of this study's results is that the analysis was carried out for artificial surfaces as a whole, as well as for a variety of individual urban categories (discontinuous urban fabric, isolate residential areas, industrial and commercial units, and construction sites.

In the case of the Madrid Region, the variables which cropped up time and again in relation to the increase in urban land are population density, distance to roads, percentage of building land available, and topography. The situation was very similar in Granada, the variables most closely related to urban growth being identified as population density and growth, gradient and altitude of terrain, percentage of building land available and distance to commercial areas, universities, roads and pre-existing urban areas. Thus, we have been able to fix valuable bases for understanding the rationales behind urban expansion in these two areas and using this information as a way into the models for simulating the future urban growth to be simulated, especially for the trend situation (explained below).

More information in:

Plata Rocha, W.; Gómez Delgado, M. and Bosque Sendra, J. (2008). *Análisis de factores explicativos del crecimiento urbano para la Comunidad de Madrid a nivel municipal*, XIII Congreso Nacional de TIG, Servicio de Publicaciones de la Universidad pp. 121-134.

Plata Rocha, W.; Gómez Delgado, M. and Bosque Sendra, J. (2009): "Incidencia de la zonificación del territorio en los factores explicativos del crecimiento urbano de la Comunidad de Madrid"; *XII Conferencia Iberoamericana en Sistemas de Información Geográfica*, Heredia (Costa Rica), Junio de 2009.

Plata Rocha, W.; Gómez Delgado, M. and Bosque Sendra, J. (2009): "Análisis de factores explicativos del crecimiento urbano en la Comunidad de Madrid a través de métodos estadísticos (RLO y MLA) y SIG", *Revista de Planeamiento Territorial y Urbanismo Iberoamericana*, Vol.4.

Once the analysis of developments over the period of study was completed, the Project went on to simulate the urban development that might occur in the future, devising different situations in order to analyse their potential impacts.

The definition of **future urban growth scenarios** was carried out with the agreement of the research teams involved in the Project and using as a benchmark the scenarios put forward by the Inter-governmental Panel of Experts on Climate Change and those proposed as part of the European Union Project, PRELUDE (*Prospective Environmental Analysis of Land Use Development in Europe*). Three scenarios were finally decided upon: the business as usual scenario, the crisis scenario, and the innovation and sustainability scenario. The point of departure was the year 2000, and the deadline for simulation was the year 2020. What follows is a summary of the storyline of each scenario.

### 1. Business as usual scenario

The survival of any economic uncertainty or crisis by the model which has permitted the extraordinary development of the last fifteen years, together with the ongoing primacy of economic interests over environmental and social issues, forms the basis of this scenario.

Thus, this scenario presumes the confirmation and consolidation of the models and intensities of growth registered for the period 1990-2000. Accordingly, the demands for residential and productive land use will remain high, in line with maintained rates of population increase (thanks in particular to the immigration rate), rising levels of available income and the high demand for productive land uses (especially commercial and industrial) generated by new housing developments.

### 2. Crisis scenario

This scenario reflects the end of the strong economic growth enjoyed by Spain over the last few years that implies important consequences for the processes of metropolitan growth. Accordingly, this scenario assumes a significant change in the forms, patterns and intensities of growth with respect to preceding years. The demands for productive and residential land uses will drop everywhere due to the fall in demographic pressure, smaller increases in income levels, and more compact patterns of growth which will reduce the amount of productive areas associated with residential areas.

### 3. Innovation and sustainability scenario

The search for new models and formulas for economic growth and diversification will lead to an about-turn in existing models of metropolitan development. The predominant growth in housing will make way for greater productive development, which will accommodate the new fabric of innovative business, the mainstay of economic growth. Accordingly, the demand for land for metropolitan growth chiefly centre on the growth of new productive areas generated by the rising incomes generated by the innovation-driven economy, while residential demands will fall due to stable population levels.

Finally, in order to simulate and locate this increase in future urban land, we had to estimate the **future demand for urban land** for the tow areas under study and for each of the defined scenarios. The estimation model was generated using a System Dynamics-based model. The demand for residential and productive land was obtained from the combination of three estimates: the evolution of the population (bearing in mind birth, mortality and immigration rates); changes in the number of homes (bearing in mind the division of households); and the evolution of income levels. The following table shows the final results:

| DEMAND (HA) | BUSINESS AS USUAL | CRISIS | INNOVATION AND SUSTAINABILITY |
|---|---|---|---|
| **GRANADA** | | | |
| RESIDENTIAL USE | 8,012.22 | 7,141.47 | 7,459.29 |
| PRODUCTIVE USE | 1,534.3 | 1,294.62 | 1,310.19 |
| **MADRID** | | | |
| RESIDENTIAL USE | 84,541.41 | 73,646.97 | 73,744.76 |
| PRODUCTIVE USE | 31,551.42 | 27,525.97 | 25,031.41 |

*Table 5. Volume of future demand for each type of use and each area under study*

More information in:

Aguilera Benavente, F.; Plata Rocha, W.; Bosque Sendra, J. and Gómez Delgado, M.: "Diseño y simulación de escenarios de demanda de suelo urbano en ámbitos metropolitanos", Revista Internacional de Sostenibilidad, Tecnología y Humanismo, Nº4, pp.57-80.

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