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## 7. Detailed analysis of the urban development of the metropolitan area of Granada and Madrid region

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We have described in detail the changes in land use in the Madrid Region between 1990 and 2000. As we have learnt from a basic analysis by cross-tabulation of the Corine Land Cover (CLC) data at level 1, in 2000 a large part of the area of the region was used for forestry and agriculture (49.23 % and 38.04 % respectively), while 11.93 % was occupied by artificial surfaces, with only 0.80 % being taken up by bodies of water. If we compare these data with those recorded for 1990, we find that in an interval of little more than 10 years the area occupied by the first two categories has fallen (8.9 % in the case of agriculture, 0.4 % in the case of forestry), while artificial surfaces increased 47 % with respect to the land dedicated to this use in 1990, and 3.85 % in terms of the total area of the region. In fact, this urban increase is the third greatest nationally, only surpassed by the Valencia and Murcia regions.

We may say that the increase in artificial surfaces in the region was responsible for a significant loss of agricultural areas (20,305 ha) and forest and semi-natural areas (11,061 ha). The more detailed analysis of this information at CLC level 4 enabled the changes produced to be further nuanced and even the morphology of urban growth to be determined. Level 4 analysis shows that almost 43.2 % of this land gain was achieved on the basis of urban zones, more precisely, isolate residential areas (47. %), discontinuous urban fabric (44.4 %) and, to a lesser extent, continuous urban fabric (8 %). These data corroborate the non-compact urban growth in the region, a fact whose implications are not very positive from the point of view of sustainability.

More information in:

Plata Rocha, W.; Gómez Delgado, M. and Bosque Sendra, J. (2009). Cambios de usos del suelo y expansión urbana en la Comunidad de Madrid (1990-2000), *Scripta Nova*, Vol. XIII, núm. 293.

Available at: <http://www.ub.es/geocrit/sn/sn-293.htm>

Meanwhile, we have devised a quantitative method for expressing the basic aspects of the urban structure as it has been evolving in the two areas under study, taking 1981, 1991 and 2001 as the years of reference. This method is structured into two distinct phases:

- Firstly, for each of the three selected dates the structure of the city is specified with a view to measuring its evolution by grouping the raster cells in homogeneous zones related to the pattern of dispersed urban growth. To that end, the analyses explained below were carried out, all of which used the special analysis procedures habitually available in a raster GIS, which makes it easier to study the evolution of the morphology of the patch of land occupied as well as the relative position of the fragments represented:
  - Identification of the city's growth pattern: monocentric compact, polycentric compact, linear, or more or less dispersed urban growth.
  - Measurement of the density gradient for land occupation against distance from the urban centre. This analysis was also applied to urban development with respect to existing metropolitan secondary centres in order to check the structure of partial urban development in each of the region's most important municipalities. At the same time, this analysis was carried out in connection with other of the territory's structural elements such as roads, main transport nodes, or the principal services located in the city.
  - Measurement of change in land use.

- Measurement of the structure of occupied land using indexes offering information about degree of territorial compactness or fragmentation. These are some of the indexes habitually used in landscape ecology. Valuable information can also be obtained from the study of variables like density, continuity, concentration, centrality and diversity.
- Once patterns of urban growth have been deduced with respect to the model of the dispersed city, the second phase goes deeper into the deduction of the main explanatory factors of the development of both urban agglomerations with a view to demonstrating their influence over time. We work from the hypothesis that there is significant correlation between a series of variables and the phenomenon of urban growth, and that it is possible to build a model which shows us how, where and how much the urban area is going to grow over the years to come, even if the model is only orientative as far as patterns are concerned. To that end:
  - We have taken into account variables of proximity, whether physical (distance from urban zones) or temporal (accessibility), proximity being one of the main conditioning factors of urban growth.
  - The study is completed with other factors deriving from the consolidation in time of a polycentric city structure: location of hypermarkets, mixed leisure and commercial centres, technological parks, research centres, major facilities, etc.
  - The road and transport network is also a key player in the process of urban expansion. Accordingly we also study the distance from strategic transport nodes.
  - Finally, such environmental factors as the slope and orientation of terrain have been taken into account with a view to quantifying potential natural obstacles to urban growth.