

BRINGING GIS INTO REGIONAL DEVELOPMENT

Regina Salvador

regleo@mail.telepac.pt

Rui Pedro Juliao

rpj@fcsh.unl.pt

NEW UNIVERSITY OF LISBON

Geography and Regional Planning Department

Av. Berna, 26 - 1069-061 Lisboa

Portugal

Tel : 351-1-793 35 19 Fax: 351-1-797 77 59

ABSTRACT:

In the end of the present millennium, Cartography makes a magnificent come-back for two main reasons :

- The global scale change in world space.
- The technical revolution in GIS.

Geoeconomics studies the global strategies of different agents (States, regions, corporations, etc.). It demands for synthetic maps able to deal with huge amounts of data and variables.

GIS as a supporting tool for regional development can be useful in different phases:

- Analysis/Diagnosis
- Proposal/Decision
- Public Discussion
- Monitoring/Evaluation

In order to demonstrate this approach we will use two Portuguese case studies. One about Lisbon Region, the most developed area of Portugal and the one with higher growth in all EU. The other area, the Guadiana River Watershed, is one of the poorest

EU territories presenting a very low demographic density but with one of the most important mining reserves in the European Continent.

1. - Economic Geography, Development and Cartography

Economic Geography has always strongly influenced Cartography. The main reason lies in the easiness to represent and locate economic activities: agriculture, mining, industries, population, and urban concentration.

In the end of the present millennium, Cartography makes a magnificent comeback for two main reasons:

- The global scale change in world space.
- The technical revolution in GIS: infography, GPS, etc. are increasingly used by Governments and private corporations as fundamental tools for their strategies.

After a relative long period following II World War where dynamic maps were directly connected with the German Geopolitik, the need for synthetic spatial analysis mainly in the field of Geoeconomics, makes us adapt the famous title of Yves Lacoste¹ to “La Géographie, Ça sert d’abord à faire le Commerce”.

Geoeconomics studies the global strategies of different agents (States, regions, corporations, etc.). It demands for synthetic maps able to deal with huge amounts of data and variables. Despite the enormous production of the last few years, in the market of Cartography there is still an excess of demand over the offer of these new generation maps.

We will try to fill this gap using GIS in two case studies of regional development.

The first case is the Lisbon and Tagus Valley Region, the most developed area of Portugal and the one with higher growth in all European Union. The second case is the Guadiana River Watershed Region, one of the poorest EU territories presenting a very low demographic density (<25 inhabitants/km²), but with one of the most important mining reserves in the European Continent.

¹ “La Géographie, Ça sert d’abord à faire la Guerre”.

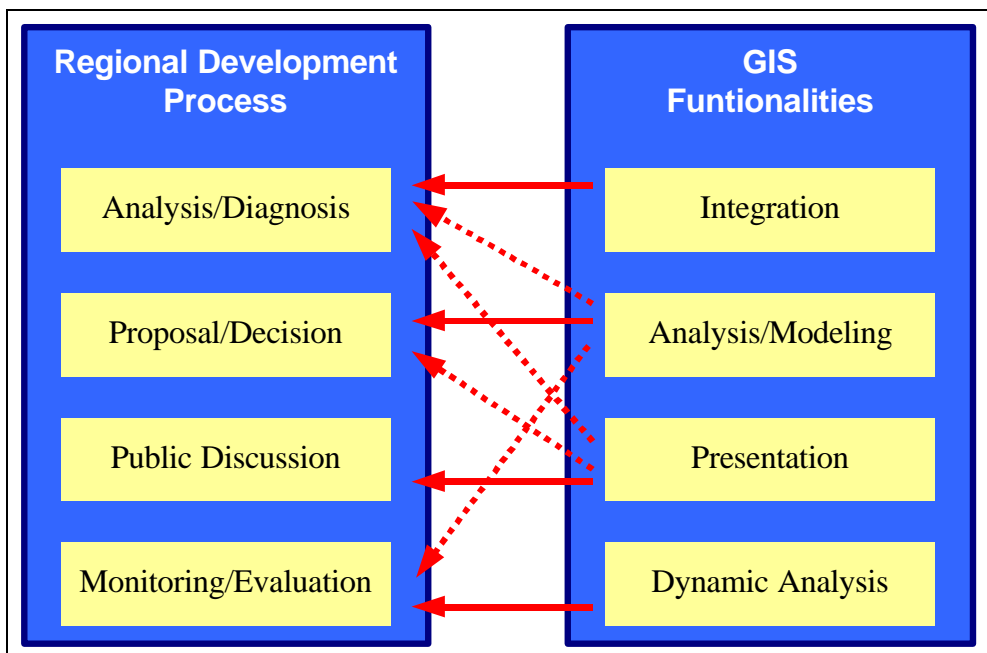
We will show how GIS can be an extremely useful tool in the different phases of regional development promotion, in both of these two opposite cases.

2. - Regional Development and GIS

If one considers Regional Development as a process, GIS - as a supporting tool for regional development – can be very useful in regional development promotion different phases:

- Analysis/Diagnosis.
- Proposal/Decision.
- Public Discussion.
- Monitoring/Evaluation.

Figure 1. - Regional Development Process and GIS



The first phase, Analysis/Diagnosis, makes use of the high performance of GIS as a data integration tool. Territorial knowledge and spatial preview can be improved by the use of this new technological methodology.

Proposal and Decision, the second phase, is perhaps the most sensitive moment in all this process. A GIS spatial analysis capability makes complex territorial modelling easier.

The third phase, Public discussion, both of policy decision and results benefits also from the GIS graphical presentation capacity.

Last, but not the least, Monitoring and Evaluation, the fourth phase, can also be implemented with the support of the GIS dynamic evaluation tools which will maximise its efficiency.

3. - Lisbon and Tagus Valley Atlas

Our first example, the Lisbon and Tagus Valley Atlas, shows how GIS's integration and graphical presentation capabilities can be used to create a tool for regional development

In the last decades, Lisbon and Tagus Valley Region (LTVR) has suffered several significant changes in key issues such as : consolidation of the Lisbon Metropolitan Area; new accessibility structure; land use and land cover shifts; and new socio-economic dynamics.

As a consequence, try to understand, work, promote and develop the (or in the) LTVR can not be done without a flexible tool that enables the agent to get a significant territorial knowledge. Knowledge of the factors behind his strategic choice and also a prospective territorial knowledge of the future scenarios, considering or not his choice.

Considering that, among other reasons:

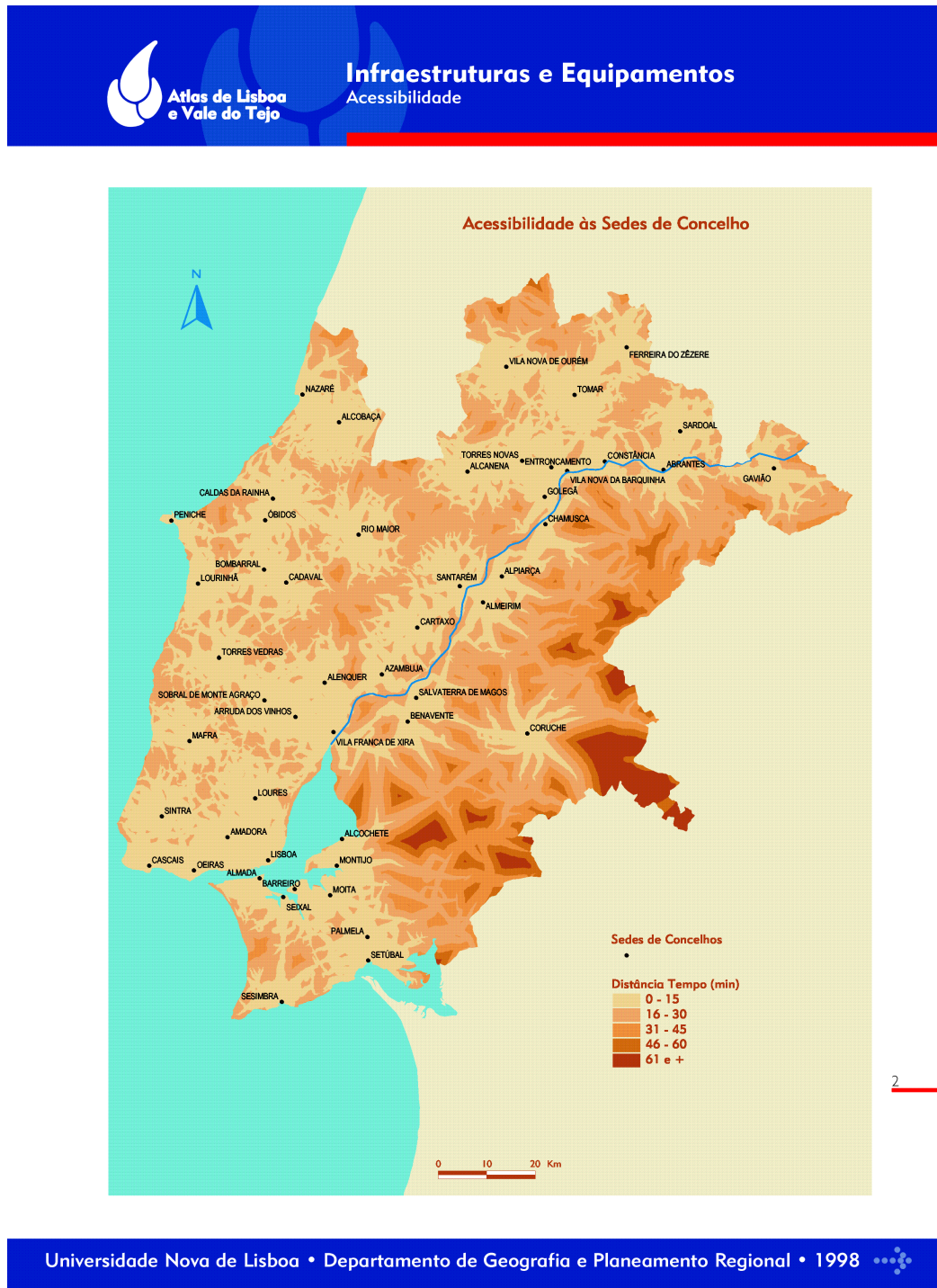
1. the rhythm of the society evolution and its spatial significance is increasing;
2. the LTVR concentrates more than 33% of the population, 42% of the GNP and 36% of total exports, within 13% of the Portuguese mainland area;
3. there isn't a single publication that describes the LTVR covering, according to an integrated vision, most of the actual key issues;

4. the lack of information can be a very strong barrier to the development of GIS applications in every field and, of course, in Regional Science;

the Geography and Regional Planning Department of the New University of Lisbon has decided to create an Atlas for the LTVR.

The Atlas was build by using a digital process with a support of a GIS which means that the information presented in this Atlas is available for any other future use. This is one of the advantages of using GIS. Once the geographical information database is settled it can be used by several projects and easily upgrade.

Figure 2. Lisbon and Tagus Valley Atlas. Example



In this particular case, the Lisbon and Tagus Valley Atlas (LTVA) covers several key issues for the understanding of the region:

- General Issues;

- Physical Geography and Environment;
- Land Use and Land Cover;
- Population/Demography;
- Housing;
- Economics and Development;
- Infrastructures and Facilities;
- Planning.

This Atlas contains 127 maps, several graphics and tables presented in 34 cards, grouped by 8 themes (presented above). Almost all cards contain some comments that can help the user to get into the debate. The debate about each theme and the debate about the future of this region.

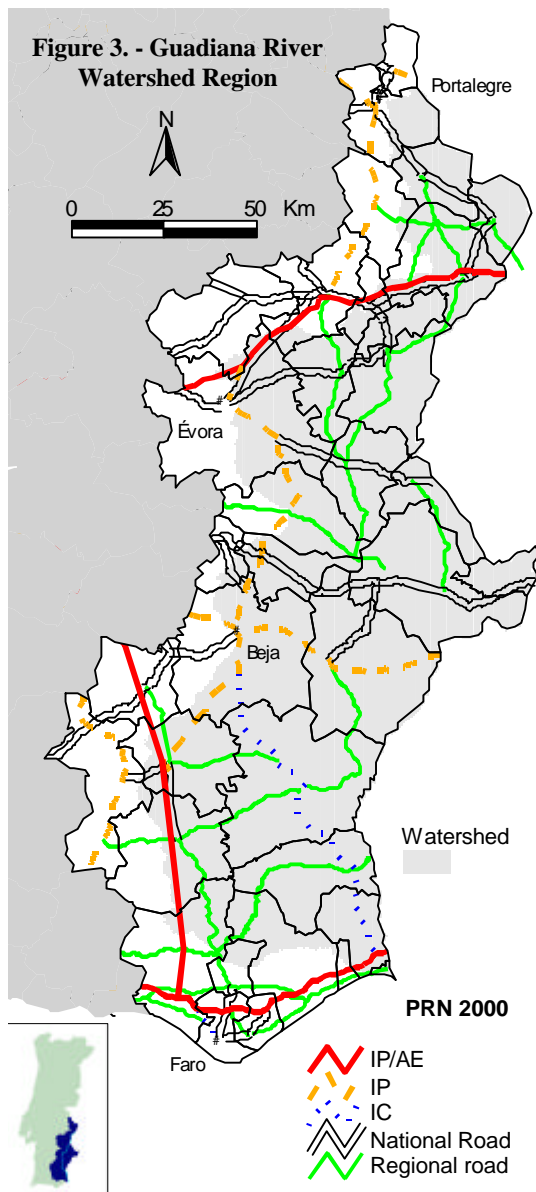
User. That is the key word for this new concept of Atlas. Instead of a reader facing a static, heavy and rigid work, the user of the LTVA is presented to a dossier that enables him to reconfigure it, by changing the cards' order or by incorporating his work into the Atlas.

The use of GIS as a supporting tool for the making of the Atlas and its edition in a dossier enables us to reaffirm the dynamic profile of the Atlas. It will be easy to upgrade the LTVA, by incorporating new cards or by replacing the cards with more accurate data. By presenting this new Atlas we didn't finish our job. We are just beginning it.

Hoping that this project can be an essential tool for all those that work on the region, planning, investing, promoting, teaching and so on, this publication was distributed, free of charges, by every school and by other public and private institutions. At the same time the release of the Atlas on the Internet is scheduled for next Autumn.

4. - Guadiana River Watershed Region

In our second example we present the use of GIS analytical tools as a key support to territorial understanding and as a regional development decision support tool.



The Guadiana River Watershed is the fourth in size in all Iberian Peninsula (after Douro, Ebro and Tagus Rivers) with a total surface of 66 800 square kilometres. About 17% of this area – the “Low Guadiana” – is in Portuguese territory (11 500 km²).

It corresponds to parts of the Alentejo and Algarve provinces (NUT2) which embark four NUT 3 regions (Norte Alentejo, Alentejo Central, Baixo Alentejo and Algarve) and 32 Councils (see Figure 3).

The climate in the Guadiana River Watershed is Mediterranean, with hot Summers and relatively cold Winters. As an old Spanish saying tells “the Guadiana river appears and disappears”. This fact, in connection with the highly irregular rain distribution regime and poor soils, makes the Guadiana region unsuitable for agriculture activities.

The INAG (Water National Institute in Portugal) commissioned one of the authors a Socio-Economic analysis of the Guadiana area. This analysis took into consideration the classical indicators (demographic, social, entrepreneurial, employment, sales, value added, productivity) used in a study of this kind. The results confirmed the common knowledge about the low development level of the area. This is one of the poorest regions in Portugal.

But the calculation of a set of socio-economic indicators is not enough. In order to develop a hydrographic plan, there is need to incorporate other elements (accessibility, infrastructures, land use, water consumption, etc.). We also wanted to present some suggestions to promote regional development.

To do so, we decided to analyse the Guadiana region at the light of the well-known neo-classical based model by John Friedmann. This MIT professor describes a centre and differentiated periphery, in which the movement of factors of production (labour and capital) are portrayed as following the predictions of the neo-classical model, i.e., the inequalities of income between regions tend to reduce. A need for some governmental intervention is seen, however, especially in the intermediate periods when the greatest regional differences are seen.

The set of movements defines four kinds of region according to this model:

- The Centre (with rapid growth and congestion problems);
- The “Upward Transitional” Region (with capital in-migration as the recipient of overspill factories and also migration of people);
- The “Downward Transitional” Region (with out-migration of people and capital);
- The “Resource Frontier” with slight population but massive natural resources.

Friedmann elaborated this model with reference to South America (and Venezuela, in particular). But he argued this kind of regions could be found in such different countries as former USSR, China, USA, Canada or Australia.

A “Resource Frontier” region presents the following characteristics:

- Presence of major natural resources and a commitment on the part of private firms (or the Government) to exploit the commercial opportunities that it presents. Generally, the resources in question will be minerals (iron core, uranium, copper, petroleum, etc.) although extensive forest and fisheries resources may have the same results. Resource frontiers do not include those regions that are formed primarily by the expansion of agriculture.
- Remoteness from existing centres of population, which is the main reason for some of the planning problems. Resource frontiers are non-contiguous areas, separated from the main centres of population by long stretches of largely uninhabited wilderness. To render them permanently habitable is a costly undertaking. Their very remoteness renders the provision of access routes expensive relative to the amount of traffic likely to be carried. This problem will contribute to the high cost of production in the area.
- Regional development focused on a city: resource frontiers are urban frontiers. “The towns were the spearheads of the frontier” writes Richard C. Wade in his scholarly analysis of early urbanisation in the American West. Because of their relative isolation, cities on the resource frontiers perform only limited central-place functions. Relative to their size, their trade and service sectors are generally atrophied. Hence, these cities are highly specialised: their chief purpose is to support and maintain the primary resource activities in the area. The hinterland or service areas of resource frontier cities will, as a rule, be small with city growth chiefly dependent on the behaviour of the demand for the exports.
- Exports are the principal reason for the existence of resource frontier. This fact establishes a clear-cut scale of priorities. The region will produce very little of what it consumes itself – hence, its import quotient will be high – and it will export, both to national and international markets, nearly everything it produces. Resource frontiers are open regions. As highly specialised and export-oriented communities they will be especially sensitive to fluctuations in the relevant export markets. The heavy initial financial amount required makes the private investors prone to base their calculations on a quick recovery of their initial investment.

- Frequently, the export markets are foreign and the same happens with the interests committed to the development of resource frontiers. As a result, the frontier may operate quite independently of the national economy and, indeed, be subject to policies that have only a tenuous relation to national interests.
- Regional population is scarce. The threshold of a minimum critical size to assure sustained growth and diversification of the region's economic structure is not easily attained.

In order to verify if the Guadiana Region can be classified as a "Resource Frontier" we had to use GIS, in particular in what respects land use and accessibility.

Using traditional Economics tools we were able to prove the following points :

- i) - The relative abundance of natural resources in the Guadiana Region. The weight of natural resource sectors (agriculture+mining+forestry+fishing) is much higher than the national average. The calculation of Location Quotients (LQ's) shows that among the 11 sectors with LQ's significantly higher than one – meaning regional specialisation in these sectors – 10² are directly connected with natural resources.
- ii) - Regional development focused on a city. Population in Guadiana Region is presenting a growing concentration pattern, in particular due to the weight of service employment (49.8% of total), mainly in City Halls. The majority of the 32 Councils of the Guadiana Region presents high urbanisation rates : 60% of the Councils have more than 40% of its population living in the Council centre. There are even cases where more than 90% of the population Council leaves in the Centre. However, we were not able to identify a Regional Capital. Only Évora (see figures 3 and 4), a city in the periphery of the Region seems to assume this role.
- iii) - An export-oriented Region: according to our calculations almost 40% of the regional production is exported (Economic Basis = 34.11). The two main

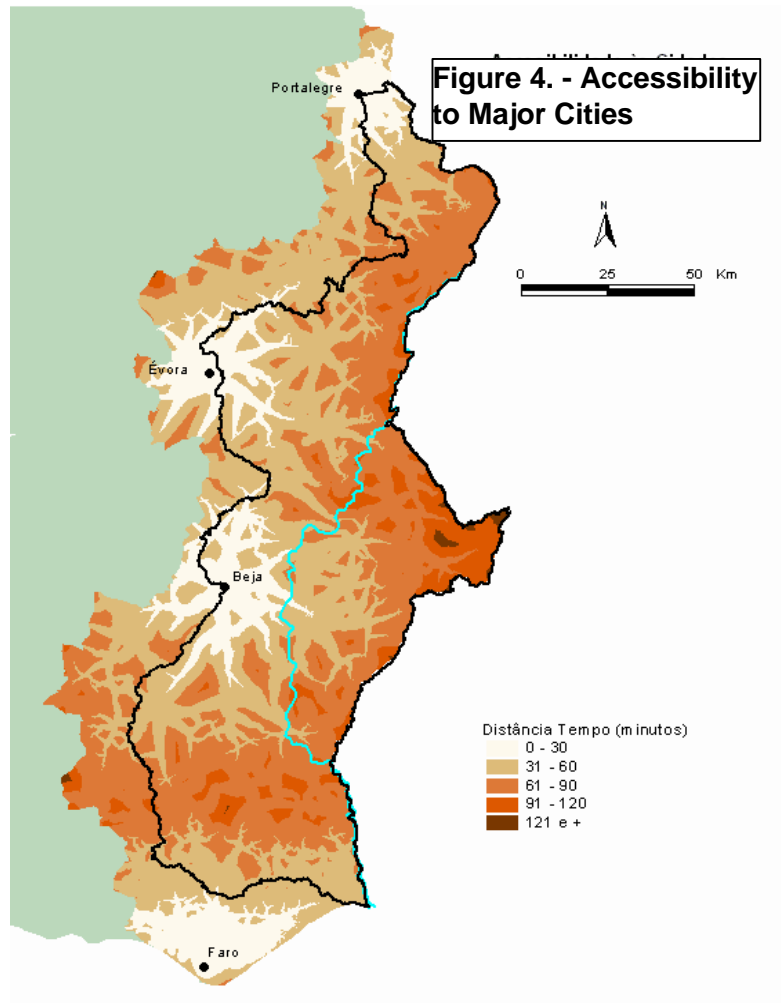
² The competitive sectors in the Guadiana Region are the following : mining; fishing and canned fish; cereal manufactured products; olive-oil products; other foodstuff; wood and cork products; paper industry; restaurants and hotels; wholesale and retail trade; workmanship; and cattle raising.

exporting sectors, responsible for more than 40% of total exports, are mining and forest products (cork, wood, paper industry and olive-oil products). It is curious to note that the majority of these exports come from the Alentejo Councils (Economic Basis = 36.02), as the Algarve Councils are the most backward in the Algarve Region and still not occupied by the “tourist fever”.

- iv) - Foreign Direct Investment: we were able to identify the presence of multinational “Rio Tinto”, exploring copper and tin in what is the greatest pyritiferous strip in the European Union. Cork is exported to the North of Portugal, mainly to be explored by the Amorim Group, the greatest world-wide. Paper industry belongs to a major enterprise, a joint-venture of Portuguese and Nordic capitals. . Other sectors (mineral water, canned fish) are also dominated by large companies.
- v) - Regional population is scarce. The demographic density is low (<25 inhabitants for km², to a Portuguese national average of 107.1 inhabitants/km²).

But the traditional economic analysis tools were not able to give us information on the remoteness and wilderness aspects of these frontier regions. This shouldn't be a surprise as these characteristics are essentially spatial and traditional methodologies don't have tools to integrate them.

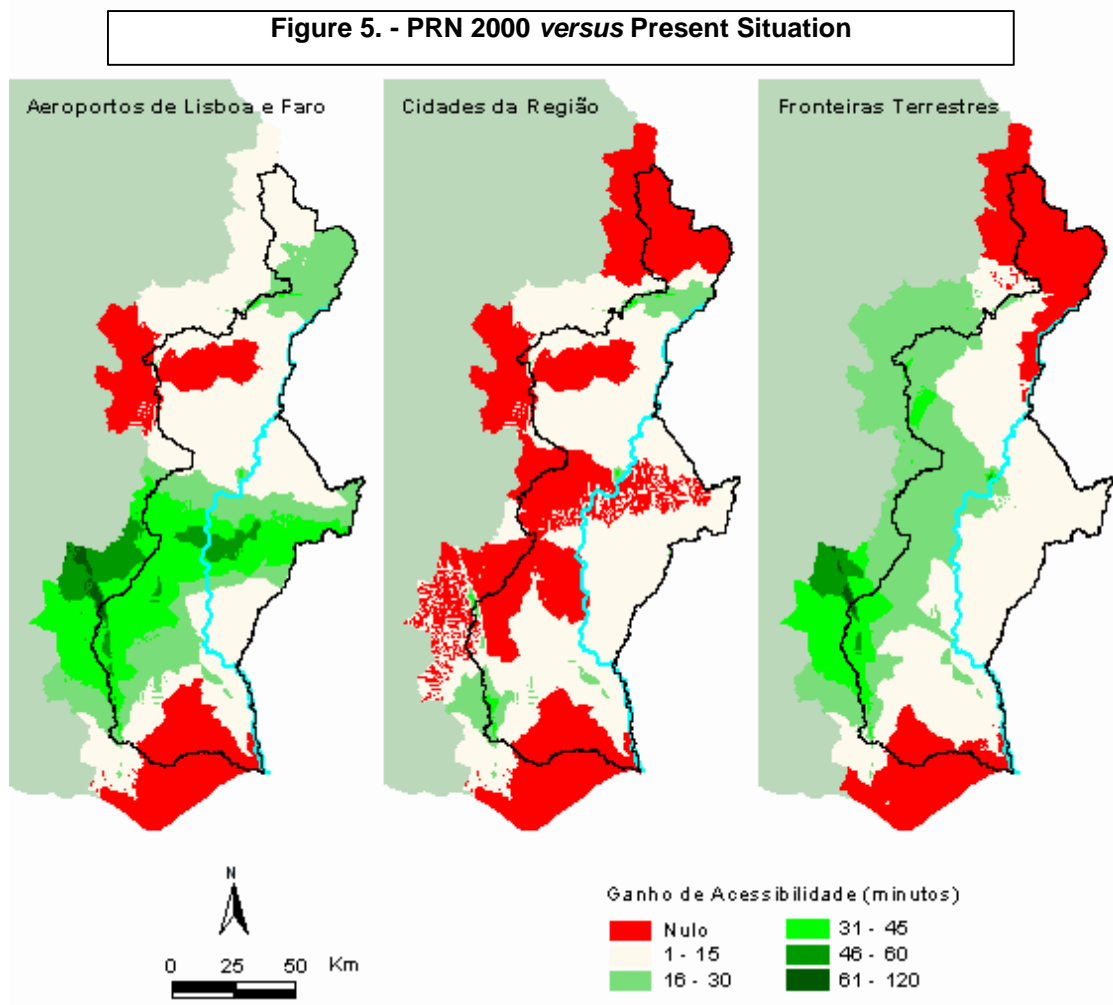
The use of GIS was crucial at this stage. By using accessibility models (see figure 4) and other spatial information, like CORINE land cover data, it was quite easy to prove that even if this territory is not the "*Old American West*" it is, for sure, the "*Deep Portuguese East*".



More than 85% of the area is taken by agriculture or forest and 10% is void while the urban area is, more or less, only 0.35% of the territory.

If one takes under consideration accessibility, the figures speak for themselves: more than 50% of the territory is 90 or plus minutes of travelling distance to the nearest city and 70% is 120 or plus minutes of travelling distance to the nearest international airport.

The problem is serious considering that with the new National Road Master Plan (PRN2000) the accessibility will only increase towards the borders and the international airports (see figure 5).



5. - Final Remarks

The two examples presented in this paper have shown how GIS can be integrated into Regional Science.

The two projects have totally different purposes, but one common feature : the use of GIS in its core methodology. Obviously, each project uses GIS according to its specific needs.

The Lisbon and Tagus Valley Atlas can be considered as an important tool for those who are working in this region. Its primary design is regional analysis and diagnosis - the first phase of the regional development process. Nevertheless, it can also be used to present planning proposals, like the ones referred in its Chapter VIII. The point is that in this

project GIS was incorporated as a tool for data integration, analysis and cartographic presentation (remember figure 1).

Our second example is a completely different one. In this case study, GIS is used as an analytical tool in order to increase the territorial knowledge of the study area. The use of GIS has proved to be essential for a better and more complete understanding of the Guadiana River Watershed than that provided by the traditional economic approach.

Our final remark must be a statement that stresses the need and opportunity for using GIS in Regional Science studies.

References

BURROUGH, P. e McDONNELL, R. (1998): Principles of Geographical Information Systems, Oxford University Press, New York

FRIEDMANN, John (1966) – Regional Development Policy: A Case Study of Venezuela, The MIT Press.

JULIÃO, Rui Pedro (1998) – Measuring Accessibility. A GIS based methodology for accessibility evaluation, in "GIS PlaNET'98 Proceedings", GIS PlaNET'98, Lisboa.

LONGLEY, P.; GOODCHILD, M.; MAGUIRE, D. e RHIND, D. (1999): Geographical Information Systems: Principles, Techniques, Applications and Management, 2 vols., 2^a Edição, John Wiley & Sons, New York

MARBLE, Duane F. (1990) – The Potential Methodological Impact of Geographic Information Systems on the Social Sciences, in Allen, Zubrow and Green (Eds.) "Interpreting Space : GIS and Archaeology", Taylor & Francis, London.

MORRIS, Arthur (1998) – Geography and Development, UCL Press, London.

PORTER, Michael (1994) – Construir as Vantagens Competitivas de Portugal, Ed. Forum para a Competitividade, Lisboa.

SALVADOR, Regina (1998) (Coord.) – Vantagens Competitivas Regionais, Volumes IV e V, AIP/PEDIP, Lisboa.

SALVADOR, Regina (1998) – Análise Sócio-Económica do PBH do Rio Guadiana, CIRIUS para a Hidroprojecto,SA.

SOARES, Nuno Pires (1998) – O Sistema Urbano Português 1890/1991, Dissertação de Doutoramento apresentada à UNL/FCSH.

WADE, Richard (1959) – The Urban Frontier. The Rise of Western Cities, 1790-1830, Harvard University Press, Cambridge.