

# **Potential areas of determination for urban sprawl through analysis of multi-criteria – the urban planning experience of Mateus Leme/MG**

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This article presents the methodological experience in the application of GIS techniques in mapping and analysis of potential areas for Urban Sprawl in the city of Mateus Leme, belonging to the metropolitan region of Belo Horizonte (MRBH). This experience occurred in 2014 from a technical cooperation agreement between the city of Mateus Leme, the Metropolitan Agency RMBH and the prosecutor of Minas Gerais, for the preparation of the Specific Project of Urban Sprawl (SPUS) of Mateus Leme. To eliminate the fragmented treatment and control the occupation of the territory to ensure integrated management, including risks and natural disasters, Law nº. 12.608/2012 establishing the National Policy of Protection and Civil Defense amended the City Charter, Law nº. 10.257/2001, creating the Article 42 -B, which has required municipalities wishing to extend its city limits, after the date of publication of the law, the drafting of a SPUS. The study was developed in GIS environment (Geographic Information Systems) and used a relational database to store the information and attributes of geographic objects (in tables) and files, to save the geometric representations of these objects (spatial representations) provided that the crossings between variables (Analysis of multi-criteria) resulting in land potential areas for Urban Sprawl. This result supported the discussion and the proposed new perimeter of Urban Sprawl of the city.

## 1 INTRODUCTION

The sustainable development of a municipality is directly associated with the planning and management of resources of its territory and its population. The territorial planning aims to define the best way to engage a city, defining basic and potencial parameters, uses, regions and making a democratic access to available resources.

The basic tool of the urban development policy, which gives the municipality the guidelines and policies needed for sustainable development is the Master Plan. This instrument was defined by the Constitution (BRASIL, 1988) and regulated by Federal Law No.10.257, of July 10, 2001, known as the City Statute, which established a period of five years from its publication for approval or revision of Master Plans by municipalities.

After approval of master plans, many municipalities started to give a fragmented treatment the formal process of urban sprawl, disregarding the boundaries of urban perimeters defined in their plans. Determining the areas of urban sprawl ceased to be conducted in the public interest and is now directed by the particular interest of entrepreneurs and landowners. This practice is not considering the infrastructure capacity and the impact of peripheral occupations.

In order to eliminate the fragmented treatment and control the occupation of the territory to ensure integrated management, including risks and natural disasters, Law No. 12,608, 2012 establishing the National Policy on Protection and Civil Defence, also changed the City Statute, creating Article 42b, which has required municipalities wishing to extend its city limits, preparing a Specific Project of Urban Sprawl (SPUS). The specific project is therefore a *sine qua non* condition for the approval of new urban sprawl projects since 2012, and should be considered as an inclusion in the Master Plan of the municipality and shall fully make use of its provisions and instruments.

The municipality of Mateus Leme - MG became part of the metropolitan region of Belo Horizonte (MRBH) in 1989 (IBGE, 2010). From this integration the city showed a significant growth process of urban settlement, which was mainly along the state highway MG-050, which crosses the city from east to west direction. Urban growth disregarded the presence of important natural resources such as springs, forests and soil, and over the years has generated significant environmental impacts in the region.

Furthermore, in 2013 the council approved the Law No. 2632 which amended the city limits without performing SPUS, being the same revoked in 2014 on the recommendation of the Metropolitan Agency MRBH and prosecutors of Minas Gerais.

To rethink the urban sprawl areas and the delineation of a new urban area, the municipality entered into with the State a technical cooperation agreement to facilitate the studies and analyzes that could support the discussions. Given the short time frame for the development of studies, the technical team chose to use geoprocessing techniques for the handling of spatial data.

## **2 OBJECTIVES**

The overall objective is to analyze and discuss contemporary methods of physical-territorial organization that use GIS as a tool for improvement in understanding and reading of the city.

In addition, it sought to investigate the relevant variables in the territorial analysis to propose a robust collection capable of general application; test spatial analysis modeling techniques in SIG; simulate an urban macro-zoning for the study object highlighting and ordering the priority areas for urban sprawl, environmental preservation and special duty; compare the current zoning with prepared by the methodology applied in this research; validate the application of the methodology as support for the development of SPUS; and expand the view of the city to ensure propositions of policies consistent with the collective interest.

## **3 METHODOLOGY**

The application of GIS in the municipality SPUS of Mateus Leme was established for three methodological stages: the development of a database of geographic data and definition of the relevant variables, advanced analysis in a GIS environment and execution of crossings for the preparation of synthesis maps.

The first step was the analysis of secondary data represented by public and official cartographic databases. From there it selected the relevant cartographic databases for the study of urban sprawl and development of a geographic database with mapping of variables, here called thematic mapping. The variables were organized by themes, received an identification number (ID) and resulted in 28 thematic maps. The thematic mapping represented the spatial distribution of topics and

conditions, which besides allowing loose analysis also allowed the generation of new knowledge on related areas, either by simple overlay thematic or map algebra.

The second stage included the crossing of thematic maps in GIS (Geographic Information Systems) through the Analysis of multi-criteria for analytical purposes, ie the crossing and the algebra of maps that allowed uniting themes related or striking each other and generate integrated information to generate knowledge on specific issues. The Analysis of multi-criteria, also known as Weight Hierarchical Analysis, which according to Moura (2007, p. 2900) is well suited for the use of geotechnology in creating variables synthesis aimed at identifying priority areas for some phenomenon or geographical arrangement . This analysis of multi-criteria it is an image overlay technique that have a common scale for diverse and different issues, with the aim of creating an integrated analysis. In this sense, the analysis of multi-criteria allows to take all these issues into account, through the reclassification of amounts of files used to a common scale for availability or preference, potential or similarity.

Finally, the third stage consisted of mapping synthesis, which enabled the determination and understanding of the potential vectors for urban sprawl. Analysis and validation of the results were made from public hearings, discussion groups and field trips for sampling for reality check.

#### **4 RESULTS**

The analysis should assess not only the conditions of urban sprawl from the point of view of its environmental suitability and respect the constraints of legislation on areas of permanent protection, as also the treatment given so means methodological gain, since the processes can be adopted for other municipal diagnostics.

The synthesis maps allow zoning compliance reviews and land use, priority vectors for investment, potential areas for occupation and the map overview of the potential of urban sprawl.

The production of this study revealed that as well as an important tool to aid decision-making, analysis of multi-criteria applied in a multidisciplinary way with the contribution of each specialist allows for more consistent results with the complexity of local dynamics.

The possibilities for analyzes and reflections that can still be built, in order to support decision making for territorial planning area, are many. With the construction of a methodology that aggregates various techniques and tools can determine the readings of urban space and move in interpreting the results. This study aimed to present the experience of a municipality that making use of geoprocessing techniques for the planning of its urban sprawl, managed to conduct a study of low cost and in an expeditious time frame.

The refinement of techniques and clustering methods should be conducted to make increasingly reading the available urban space and democratic decisions. Therefore, the use of geoprocessing tools that didactically spatialize environmental and urban issues should be encouraged and seen as a powerful tool for planning and urban management for municipal government.

Therefore, it is suggested as a methodological complement to studies of determination of areas for urban sprawl, the modeling of urban sprawl in order to simulate a predictive scenario, which would address some possibilities of analysis not formalized the process carried out in 2014 in the municipality. With this, you will set yourself a strong support base for decision-making on large scales.

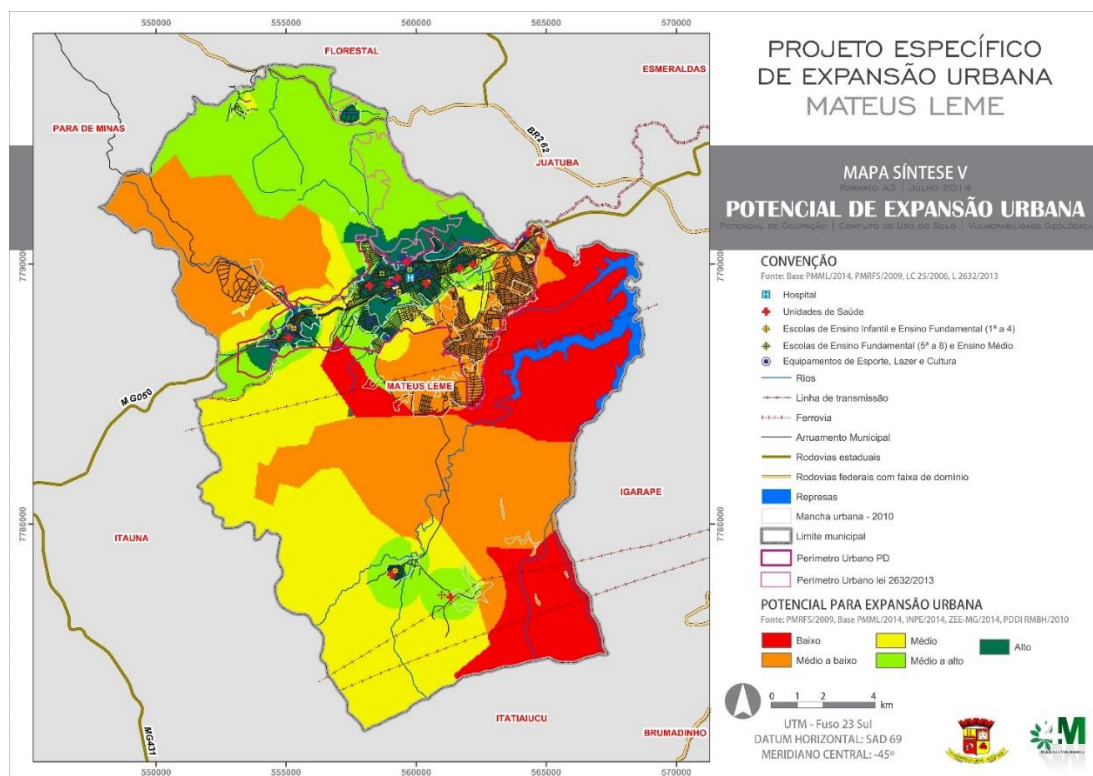


Figure 1 – Map of potential areas for urban sprawl in the city of Mateus Leme. Being areas in red the least conducive to urban sprawl, followed by orange, yellow, light green and dark green, the latter one being the areas with greatest potential for urban sprawl.

Authorship: Mateus Leme, 2014.

## 5 REFERENCES

- BRASIL. Constituição (1988). Constituição da República Federativa do Brasil. Diário Oficial da União, Brasília, 1988.
- BRASIL. Lei Nº 10.257 - de 10 de julho de 2001, regulamenta os arts. 182 e 183 da Constituição Federal, estabelece diretrizes gerais da política urbana e dá outras providências. Diário Oficial da União, Brasília, 10 jul. 2001.
- BRASIL. Lei Nº 12.608 - de 10 de abril de 2012, institui a Política Nacional de Proteção e Defesa Civil - PNPDEC; dispõe sobre o Sistema Nacional de Proteção e Defesa Civil - SINPDEC e o Conselho Nacional de Proteção e Defesa Civil - CONPDEC; autoriza a criação de sistema de informações e monitoramento de desastres; altera as Leis nos 12.340, de 1o de dezembro de 2010, 10.257, de 10 de julho de 2001, 6.766, de 19 de dezembro de 1979, 8.239, de 4 de outubro de 1991, e 9.394, de 20 de dezembro de 1996; e dá outras providências. Diário Oficial da União, Brasília, 10 abr. 2012.
- INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). Censo demográfico de 2010. Rio de Janeiro: IBGE. Disponível em: <<http://www.ibge.gov.br/cidadesat/topwindow.htm?1>>. Acesso em: 20 out. 2014.
- MATEUS LEME. Lei Nº 2.632 - de 25 de outubro de 2013, amplia o perímetro urbano do município de Mateus Leme. Diário Oficial do Município, Mateus Leme, 25 out. 2013.
- MINAS GERAIS. Secretaria Estadual de Desenvolvimento Regional – SEDRU. Estratégia de Desenvolvimento da Cidade (CDS), com foco na redução da desigualdade social e da pobreza, para o Vetor Norte da Região Metropolitana de Belo Horizonte (RMBH), Produto 05- Relatório de Consolidação do Diagnóstico Participativo, Volume I, 2009.

- MINAS GERAIS. Secretária de Estado de Desenvolvimento Regional e Política Urbana. Programa de Desenvolvimento e Gestão da Região Metropolitana de Belo Horizonte. Disponível em: <[http://www.institutohorizontes.org.br/imagens/estudoseprojetos/DOCUMENTO\\_FINAL\\_VETOR\\_OESTE.pdf](http://www.institutohorizontes.org.br/imagens/estudoseprojetos/DOCUMENTO_FINAL_VETOR_OESTE.pdf)>. Acesso em: 3 ago. 2011.
- MOURA, A.C.M. Reflexões metodológicas como subsídio para estudos ambientais baseados em Análise de Multicritérios. In: Anais XIII Simpósio Brasileiro de Sensoriamento Remoto, Florianópolis - SC, Brasil, 2007. p. 2899-2906.