Combining muti-criteria analysis and GIS tools to solve competitive location problems

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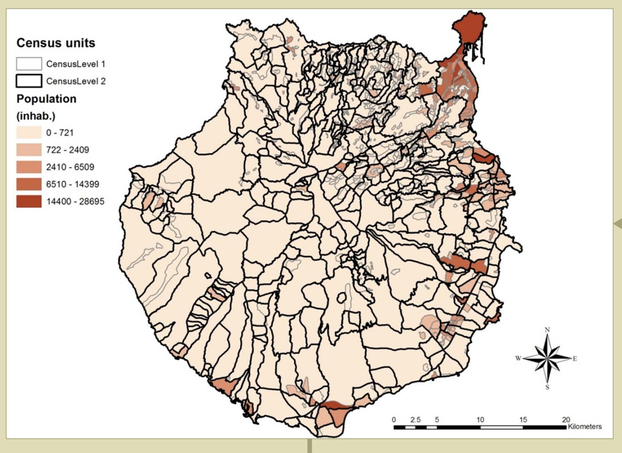
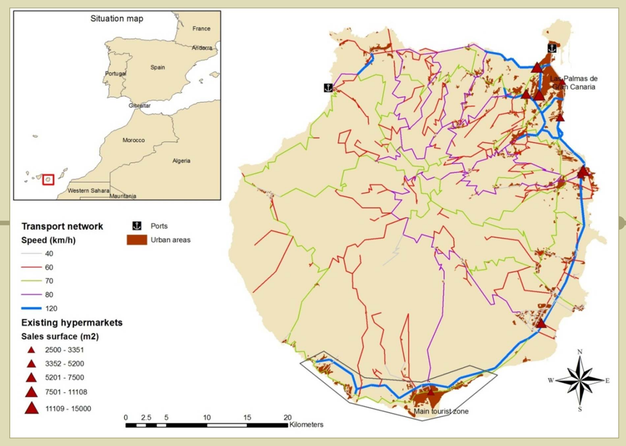
Abstract

In this paper, a competitive location problem is solved using Geographical Information Systems (GIS). A new firm wants to determine the best location for a facility that must compete with the existing stores in the market. First, we show how a map with the estimated Huff capture for the planar and network competitive location problems considering both continuous and discrete demand distributions, can be obtained using GIS tools. Later, these maps can be incorporated as a criterion together with other spatial characteristics into a multi-criteria analysis in order to improve the solution obtained by the simple location problem. The final result is a map where the potential locations are scored representing the goodness of the site for locating a new facility in the competitive market.

Discrete demand: The demand of each administrative unit is aggregated on its centroid or population center of gravity.

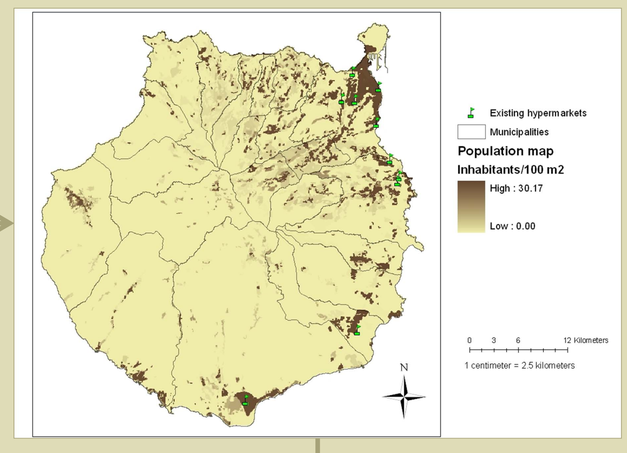


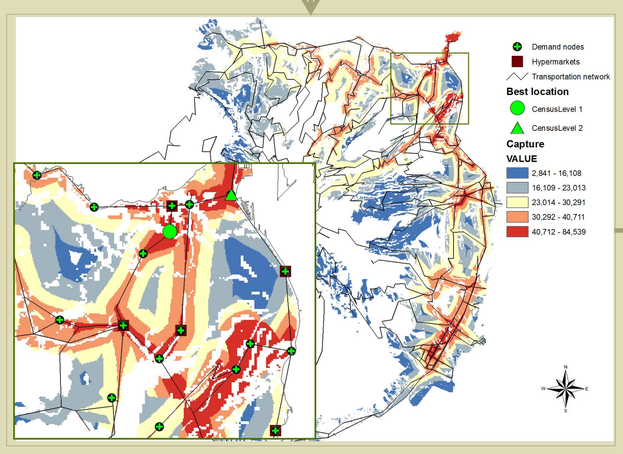


Market: Locations of the existing stores and the road network.

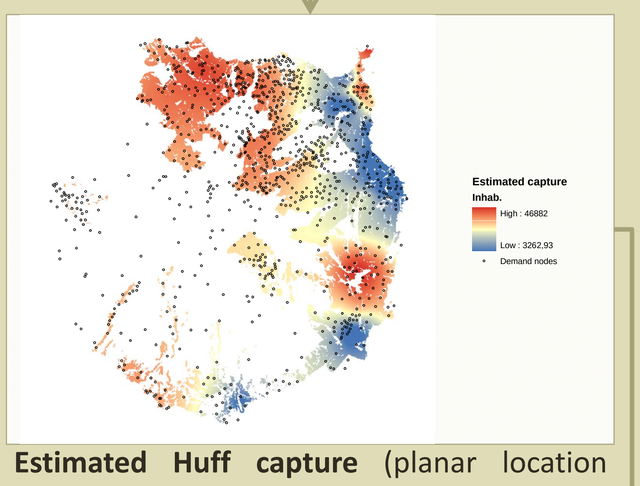
Feasible region: The areas where the location of the new facility is not allowed can be easily discarded.

Continuous demand: Each pixel in the map has associated the population of the area that represents.

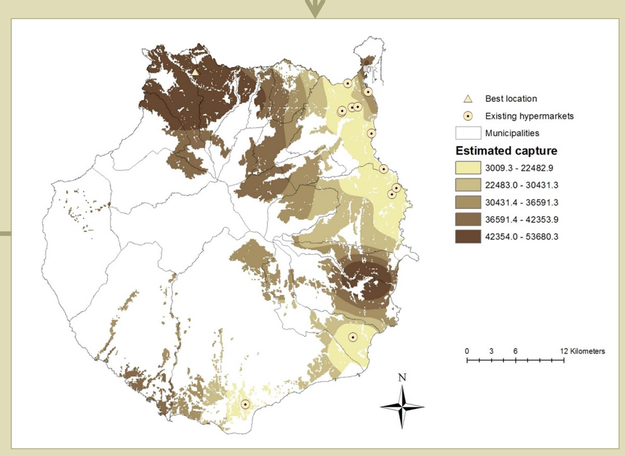




Estimated Huff capture (network location problem considering discrete demand).



Estimated Huff capture (planar location problem considering discrete demand).



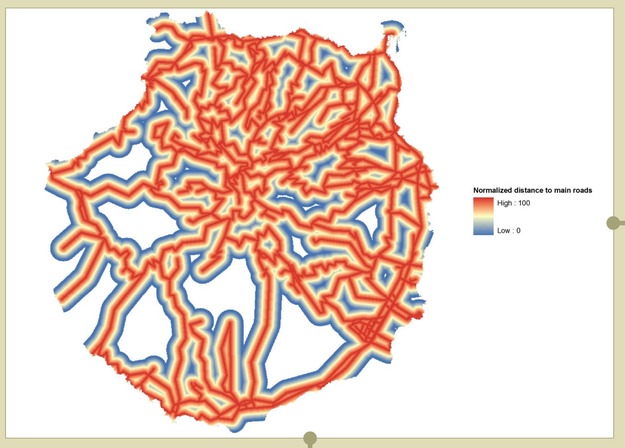
Estimated Huff capture (planar location problem considering continuous demand).

Estimated capture map

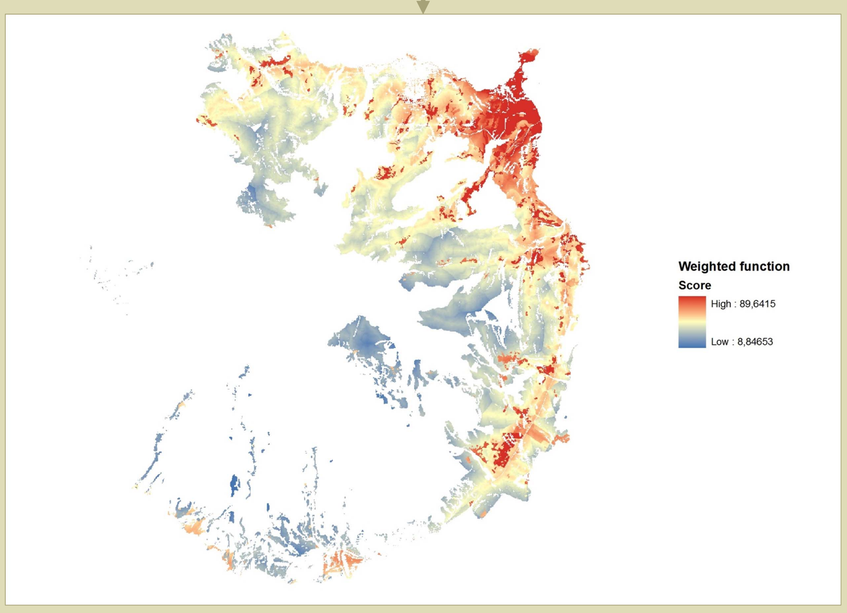
The use of the capture map provides the decision maker with a broader vision of the problem and allows for comparisons between different alternatives in contrast to the traditional OR methods, which only give a global optimum or, when it is not possible, a set of local optima.

Criterion: Maximize the estimated Huff capture.

Criterion: Minimize distance to the main roads

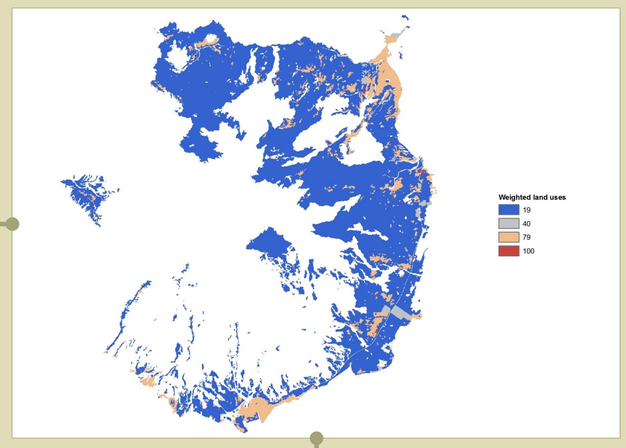


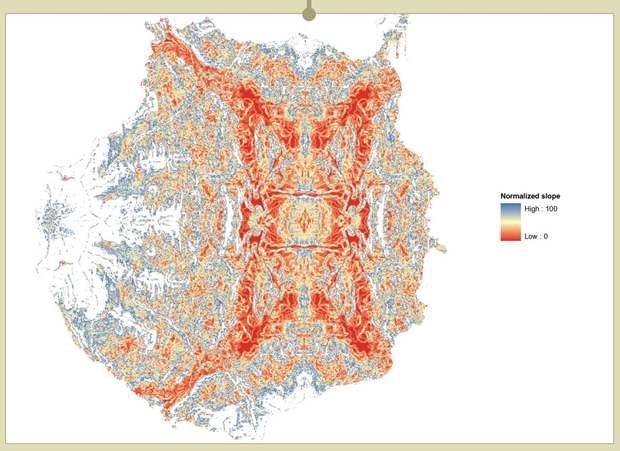
Multi-criteria analysis: using GIS tools based on AHP or AHP_OWA (for example).



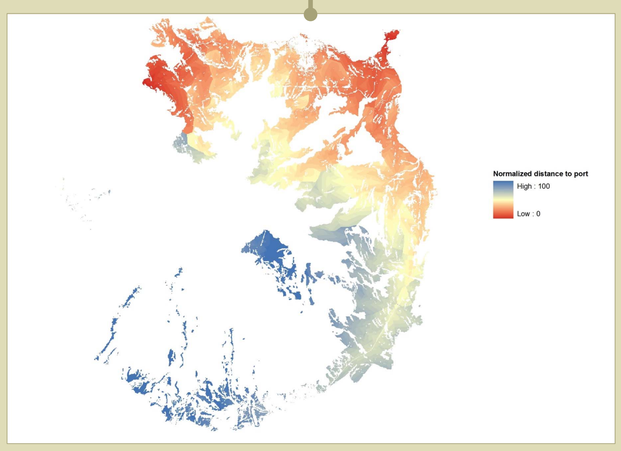
Score map: Each pixel has associated the score resulting from the linear weighted function involving all the criteria considered in the study.

Criterion: Maximize the compatibility of the land use with the location of a new facility.





Criterion: Minimize the slope of the terrain where the new facility will be built.



Criterion: Minimize the distance to the trading ports.

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