IDENTIFICATION AND MAPPING OF FOOD DESERTS IN RURAL AREAS: A CASE STUDY FROM SLOVAKIA

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ABSTRACT:
The paper focuses on answers to these questions: What are food deserts? How to analyze food deserts? Where are food deserts? Is there some practical significance to identify them? Food deserts were mapped in the rural villages of functional urban region of Bratislava. The binary accessibility measure using GIS tools was applied to identify food deserts.

Key-words: *Food deserts, Countryside, Accessibility measure, GIS, Bratislava.*

1. INTRODUCTION

What are food deserts? The answer to this question is not clear. However, food deserts became objects of many studies in recent period, (Walker, Keane & Burke, 2010). Food deserts are defined variously: „[...] area, where foods are expensive and relatively unavailable“, (Cummins and Macintyre: 2002, p. 2115). Other authors have defined them as „[...] areas of poor access to the provision of healthy affordable food, usually related to lack of large retailers“, (Gregory et al.: 2009, p. 259). In this paper, the term food deserts is understood as areas in which consumers has no access to large grocery stores associated with cheaper and healthier food in comparison with local stores.

Food deserts are more frequently mapped in urban environment (Apparicio, Cloutier & Shearmur, 2007; Clarke, Eyre, & Guy, 2002; Guy, Clarke, & Eyre, 2004). Studies concentrated on rural areas occur rarely (Furey, Strugnell, & McIlveen, 2001; Hubley, 2011), despite the fact that rural areas can be considered as underpowered in the context of food retail (Kunc et al., 2012a, 2012b). Shopping in cities keeps becoming more and more frequent for people from rural areas (Maryáš et al., 2014).

The aim of this paper is to map the food stores in rural environment in the functional urban region (daily urban systems) Bratislava and identification of food deserts by measuring the accessibility of large grocery stores. Authors' intention is to seek answers to the following questions: What are food deserts? How to analyze food deserts? Where are food deserts? Is there some practical significance to identify them?

2. METHODS AND DATA

How to analyze food desert? It cannot be argued with strict answer by mathematical formula or set of indicators (Shaw 2006). The literature offers several methods for analyzing and evaluating food deserts (Furey, Strugnell, & McIlveen, 2001; Smoyer-Tomic, Spence, & Amrhein, 2006; Zenk et al., 2005). In general as an appropriate tools to analyze food deserts is accepted measuring of accessibility of selected food stores in the region (Moore & Diez Roux, 2006; Križan, Tolmáči, & Lauko, 2008).

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Applied methodological approach can be divided into two basic phases. The first one (descriptive) consisted of preparation of documents and data for the next phase (analytical). The first phase was description of the current situation of food retailing in the region (number of stores and size of sales area) and preparation of data for analysis. The data can be classified into several groups. The first consists of numerical data designed to accessibility measure. The second group consists of graphical data as a basis for GIS analysis. Description of the food retailing was based on empirical evidence and data from Statistical Office of the Slovak Republic. Electronic questionnaires and telephone interviews (Shaw, 2006) with the mayors of all rural municipalities was applied to verify this data. Thus was created a database of food retailing in FUR Bratislava. Second phase of research (analytical) can be divided into numerical and graphical part. The numerical part was based on measure of accessibility (Acc) of the analyzed food stores. The cartographic part was based on visualization of these analyzes. The binary accessibility measure was applied (Ingrman, 1971):

$$Acc_i = c_{ij} \qquad \text{pre } i = 1, 2, 3, \ldots 108 \qquad j = 1, 2, 3, \ldots 80$$

Where: c_{ij} is the distance between the origin i (rural municipalities) and the destination j (large grocery stores).

The results from numerical part of analytical phase were transformed into the GIS and the Network Analyst (ArcGIS 10.0) was applied. GIS is not only (carto) graphical tool, but also has wider application in the food deserts theme as a suitable analytical tool (Apparicio, Cloutier, & Shearmur, 2007; McEntee & Agyeman, 2010).

3. ANALYSIS

3.1 Characteristics of study area

The object of the research was a functional urban region (FUR) Bratislava located on the south-west of Slovakia (**Fig. 1A**). FUR in Slovakia were defined by Bezák (2000) based on the concept of daily urban systems, taking into account spatial and functional relationships between the city and its hinterland (**Fig. 1B**).

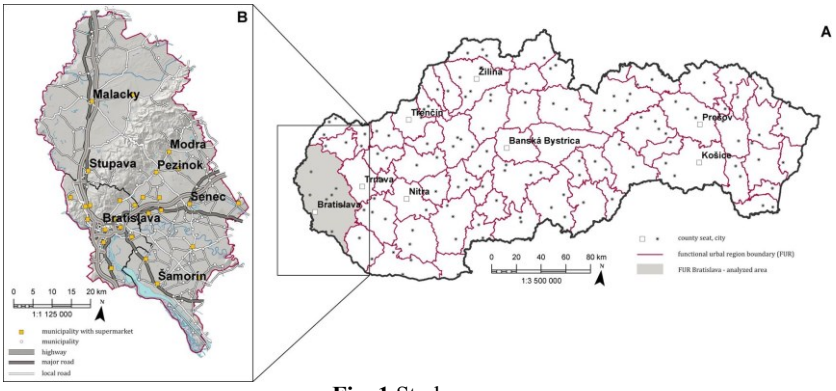

Fig. 1 Study area.

Transport infrastructure (motorways D1 and D2) and services are at a high level (Bratislava as the capital) in FUR Bratislava (Horňák & Pšenka 2013). Although Bratislava

as a supra-regional shopping center has an above-average commercial facilities, retail network of the region is very heterogeneous (Kita & Grossmanová 2014). Strongly contrasts can be identified in urban and rural regions.

3.2 Mapping of food deserts in FUR Bratislava

Where are food deserts? Spatial distribution of supermarkets in the analyzed region is significantly heterogeneous (**Fig. 2).** The reasons of this distribution can be based on two basic groups of interacting factors. The first are the natural conditions of the region, some of which can be considered as barriers to development. These are the Malé Karpaty mountains and rivers Danube and Moravia. The second group of factors presents the socio-economic conditions of the region. In general development of services (retail) happens significantly along major transport lines or locations with more favorable accessibility to the capital within the residential suburbanization (Šveda, 2010; Tóth, 2012; Zubriczký, 2004).

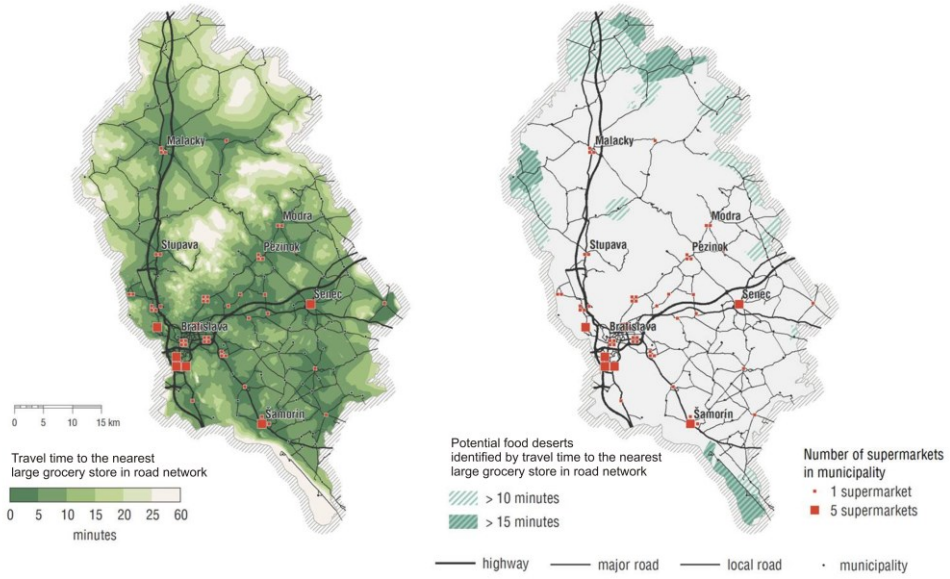

Fig. 2 Potential food deserts in FUR Bratislava.

Less favorable accessibility was also observed in the case of municipalities located south of the Danube near the border with Hungary In general several border villages (outside the main transport corridors) are characterized by less favorable availability. However, the possibility of buying food outside of Slovakia or outside of Bratislava FUR can also be considered in this case.

It is questionable about the food desert delimitation and the selection of the limits (Jiao et al., 2012). If the limit for food desert delimitation is accessibility of large grocery stores within 10 min (in the road network) there could be identified 23 villages defined as food deserts (**Table. 1**). In the case of limit 15 min the number of municipalities was reduced to 9. These are mainly rural municipalities that can be called marginal previously evaluated in the context of natural and socio-economic barriers. Extremely negative values were measured for the municipalities located behind the Gabčíkovo canal system (**Fig. 2**).

Almost hour travel time to the nearest large grocery store in the region are significantly almost ten times higher from the region-wide average (6.52 min).

In identified food deserts based on the accessibility of large grocery stores within 10 minutes lives 2.6% of all residents FUR coming from 14 municipalities (11.5%). However the share of just only rural population increased to 11.1%. In the case of analysis based on the accessibility of grocery stores within 15 minutes share of people living in food deserts was established on 0.9% of all residents FUR (9 villages) respectively share of 3.7% of the population in the rural area FUR.

Table 1. Accessibility of large grocery stores in FUR Bratislava.

Accessibility [min]	Number of municipalities	Share of municipalities [%]	Cumulative share of municipalities [%]	Share of population [%]	Cumulative share of population [%]
less than 5,0	69	56,5	56,5	88,9	88,9
5,1-10,0	30	24,6	81,1	7,6	96,5
10,1-15,0	14	11,5	92,6	2,6	99,1
more than 15,0	9	7,4	100,0	0,9	100,0

Food deserts dominates in the north of FUR. Lower density of settlement and transport infrastructure, less jobs, lifestyle of residents in rural municipalities and related consumer behavior (Lauko, Križan & Tolmáči, 2008) and a number of natural and socio-economic barriers are associated with less favorable accessibility of large grocery stores in this part of the region (**Fig. 2**). The western and northwestern part of the region is likely catchment area for food shopping outside the FUR Bratislava. It may create some distortion in terms of spatial distortions of isochrones. Overall in the three municipalities from FUR Bratislava there are no food stores. In general they could be identified as food deserts.

4. DISCUSSION AND CONCLUSION

Is there some practical significance to identify food deserts? The answer can be found in a wider context. In general it can be stated that the natural environment and socio-economic conditions at the regional level also makes the existence of disparities in health issues (Sexton, 2000). These disparities can be associated with many factors, including the accessibility of low cost and healthier food which is characteristic for large grocery stores in comparison with local stores (Morland et al., 2002). So less favorable accessibility of large grocery stores for low income groups of citizens who do not own a car leads to buying food in smaller local stores which often offer lower variability of food for higher prices (Wrigley, 2002). This results to the formation of spatial disparities and distortions of the concept of spatial justice. It can also be noted that for certain groups of consumers (for example diabetes, gluten-free diet) the accessibility of large grocery stores is the key factor in the selection of shops because they offer a wider range of special products (Cummins & Macintyre, 2002). Several food deserts were identified in the analyzed region. These are located mostly in the marginal parts of FUR (means by location) with a less favorable accessibility to nearby towns respectively are located in parts of FUR with the low density of settlements. However, overall number of these food deserts (taking into account the criteria of 15 min) is almost negligible where lives 3.7% of the rural population from FUR Bratislava. Identify of food deserts whether in the urban or rural areas can be considered as

a suitable tool for planners and managers of retail companies. The results can also be used in solving with the traffic situation in the region in terms of service functions of regional center and also in many fields of decision-making process at municipal or local government level. Furthermore also in the decision-making city mayor and competent leadership for local government and so on.

Future research could be focused on the evaluation of qualitative not only quantitative indicators of retail sales in context of this type and quality of food vs. the number and size of companies. The issue of food deserts can also evaluate the social and economic interlinking (household income, car ownership, finances spent on cost of transport at the large grocery stores, etc.), (Macintyre, 2007). Such interdisciplinary cooperation helps to identify and map the food deserts more realistic and opens wider application possibilities.

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