How to identify food deserts in Amazonian cities?

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Summary

Food deserts are areas without affordable access to healthy foods. This paper explores whether food deserts are present within urban areas of the Brazilian Amazon. The availability and price of a variety of food products was surveyed in a total of 304 shops, across 3 cities in 2015. Least-cost distances were calculated to estimate travel distance to access products, with map overlay used to help identify areas with poor access to a variety of healthy food - these were defined as food deserts.

KEYWORDS: food desert, food security, vulnerability, poverty, Amazonia

1. Introduction

Food deserts are defined as areas lacking affordable access to healthy food products (Alkon, Block et al. 2013, Alviola, Nayga et al. 2013, Cummins 2014, LeClair and Aksan 2014, Martin, Ghosh et al. 2014, Widener and Shannon 2014). In regions such as Amazonia, inadequate access to nutritious, affordable food – an important requisite for food security – is likely to be a particular challenge to the urban poor. This paper explores the extent to which food deserts exist in urban areas within Amazonas state, Brazil, which has rapidly urbanized and has high levels of urban poverty. This study focuses on three cities: Iranduba with a population of 15,000 people; Presidente Figueiredo 11,000 people; and Novo Airão 9,500 people (IBGE population census 2010).

Within the cities studied shopping from a mixture of small shops is much more significant to shopping behaviour than access to large supermarkets. Using data from 304 shops surveyed during March and April 2015 this paper explores the use of GIS techniques to analyse food deserts, in terms of the availability of healthy food products.

2. Methodology

2.1 Data collection and acquisition

All food shops were surveyed within these towns, with a variety of information gathered including the availability and price of a selection of food products. Travel distances were modelled along roads and paths. These were extracted from OpenStreetMap and supplemented with additional roads or paths visible within either the ArcGIS Imagery basemap layer or Google Earth.

2.2 Analysis assumptions

A maximum walking distance of 250m was assumed for this study. This distance was based upon a travel time of 5 minutes (LeClair and Aksan 2014) and typical walking speed of $3kmh^{-1}$ in the tropics. This also reflects that it is often children travelling to access food and that much food shopping occurs in small quantities on a daily basis.

2.3 Foods

Table 1 lists the foods considered during this study. These are representative of a range of healthy foods, commonly consumed within Amazonian cities. All foods listed here were included in the analysis of food availability (table 1).

Table 1: Healthy foods selected for the analysis

Category	**Food product**	**% of shops food product is sold in**
Staples	Toasted manioc flour (*farinha*)	88
	Beans	62
	Bread	40
Animal protein	Chicken	68
	Meat with bones	9
	Tinned preserved beef	78
	Eggs	86
Vegetables and fruit	Onions	62
	Tomatoes	51
	Peppers	31
	Cheiro Verde (mix of herbs and spring onions)	27
	Bananas	36
	Apples	9
	Açai	6
	Grapes	4
	Oranges	3
	Melon	3
	Other fruit or vegetable	12

2.4 Availability

Food availability was assessed by using least cost surfaces to estimate the distance required for a household to travel to source a given product. An analysis mask was created by buffering roads and paths by 15m. This was also converted to raster surface of 5m resolution, which was used as a cost surface within the analysis. Cost distance surfaces were calculated for each food product, representing the distance to the nearest shop selling that product. A further analysis mask was applied to constrain results only to residential areas, before the cost distance surfaces were reclassified to identify areas within 250m of each food product. The number of products available within each food category listed in table 1 was then added together.

A combination of reclassification and map overlay were used to define the location of food deserts. These were defined as areas without access to: farinha, beans and bread; at least 5 different types of fruit or vegetable; and a variety of affordable healthy sources of animal protein (at least 3 of the surveyed products, conserved beef, meat on the bone, chicken and eggs) within 250m of a household. The proportion of the residential area within each census sector that fell within a food desert was then calculated. The number of households potentially living within a food desert was calculated from the total number of households within a census sector and the proportion of the residential area within that census sector that was defined as a food desert.

2.5 Shop types

Shop types were defined by counting the number of the following facilities that were available: they accept credit cards; employ none family members; have shopping trolleys; have electricity; provide customers direct access to the products; have a computerised till; and have more than one till. Those shops with none of these facilities were classified as type 1; those with 1 facility as type 2; 2-4 facilities as type 3; and 5-7 facilities as type 4. The number of shops of each type, per 100 households, was calculated for each census sector and compared with rates of absolute poverty in order to examine the relationship between poverty and shop type.

3. Results and conclusion

The results from this study show that food deserts as defined in terms of food availability are widespread in small towns within Amazonas, with around half of households in the towns studied considered to be living within a food desert (Table 2). There is, however, little evidence to suggest that food deserts are more likely to occur in poorer areas. These food deserts may contribute to the high levels of food insecurity experienced within the state. The GIS approach applied not only enables food deserts to be identified, but also the types of products which are missing within food deserts, enabling policy makers to potentially work with local shop owners to improve the provision of specific food products.

While no evidence was found that food deserts were more likely to exist in poorer areas, the number of small type 1 or 2 shops was seen to increase in relation to the percentage of households living in absolute poverty. In these poorest areas there were very few type 3 or 4 shops, thus highlighting the importance of the network of small family run shops in proving access to food for poor households.

Table 2: Total and percentage of households within a food desert.

Town	*Total Households*	*Percentage of households*
Iranduba	3,689	50
Novo Airão	2,081	38
Presidente Figueiredo	2,918	60
Total	**8,688**	**51**

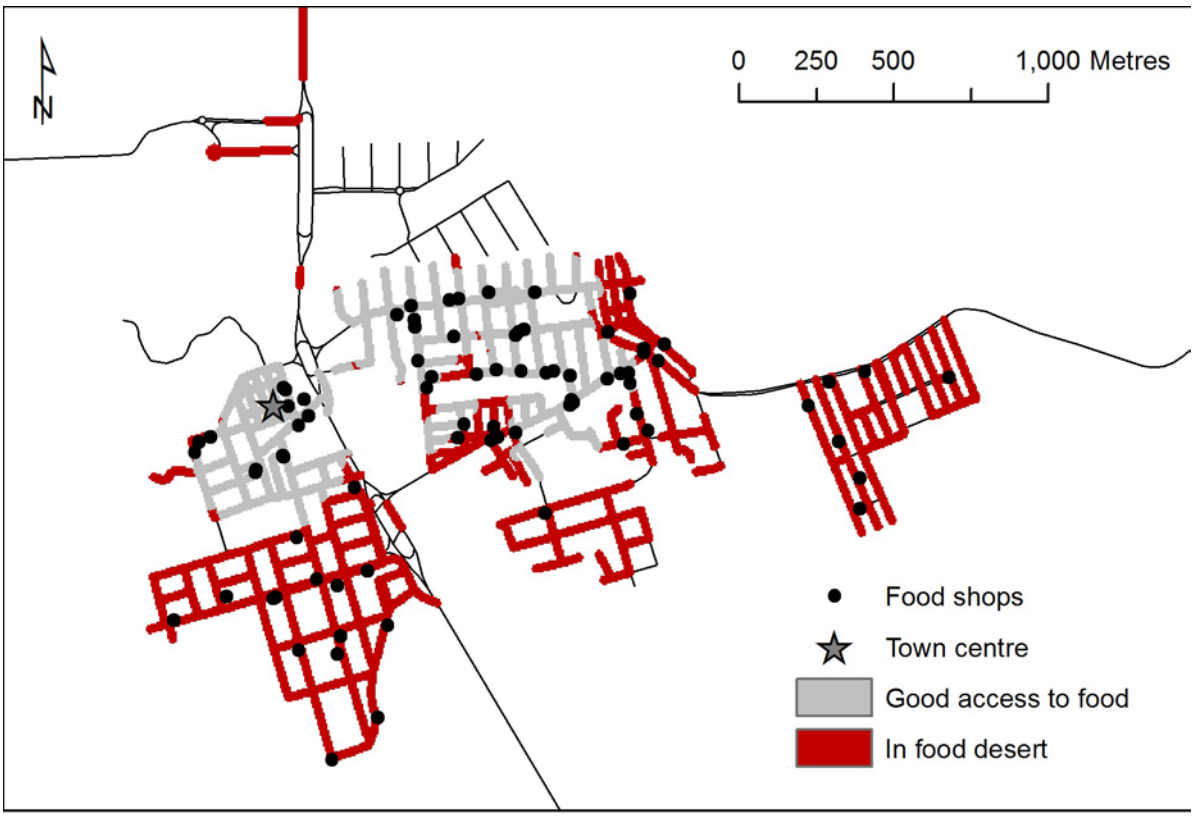

Figure 1: Potential food deserts in Presidente Figueiredo.

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6. Bibliography

Gemma Davies is the GIS Officer for the Lancaster Environment Centre, providing support for teaching and research throughout the department.

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