The impacts of urban dynamics on water resources in the Distrito Federal do Brasil

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Introduction

Rapid population growth requires on one side the availability of a growing amount of water resources for human consumption and results on the other side in an increase of impervious surface. Today already more than half of humanity lives in urban areas (UN 2011).

Fifty years ago Brasília was planned to host approximately 600,000 people. Today, the city and its adjacent “New Towns” (satellite towns) possess about 2,500,000 inhabitants with a growth rate that is expected to continue to increase (Fig.1).

As a consequence this rapid population growth has a strong impact on water resources both in quality and quantity. The period of greatest demand for irrigation coincides with lower water availability, from May to September, which increases the risks of conflicts about water use in the Distrito Federal (DF). However, a quantitative impact assessment of the urban land-use changes on the water availability is lacking, especially with respect to the future urban development.

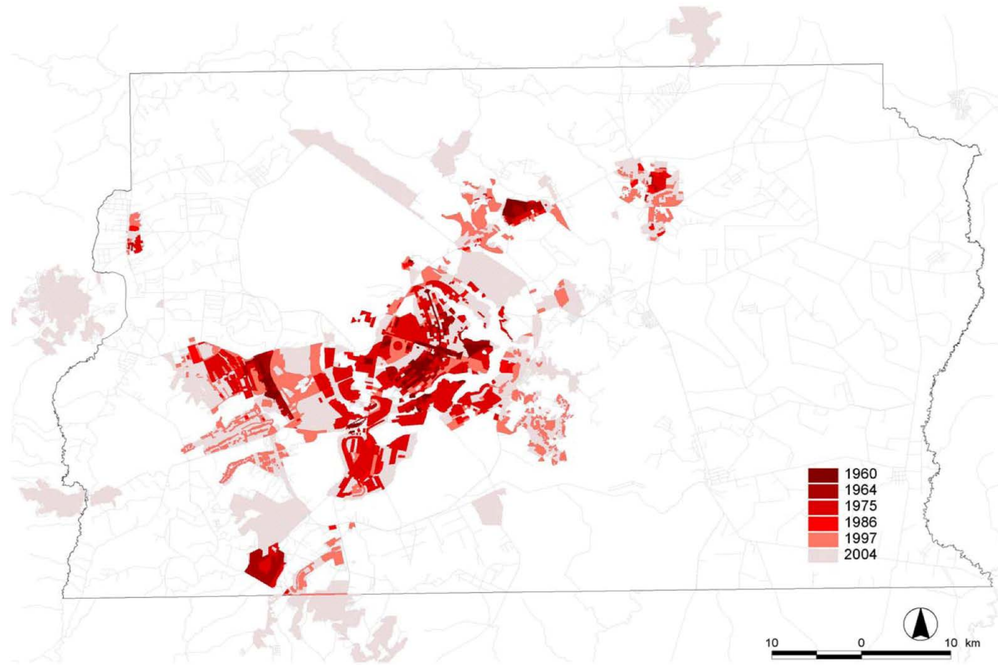

Fig. 1: Distrito Federal - urban growth from 1960 to 2004 (CODEPLAN 2007)

UST	Parameters	Characterisation	Visual example	UST Detail
RH 5 – medium density	location	Sector Traditional - Planaltina, Paranoa, Vila Planalto, Guara		
	building structure	alvenaria/concrete (roof - ceramic), 150 m^2 - 250 m^2, 1 and 2 storeys high, residential		
	lotsize	from 250 till 500 m²		
	impervious surface	from 50 to 75%		
	green area	low		
	runoff	very high		
	urban infrastructure	WS, WC, DS, S		
	water consumption	from 200 to 300 l/inhab*day		
	income	low to average		
	legal status	legal		
	description	building size: heterogeneos, with few swimming pools and small yards. Some houses have asbestos tiles and some clay		
RB 1 – Apartment blocks	location	Planaltina, Guara, Cruzeiro		
	building structure	concrete, 50qm - 80qm, High rise buildings up to 6 floors, residential		
	lotsize	not apply		
	impervious surface	from 50 to 75%		
	green area	low		
	runoff	average, high		
	urban infrastructure	WS, WC, DS, S		
	water consumption	from 150 to 200 l/inhab*day		
	income	average		
	legal status	legal		
	description	Buildings up to 6 floors in areas legally designed for this purpose.		
C2 – Commercial building	location	Plano Piloto, Taguatinga, Paranoá, Ceilandia	 	 
	building structure	concrete, high rise buildings up to 6 storeys, commercial (some times residential)		
	lotsize	not apply		
	impervious surface	more than 75%		
	green area	very low, except for Plano Piloto (low)		
	runoff	High , except for Plano Piloto (average)		
	urban infrastructure	WS, WC, DS, S		
	water consumption	Water consumption variable		
	income	not apply		
	legal status	legal		
	description	Commercial areas, usually with three floors. First and second floor commercial. Third residential. Sites along main streets, storage buildings / factories.		

Fig. 2: Urban structure types classification key

Research goals

The overall objective of this study is to develop a set of parameters for monitoring as well as predicting processes to assess the impact on water resources resulting from changes in land use through ongoing urbanization.

Data and Methods

Urban investigations in this field of research focus on land-use consumption at regional scale.

The analysis of very high resolution remote sensing data (<1m to 10 m) in combination with GIS and socio-economic data lead to a differentiation of distinct urban structure types. These different data sources are analysed conjointly using the OBIA approach (Object Based Image Analysis) (Blaschke, 2010). OBIA is based on image segmentation approaches which generate areas by referring to one or more homogeneity criteria. The segments have additional spectral information (mean values, median, min, max, ratios) and spatial information (distances, neighbourhoods, topologies, etc.). Furthermore, supplemental information e.g. from GIS data can be included in the classification process (Blaschke,2010). The relation of USTs to information on neighborhood water consumption, urban infrastructure, and impervious surfaces allows the estimation of their impact on water resources.

Results and discussion

The first results of this ongoing research is a classification tree and inventory of the urban structure types. Figure 2 shows an example. The applied classification framework contains the most relevant characteristics of each UST. Connecting the urban structure types with the information on water consumption as shown in Figure 2 allows for an estimation of the overall amount of water consumption in the city and its changes over time.

Acknowledgment

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