Brasilia, Brazil: economic and social costs of dispersion

Introduction

Brazil's Capital, Brasilia, is a peculiar city, for better or for worse. On the plus side, the city's form-space configuration conveys a striking image. Its generous green areas, associated with the mild climate of Brazil's Central Plateau, affords good bioclimatic performance. On the minus side, there are serious problems concerning low urban densities, dispersion of occupied areas with no man's land in between, and a perverse relation between location of jobs and homes (82% of formal jobs, and 44% of total jobs concentrated in an area in which only 10% of the metropolitan population live). Socioeconomic implications of these attributes are serious. Urban infrastructure is underused, intense commuting between peripheral areas and the urban core is a daily nuisance, and urban configuration does not favor transit systems.

Not all is lost, though. New boroughs have occupied vacant land in between previously isolated urban areas. Densities are usually higher in these new projects – although sometimes too high, which implies diseconomies of scale. Some attempts at decentralising jobs have emerged but they have been too timid so far. This paper discusses the main attributes of the metropolis concerning the economics of urban sprawl besides analysing current trends vis-à-vis proposals of land use as presented in the most recent versions of the metropolitan development plan.

Basic structure

Talking about Brasília demands an initial explanation. The Brazilian Capital is a metropolis with 2,455,903 inhabitants (IBGE, 2007) within the confines of the Brazilian Federal District (henceforth FD), plus almost a million more people in urban areas which sprawl beyond the borders of the FD into the neighbouring State of Goiás. (For lack of proper data, however, only the urban areas within the FD will be considered.)

The city is legally subdivided into 29 Administrative Regions. (However, this is the result of rather recent administrative restructuring. The information so far available and which is disaggregated by region refers to the previous division into 19 regions. This is what has been used here.) These regions are improperly called "cities" or "towns". We should rather call them boroughs of the metropolis – that is what they actually are. The elements initially proposed by Lucio Costa's Plan (Costa, 1995) constitute only a small part of the whole city today and are situated in three regions, officially called "Brasilia", "South Lake" and "North Lake", in which only circa 12% of the metropolitan population live. However, in this text, "Brasília" will refer to the metropolis. Over time it became common to use the denomination "Pilot Plan" (or simply "Plan") only for the residential "wings" and their immediate surroundings originally proposed by Lucio Costa. The dichotomy thus adopted – "Brasília" / "Pilot Plan" – is justified historically, can be found on street signs and in people's imagination: inhabitants of the "satellite towns" consider themselves inhabitants of "Brasilia" (Branco, 2006). This is a correct reading, for they live in parts of the metropolis and rightly capture the nature of the whole city and the complementarity of its various bits.

However, the history of the urban scape of the FD is more complex than Pilot Plan/Satellite Cities dichotomy suggests. There were two urban nuclei which pre-date the Capital, the configuration of which resembles vernacular Brazilian cities; slums were self-produced by workers who migrated to the FD during the initial stages of the building of the city (the last one, Old Paranóa, was bulldozed by the local government in 1989); also, in initial times, construction companies built camps to house architects, engineers, technicians and manual workers, the remains of which still exist; there are significant differences between the "classic modernism" of the Plan, the "peripheral modernism" of satellite cities and the "post-modernism" of more recent times; gated communities are the new pattern of urban expansion; since the early stages of implementation of the Plan, new building types have been added to those originally envisaged.

Fragmentation

It is not simply that so many types constitute Brasilia's townscape. Historical cities are usually a *collage* of "layers" of morphic types that correspond to periods of time. The specificity in Brasilia is that such types are sharply separated in space by significant discontinuities: there are large zones of no man's land in between them. Brasilia is an interesting example of one of the most typical characteristics of Brazilian cities, namely *fragmentation*, when compared to cities in other regions of the world – North America, Europe, Asia and the Pacific etc., as we have shown elsewhere at length (Medeiros, 2006). This makes it difficult to move around, from one part of the city to another. A number of indices are employed here to illustrate how such discontinuities may be characterised. The first is the *measure of integration* ("space syntax" theory, Hillier & Hanson, 1984). This measure derives from a theoretical-methodological framework by which "topological accessibility" among parts of an urban system may be quantified. Cities may be "shallower", or more integrated, i.e. it is easier to move from one part to another through a lower threshold of turns along the road system; or they may be "deeper", or less integrated, i.e. one is required to turn more frequently through the street system over a similar geometrical distance. Traditional ways of measuring average integration for entire cities (Hillier & Hanson, 1984) yielded results ranging from 0.18 (for the least integrated city) to 2.70 (for the most integrated), values obtained in our exploratory comparative study of cities around the world cited above (Medeiros, 2006). In order to facilitate the reading of such measures, we have normalised them from "0" (least integrated) to "100" (most integrated). To offer the reader an empirical glimpse of the findings, readings for the eight most integrated cities in the world are as follows: Hollywood (100.00), New York (83.33), Denver (81.53), Los Angeles (77.08), Mexico City (66.50), Las Vegas (64.37), Miami (58.19) and Chicago (53.24). Not surprisingly, with the exception of Mexico City, all are North American cities, with their markedly orthogonal regular grid, which minimises topological distances among their parts, and thus facilitates mobility. Brasilia's average integration is 26.50, thus much lower than the figures quoted above, as is usually the case with Brazilian cities. Nevertheless, although the measure of integration is informative for Brasilia, it does not depict its specificity to the full: long axes connecting the central nucleus to the satellite ones reduce topological distance, but mask real geometrical separation amongst them. We therefore resort to the measure of *dispersion.*

Dispersion

A measure of *dispersion* was originally proposed by Bertaud and Malpezzi (2003). Taking into account the population of the demographic census zones, they have considered how the population is deployed in space in relation to the Central Business District (CDB). For the sake of clarity, we have adapted their formula thus (Holanda, 2003):

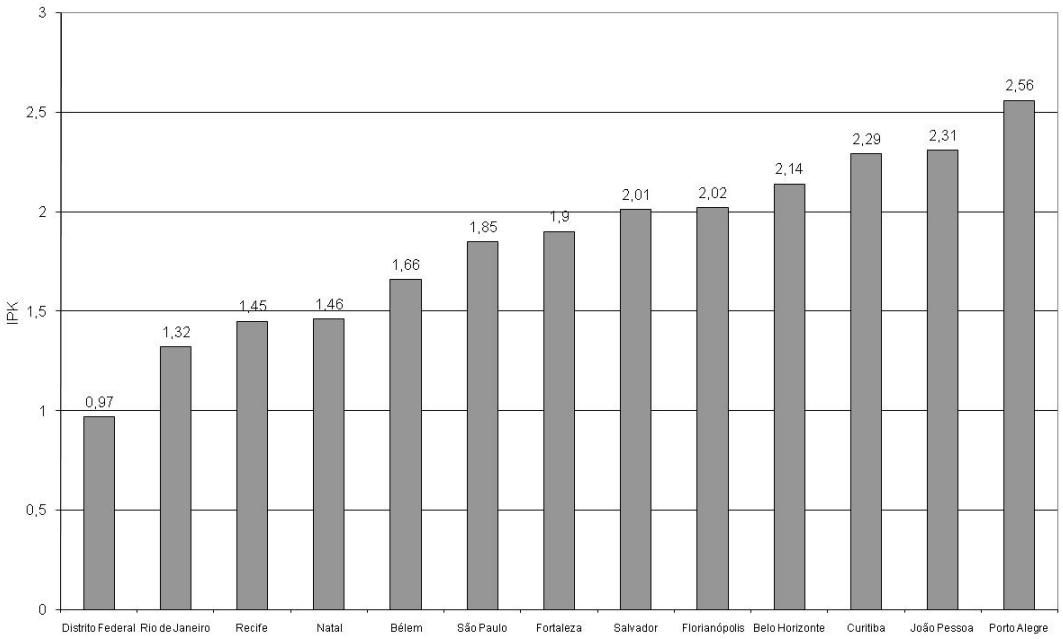
$$\rho = \frac{\sum_i d_i p_i}{PC}$$

where: ρ is the index of dispersion, *d* the distance from the centroid of each census zone to the CBD, *p* the population of each census zone, *P* the total urban population, and *C* the average distance from the points of a circle to its centre, the area of which is equivalent to the urban area of the city under analysis (equal to 2/3 of the radius of such a circle).

Bertaud & Malpezzi (2003) have calculated the dispersion index for 50 cities around the globe, Brasilia included. Their numbers range from Shanghai (0.78) as the most compact city, to Brasilia (3.26), as the most dispersed city in their sample. (Merely out of curiosity, Beijing is the sixth most compact city in the sample, measuring 0.89.) More recently (Ribeiro, 2008), using the same methodology but taking into account more precise data from satellite images and census

zones, we have included 10 other Brazilian cities in the sample and recalculated the measures for the Brazilian cases, arriving at the figure of 2.62 for Brasilia (it turns out that the most dispersed city now becomes Mumbai, India (3.08)). Furthermore, owing to specific methodological procedures adopted in that research (Ribeiro, 2008), we have normalised values into a scale ranging from "+1" (most compact) to "-1" (most dispersed) and we have recorded -0.60 for Brasilia, thus indicating its high level of sprawl.
However useful, the dispersion measure (like any measure, for that matter) has limitations. It is mostly based on demographic distances to CBD but poorly depicts city sprawl when people concentrate fairly near the centre but the overall *city form* physically sprawls widely over the territory. This is all the more important for Brasilia because there are strong discontinuities in the urban tissue that are inevitably served by infrastructure. The bits of infrastructure running through no man's land thus contain large portions that display a small number of connections to buildings, or no connections at all. We have thus proposed a measure of infrastructure *idleness* (Ribeiro, 2008). This index allows one to calculate the total length of road segments crossing areas in which the demographic census indicates no inhabitants at all. Among Brazilian cities, Brasilia is the runner-up in this respect, with 0.47 idle linear meters per capita. (It is telling that "pride of place" goes to Florianopolis (0.60), a city which sprawls *physically* but is otherwise very demographically compact, according to the traditional measure of dispersion, as calculated by the procedures indicated above: +0.71. This demonstrates the necessary cross-over between the two measures.)
The costs of such sprawl in Brasilia may be depicted by various indices. One of them is the passenger per kilometre ratio for transit routes (PKR), a traditional indicator in transportation studies. In this, Brasilia tops the rank among Brazilian cities (Graph 1 – in this graph Brasilia appears as "Distrito Federal"). It is no coincidence that Brasilia has the highest transit fares in the country. (Notice how Florianopolis performs rather well on this, despite performing very poorly when infrastructure idleness is concerned, as seen above.)

Eccentricity
Fragmentation and dispersion are problematic enough concerning city space-form in Brasilia. We must add to that, though, what we have been calling *eccentricity* (Holanda et al., 2002, Holanda, 2003). The originally planned sectors of the capital (which today include the "Brasília", "South Lake" and "North Lake" regions) have never been *central* concerning the overall urban system. The urbanistic concept Lucio Costa adopted in the Pilot Plan, by its very design, excluded lower income strata (few people could afford living in six-storey apartment blocks). Thus, the first satellite towns for housing poorer families began to appear even before the inauguration of the city in 1960 (Taguatinga, 25km to the west of the Plan, which recorded 243,575 inhabitants in the 2000 Census (IBGE, 2002), was created in 1958). Others followed in its wake (Holanda, 2003).
We have worked with three concepts of *centrality* to characterise the situation. The city has: 1) a *Central Business District* (*CBD*), i.e. the point around which the great majority of services and jobs concentrate; 2) a *demographic centre*, i.e. the point that minimises distances on average for all inhabitants of the metropolis, taking into account the places where they live; 3) a *morphological centre*, i.e. the point representing the most accessible place in the city relative to the street system. This has been done with the help of: 1) GIS techniques, by which socioeconomic data is related to the digital map of the census zones; 2) space syntax techniques, by which the city's accessibility structure is represented by the "axial map", i.e. by lines approximately coinciding with the axes of the streets and roads, as seen in Figures 1 and 2 (warmer line colours – tending to red – represent more accessible streets, cooler line colours – tending to blue – represent less accessible streets). (Developed on the basis of Medeiros, 2006 and Ribeiro, 2008.)



Graph 1. PKR in 13 Brazilian cities.
Source: http://ntu.org.br/banco/estatisticas, accessed June 21, 2008.

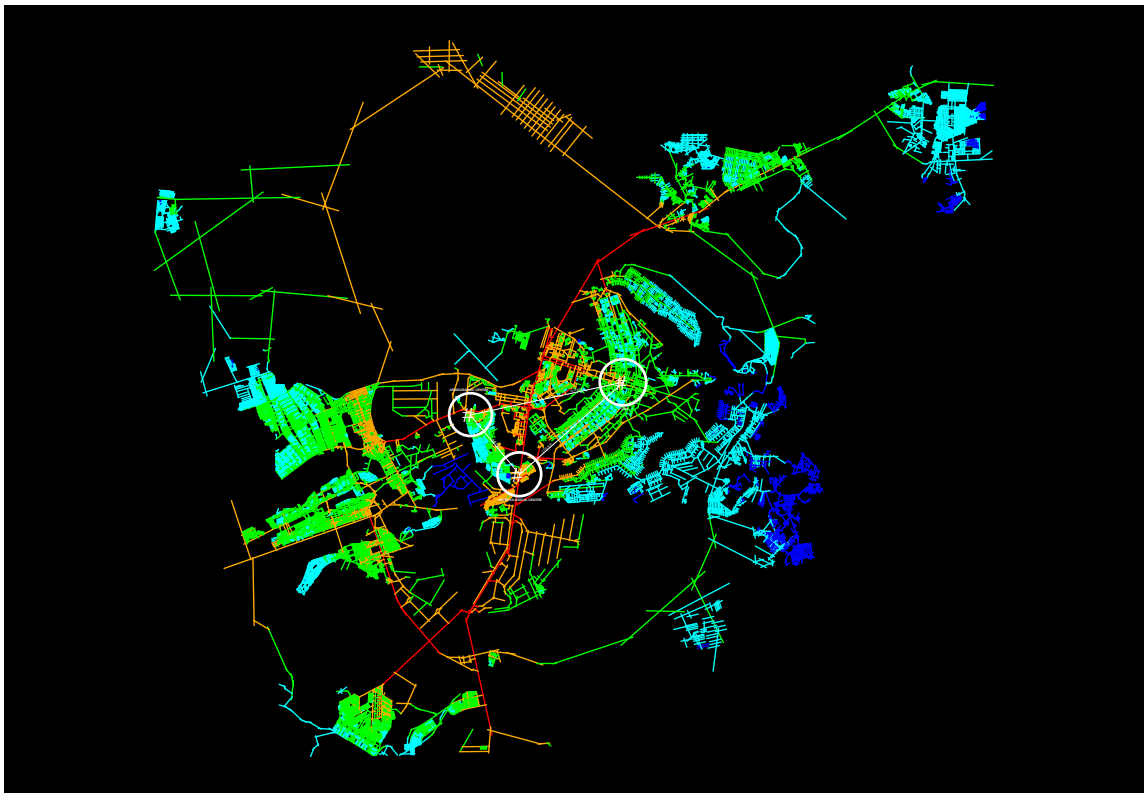


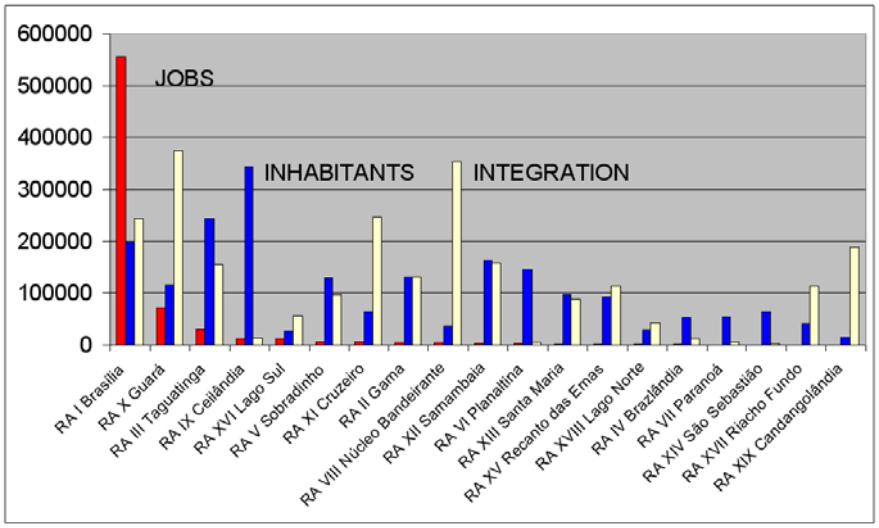
Figure 1. Brasilia, the "tricephalous" city. Axial map of the Federal District (the 3 centres in white circles).

Figure 2. Brasilia, the "tricephalous" city. Detail, showing the distances among CBD, demographic centre and morphological centre.

The result is that we have a curious "tricephalous" city, in which the three centres are separated from each other by long distances: 1) the demographic centre is separated from the CBD by 11.6km; 2) the morphological centre is separated from the CBD by 10.3km; 3) the demographic centre is separated from the morphological centre by 5.8km. By way of comparison, consider the respective distances in São Paulo: 1) the demographic centre is separated from the CBD by 3.4km; 2) the morphological centre is separated from the CBD by 1.5km; 3) the demographic centre is separated from the morphological centre by 2.3km. (That is not to say São Paulo is a paradise, but it does at least indicate an absence of these configurational problems.) No great flights of imagination are needed to reckon the hefty social costs involved in the predicament encountered in Brasilia, which boil down to long distances between residential areas (for the demographic centre is far from the morphological one) and to great distances from homes and jobs and services (for the demographic centre is far from the CBD). This imbalance is well illustrated by a graph that represents the three variables under consideration. Graph 2 shows, in the lines, the administrative regions of the Federal District and, in the columns, the number of jobs, the number of inhabitants and the accessibility of each region. Differences in column heights speak for themselves. (Values have been normalised to similar scales for the sake of comparison, but what matters is to observe the relative differences among their heights.)

Sociospatial segregation

The perverse combination of fragmentation, dispersion and eccentricity has harmful consequences as to sociospatial segregation in Brasilia. Again on the basis of socioeconomic data from census zones and using GIS techniques, it was possible to reveal a positive correlation between family income and distance from the CBD – we found R^2=0.44 – that is to



Graph 2. Comparison between jobs, inhabitants and accessibility ("integration") per Administrative Region in the Federal District.

say, poor families tend to live farther away from city centre than richer ones. This is not hardly original, since sociospatial segregation is typical of other cities in Brazil and in other parts of the world. What is more typical here is the long distances which obtain between home and city centre, as a consequence of the configurational traits we have been describing. Here again a comparison with other cities is useful. Observe, in Table 1, a comparison of per capita distances from city centre in cities with various population sizes: it is telling that Brasilia, much smaller than 5 of the other 6 cities, displays much longer distances. As poor families tend to live on the periphery rather than in the centre (as seen), they are penalized more than richer ones.
Yet, it is important to realize that building typology may strongly influence the deployment of families in the territory, according to family income. As may happen in other cities, there are poor "enclaves" quite near the city centre, due both to variation of building types and special historical circumstances. Moreover, there are also rich families living far away from the centre, although this is more an American than a Brazilian trait. We have carried out a survey in 8 very different areas concerning social stratification, and the results are quite interesting (Holanda, 2007). A case in point is Vila Planalto.

CITIES	AVERAGE DISTANCE PER CAPITA TO CENTRE (KM)	POPULATION
CURITIBA	7.7	1,644,000
PARIS	10,0	7,878,000
MOSCOW	10.6	8,497,000
LONDON	12.6	6,626,000
BERLIN	12.7	4,212,000
BANGKOK	13.1	7,628,000
BRASÍLIA	**24.3**	**2,455,903**

Table 1. Distances per capita from city centre among cities with various population sizes. Source: Bertaud (2003) and the present authors.

The study of Vila Planalto (Figure 3), situated a mere 1,500m from the Three Powers Plazza – the heart of the city (and of the Republic!...) – has offered the most rewarding results. The Vila dates from the beginnings of the construction of the city. It started out as a construction company camp providing housing for company personnel at all levels – architects, engineers, technicians, manual labourers. It was quite varied in terms of plots, houses, blocks, streets, alleys, sidewalks etc., according to the respective social classes to which they belonged. Today, 48 years after the inauguration of Brasilia, this variation is still clearly stamped on its configuration. The average plot is very small (143m^2) and 46% of all plots measure less than 100m^2. Some streets are so narrow that they almost prevent cars from passing through. And yet the Vila has an income stratification very close to the stratification for the FD as a whole – it is almost, as it were, a microcosm of the entire metropolis: there is a slight higher proportion of rich people in the FD (10.4% in the Vila, against 11.9% in the FD), middle income groups are also larger in the FD (49.8% in the Vila, 57% in the FD), and there are about 7% more poor families in the Vila than in the FD (39.7% in the Vila, 32.5% in the FD). Average income is US$ 897.61. Some gentrification has occurred. The picturesque character of the Vila, as well as its privileged location, has attracted middle class intellectuals, some of them teachers at University of Brasilia. The best houses are suited to adaptations that correspond to middle class expectations and are situated in streets providing generous parking space. But such houses are a clear minority. The majority of the Vila's architecture and townscape is not fashionable to middle class taste, let alone that of the rich. Thus, gentrification seems to be reaching a ceiling, imposed by the architecture of the place and by the impossibility, enforced by law, of altering some of its fundamental characteristics. More than four decades after the Federal Government moved to the Central Plateau of Brazil, market forces have not proved powerful enough to expel low income families from the place. When Brasilia was decreed World Cultural Heritage by UNESCO (1989), the Vila was included in the perimeter of the area encompassed. Henceforth, it was no longer possible to make alterations implying changes to the fundamental traits of plots, houses, blocks, streets and squares. This has further contributed to easing market pressures on the Vila's building stock and ensured the permanence of lower income families. Architecture has spoken louder as an independent variable.

Concerning social stratification in its relations with urbanistic policies, Vila Planalto encapsulates a precious lesson. The government should be aware that, if it wished to enforce policies aimed at making a more democratic city, concerning income layers distribution in space, it should take into account the need to *set limits* concerning building and urbanistic typologies. We know that not all types are fashionable among middle and upper classes, and this would imply that balanced boroughs might obtain if, within the borough, we were to have a greater variation of types, as the Vila proves so eloquently.

Zooming in: variation in quality of urban life

Authoritative surveys place Brasilia as the Brazilian city with the best quality of life among all urban nuclei in the country, all aspects considered (Fundação Getúlio Vargas, 2006). Still, a "city of great contrasts" is a commonplace that fairly describes the Capital – perhaps it also ranks top in this regard, among its fellow urban conglomerates in Brazil. On the one hand, you have top quality urban areas (great landscape design, excellent bioclimatic performance, well served by urban facilities), emblematic buildings justly classed among the most important examples of modern architecture in the world, monumental spaces which rank among the most impressive and beautiful ever devised – on a par with those in Paris, Washington, Beijing, Teotihuacan. On the other hand, many live in precarious environmental conditions, pay dear to cover distances from home to work and for services, have little access to quality urban facilities etc.

However, this is not as clear-cut territorially as one might suppose. We have referred to poor-family enclaves in central areas. The reverse is also true: there are rich families living in peripheral areas, a tendency which is becoming more common over time. On the one hand,

dispersal affects commuting costs; on the other, large zones of natural landscape favor bioclimatic and aesthetic performance in the cityscape. Traditional urban evaluation usually considers these aspects separately. To our knowledge, no theoretical-methodological framework combines, in duly weighted fashion, socioeconomic, configurational and environmental attributes, so that a complete picture of the city may be formed.

Figure 3. Vila Planalto. Top left: the Vila is in the centre of the image, 1,500 away from the Square of the Three Powers. Top right: air view of the Vila. Bottom left: a poorer street. Bottom right: a richer street.
Source: Google Earth (top images) and the present authors (bottom images).

Thus, an effort has been made to bring all this together (Ribeiro, 2008). Data was obtained from various sources: socioeconomic information from demographic censuses, discriminated spatially by census zones; spatial data generated by our research group (axial maps of the FD); environmental data captured by means of satellite images etc. Also, whenever possible, data from other Brazilian cities (and even from other cities around the world) were considered, so that Brasilia's specific reality could be more clearly depicted by way of comparison with other examples in the country and abroad (this was particularly the case with the measures of dispersion and integration). When all such information had been brought together, we obtained an overall picture of the city which is much more refined than those traditionally presented: qualities related to accessibility to jobs are countered by less comfortable air temperature in central areas, resulting from lower altitudes; long distances to jobs are offset by high socioeconomic indicators for middle class segments that have chosen to live in pleasant, bucolic, peripheral areas; low socioeconomic indicators are countered by proximity to jobs and services in central poor-family enclaves; etc. The *Composite Quality of Urban Life Index* thus

arrived at is illustrated in Figure 4, in which warmer colors (tending to red) convey better quality of life, and cooler colors (tending to blue) convey worse quality of life. Notice that we have a much more complex picture than the double equation which is more usually put forward: central areas = heaven, periphery = hell…

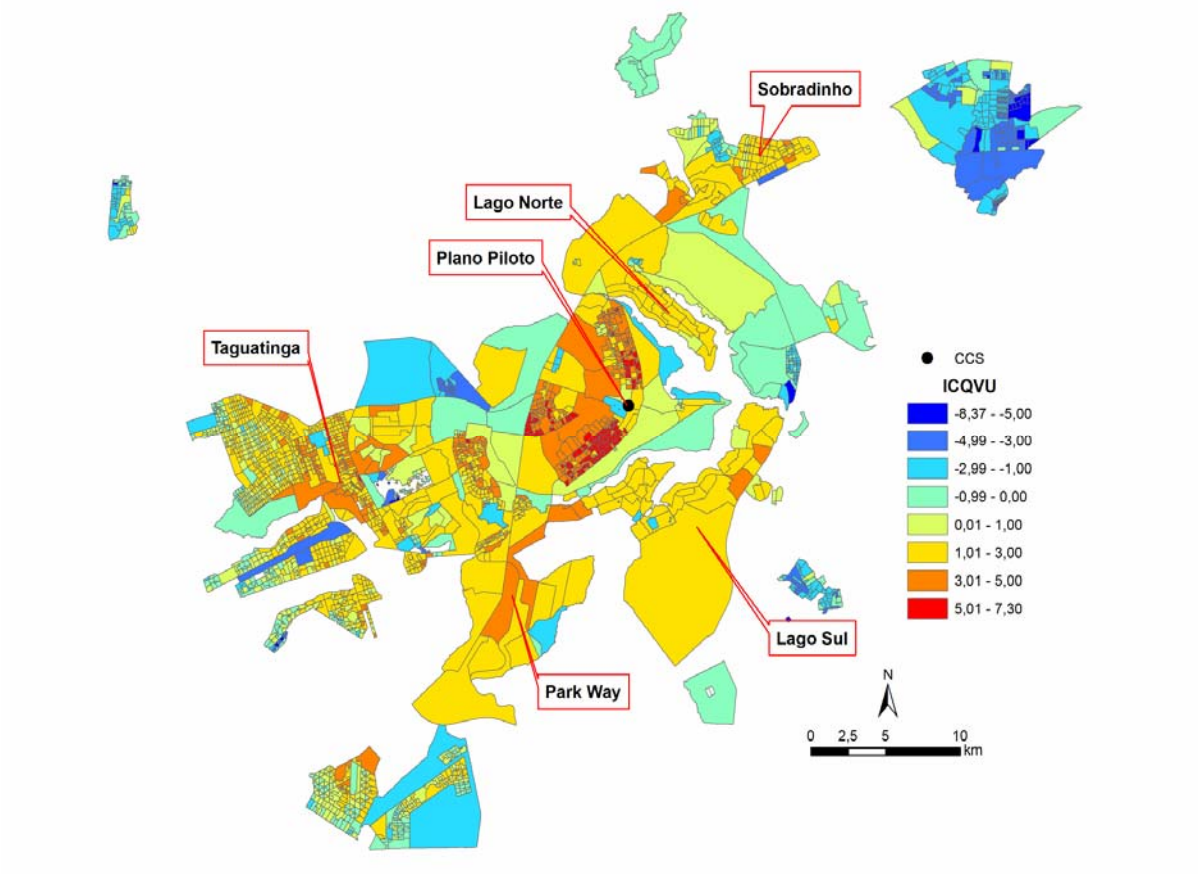


Figure 4. *Composite Quality of Urban Life Index* for the Federal District, Brazil. Source: Ribeiro (2008).

Recent trends: further dispersion versus concentrated development

New boroughs are still being added to Brasilia's metropolitan area at a brisk pace. Among Brazilian metropolitan regions, Brasilia presents the highest growth ratio of all: 3.17% and 2.92% per year on average, respectively, in the 1980-1990 and 1990-2000 decades – compare with São Paulo, for example: 1.91% and 1.67%, respectively (IBGE, 2002). The type of occupation, though, does not show tendencies of reversion concerning the perverse configuration we have been describing – except for very modest experiments. The dispersal of the territory is still increasing, as Figure 5 illustrates. New land allotments, often illegally implemented, present predominantly very low density, are discontinuous, and are comprised mainly by single family residential units. The result is, again, a patchwork pattern that prevents any efficient transit system being implemented. It will come as no surprise if the next census (2010) reveals stronger dispersion indices than those presented in this paper.

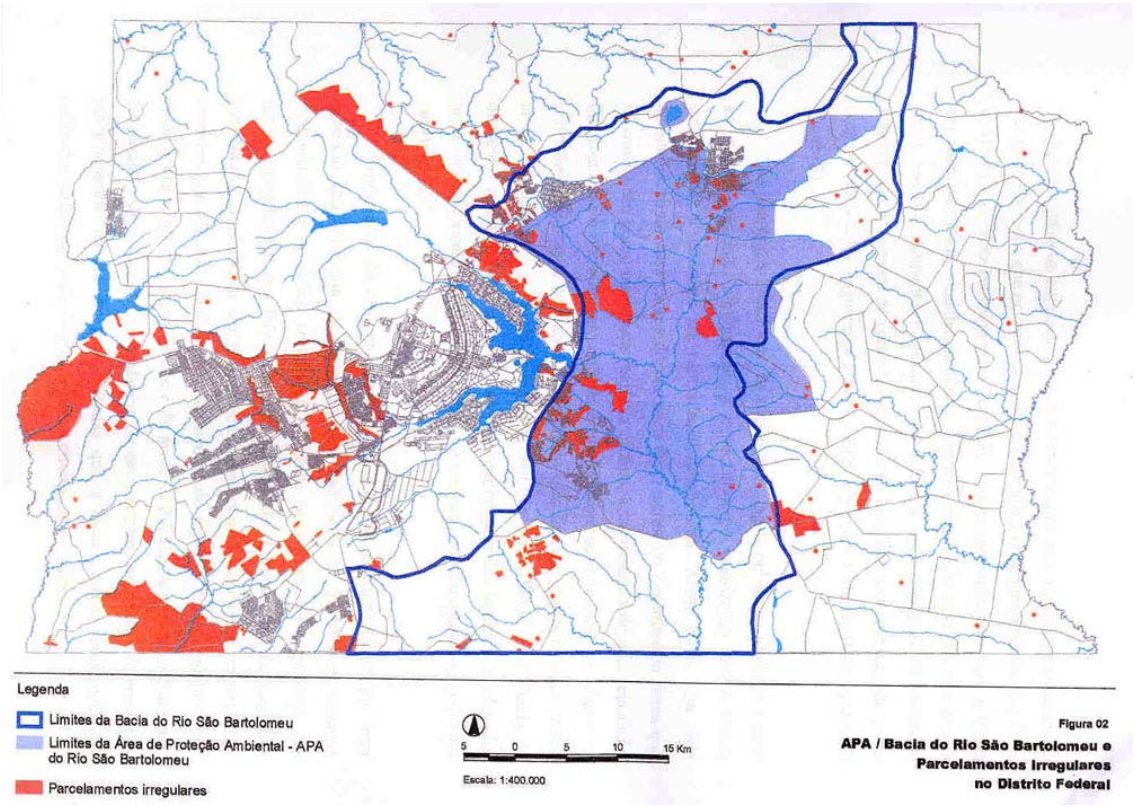


Figure 5. Irregular land allotments (in red) which have been scattered in the last 10 odd years all over the Federal District territory.
Source: local government, 2004.

On the legislative front, there has been no serious attempt to inhibit such dispersion. On the contrary, the territorial plan in course (approved in 1997 and currently being reviewed) consolidates dispersal by defining as areas for “urban consolidation” those tracts of land that currently present very low density and are scattered all over the territory, as Figure 5 well illustrates. No attempt is made to halt the proliferation of such new areas, or freezing those that already exist – the right course of action. Accordingly, there is no definition of high density urban corridors (as experienced, e.g., in Curitiba, Brazil) which would cohere with efficient transit systems.

An exception to this is the satellite nucleus of Aguas Claras, but (alas!) a sad exception (Figure 6). It lies 20km from the Pilot Plan, westwards on the route to Taguatinga, and began to be built in the early 1990s. Aguas Claras, designed by a justly respected architectural practice in Brasilia (Paulo Zimbres Arquitetos Associados), was originally an interesting proposal. It was to introduce a new urbanistic paradigm: initially intended to house approximately 120,000 inhabitants and generate 70,000 jobs, it was proposed as a linear city laid out along a transit system, with well-defined streets and avenues, shops opening directly onto public spaces etc. Unfortunately, no proper governmental control has managed to monitor implementation of the original proposal. Entrepreneurial interests have spoken louder (building heights have more than doubled in relation to the original design), land use proposals by which apartments were to mix with shops along streets have been ignored (inward looking shopping malls abound), much higher densities are creating serious circulation problems due to the unforeseen number of cars in public spaces etc. The metro system serving the city (besides also linking the cities of

Ceilandia and Samambaia to the Pilot Plan) is already overcrowded, less than 20 years after inauguration, due to a lack of proper land use policy for the territory as a whole, as discussed here.

Figure 6. City of Aguas Claras, designed by Paulo Zimbres Arquitetos Associados. Overall view of the original proposal (left) and its present skyline (right).
Source: Paulo Zimbres Arquitetos Associados (left) and the present authors (right).

Together with physical dispersion and the problematic experience of Aguas Claras, the same land use policy that has held sway over the last few decades is developing. Two aspects should be commented on here. First, there is a growing concentration of rich families closer to the centre of the metropolis. New boroughs in the close vicinity of the Pilot Plan ignore the results of surveys such as the one on Vila Planalto, and invest in housing typologies increasingly intended to the upper classes. Poor-family enclaves are fast becoming statistically insignificant. Secondly, only very modest attempts have been made to redistribute jobs over a wider section of the territory, instead of further concentrating them near the Pilot Plan. Recently, a large area has been set aside for a “digital city”, to house computer and software design firms, immediately to the west of the Pilot Plan, and which will attract 40,000 jobs. This will enhance the imbalance between jobs and homes in the metropolitan area, commented on above. An interesting exception in this is the building of the new local government headquarters near the satellite city of Taguatinga – a meagre attempt to counter the prevailing trend.

Conclusion

For all its problems, Brasilia has great potential. It is not only “historically” important, a testimony to what was once thought to be the ideal city. Together with its problems, it displays fine urban qualities, recognised by its inhabitants and visitors alike. The city’s urban tissue has great discontinuities not only among the nuclei constituting the metropolis, but also within the very central section of the city, namely the Pilot Plan. Whilst it is one of its greatest problems, this is also one of its greatest assets. Existing vacant land could be used to ameliorate substantially a city that is presently so imbalanced.

But let us not be naïve. This is not simply a matter of knowledge: many of the problems pinpointed in this text have long been diagnosed, others have been originally suggested here. Knowledge is fundamental, and we hope to have hinted at how a deeper understanding of the city through rigorous inquiry may reveal hitherto unsuspected attributes. But then comes power game. Brasilia is no different from other Brazilian or foreign cities for that matter. The production of space, here as elsewhere, is the result of clashes of contradictory interests, be they political, economic or ideological, and defended by the various tiers of the state or of civil society,

including the fierce ideological debate about the city that is still alive within the architectural and planning professions. Let us finish on an optimistic note. Many battles in the urbanistic arena in Brasilia have been lost, but some have been won. History is not written in advance. Clues are already visible that decentralization of jobs may be a stronger trend in the medium run, and the occupation of the interstices between central Brasilia and the periphery, as well as within Brasilia itself, timid as it may have been so far, begins to show. Segments in the government, civil society and academia may join forces to strengthen such trends. They may well prevail.[1]

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