



Application of factorial analysis to a Brazilian metropolitan region considering the Millennium Development Goals



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ABSTRACT

The Millennium Development Goals (MDGs) were established by the United Nations (UN) in an attempt to mitigate environmental and economic distortions that exist worldwide. To identify opportunities to meet the aspirations of the MDGs, a few indicators (as Human Development-HDI and the Gini indexes) were used in order to demonstrate existing inequalities among populations. This approach is also present in studies of such nature, in which electric energy intensity has been proposed as a way of overcoming the limitations of energy use assessment and its relationship with economic growth by means of the gross domestic product, seeking to impart evidence that can explain the environmental indexes more substantially. This article uses the factor analysis, a multivariate statistical analysis, to indicate the most closely correlated characteristics to the paths of human dignity and sustainable energy use. The aim of such analysis is to characterize regions and their clusters of typically urban cities to subsidize decision-makers in the changes for the present and future populations of these cities. The chosen cities for this study are located in the Metropolitan Region of Paraíba Valley and Northern Coast (MRPV), at an economic hub represented by the cities of São Paulo and Rio de Janeiro, with historic features often associated with their economic development. However, social choices, the cultural background in the region and geographical limitations represented by the Serra da Mantiqueira and Serra do Mar have defined peculiar characteristics to the region. The contribution of using electric energy to the development of positive actions towards the MDGs when coupled with the provision of benefits to less favored populations, as well as the autonomy suggested by the results to women, a reduction of the proliferation of diseases and extreme poverty, among other aspects, were achieved with the proposed analysis.

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1. Introduction

The cities, as they are nowadays, have well-consolidated urban features due to choices made in the past, especially in terms of commerce, agriculture, culture, religion and means of transport. Since the formation of the first civilizations, the search for natural resources, such as water and minerals, allowed the populations to cluster in small spaces. This led to the formation of the first conurbations and contributed to the first constructions which defined urban features at that time, in addition to allowing commercial intentions of cities to be supported by work force and its consumers.

Rural exodus (movement known as urbanization) has created possibilities for countries seeking to balance the economic development between rural and urban areas [2,3]. However, the perception and spread of urbanization, especially in cities in Asia and South America, were not followed by investments in infrastructure for receiving and supporting basic needs, for example, in the creation of formal jobs, and regular housing and sanitation [3,4].

Over the years, such urban drives have changed and generated serious environmental and economic problems associated with poor income distribution, extreme poverty, hunger, inequality between sexes and irregular land occupation, which contributed to the formation of irregular houses and slums, as well as environmental pollution (air, water and soil), deforestation and depletion of natural resources. It is not intended to state that land occupation is entirely responsible for significant changes in urban areas as these. Such changes are also due to choices resulting from the economic growth model adopted along the years and from the cultural characteristics of the cities, of which definitive models cannot be extracted. This means that one should not assign a unique effect arising from the cultural involvement of cities to changes of urban space, including traditions and typically rural ways of life.

There are also demographic elements, such as population ageing, which is increasingly growing in cities of Latin America, Caribbean, and Asia [3,5]. From an environmental viewpoint, Hogan [6] lays down that instead of the process of land occupation, social inequality is the first factor to be considered in environmental degradation and the main cause of the original changes of urban space. This can be evidenced by the lack of adequate infrastructure to urban living from the structuring of small towns.

Given this scenario, the United Nations (UN) proposed that the world's population should gather efforts towards the Millennium Development Goals (MDGs) in an attempt to mitigate the cited social and economic distortions [7]. The problems raised during the formation of cities are caused, in part, by overpopulation in some regions or by phenomenal development rates imposed to people, marked by environmental degradation, and mainly by profound social inequality [3]. Hence, public managers should make efforts so that significant changes will contribute to a reduction of extreme poverty and hunger, besides enabling the achievement of better indicators for primary education, greater equality between the sexes and greater autonomy for women. A reduction of child mortality, the improvement of maternal health, the combat of AIDS/malaria and other epidemics, reduction of waste of natural resources and protection of the biodiversity in search for environmental sustainability and global partnerships for development are also challenges to be met.

To identify opportunities to meet the aspirations of the MDGs, some indicators have been used in order to demonstrate the existing inequalities between populations, such as the Gini index, the Human Development Index (HDI) and the Theil index. The Gini and the Theil indexes have been used with the intention of presenting existing inequalities between population and income, while the HDI represents an indicator that correlates health, education and income [8,9].

Through these indicators, it is also known that significant correlations between the electric energy intensity¹ of the cities and their compositions can be established. For Goldemberg [10,11], neither the HDI nor the Gross Domestic Product (GDP), when considered separately, can clearly explain the social demands observed over the years. The same author claims that these social demands almost always occur in search of better living conditions, and they are not only related to the financial condition of populations, but also when they respect the traditional cultural values of populations, even if it does not represent high financial values in relation to the GDP generated in their cities, for example.

Energy use is a key element for the possibilities of imagining the fulfillment of wishes towards the MDGs. However, it is worth saying that, with caution, an increasing portion of the population of cities, lacking in better living conditions, will benefit if the power consumption, for example, does not have a mandatory dependency (necessary and sufficient) on their economic growth in the future. If the produced power units are only converted into thousands of consuming units for exclusively meeting the aspirations of the accelerated economic growth of cities, then each minimum contribution of energy consumption will not even be enough to promote the slightest social development. However, if these minimum contributions of energy consumption can generate the slightest perceptions of socio-environmental development, then individuals outside the scope of development and economic growth will be attended, without the attachment of weights from either side.

It is noticed that opportunities such as the use of renewable energy technologies (such as solar photovoltaic, wind energy and biomass energy from sugar cane, wood and urban waste) should be used, regardless of the economic growth objective, and correlated to the development of human dignity in cities. These technologies will allow future populations to be attended in their basic needs, e.g. in water heating for cooking, personal hygiene, or to meet ordinary demands as lighting and refrigeration.

Dahiya [2] reports that energy use is a key element in Asian cities, along with access to water, for better sanitation conditions and solid waste management to be achieved with the purpose of developing the MDG set, particularly regarding the reduction of extreme poverty and social inequalities in urban areas of cities. It is observed that this process has been occurring more slowly when compared to the rural areas of the Asian region. This is due to the development standards defined by the choices of decision-makers of cities, the differences between living standards required in urban and rural areas, in addition to investments allocated to rural areas due to understanding that the problem is not predominantly

¹ Electric energy intensity is defined as the ratio between the per capita electric energy consumption and income [kWh/capita/\$].

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