

Received: 10/14/2019

Accepted: 04/01/2020

## **ECONOMIC DEVELOPMENT INDEX (EDI): CALCULATION FOR MUNICIPALITIES IN THE METROPOLITAN REGION OF CAMPINAS, SP**

## **ÍNDICE DE DESENVOLVIMENTO ECONÔMICO (EDI): CÁLCULO PARA OS MUNICÍPIOS DA REGIÃO METROPOLITANA DE CAMPINAS, SP**

**Celso Fabrício Correia de Souza<sup>1</sup>**

**Josué Mastrodi Neto<sup>2</sup>**

**Celso Correia de Souza<sup>3</sup>**

**Daniel Massen Frainer<sup>4</sup>**

### **Abstract**

The construction of indices in subnational units is of utmost importance to, based on this detailed information, produce, implement and evaluate public policies considering the levels of economic sustainability. The indexes and indicators are crucial as they serve as a guide for decision making at various levels, allowing the measurement of the progress and achievement of the economic development objectives established in government actions. This research aims to find evidence on the economic sustainability of the municipalities of the Metropolitan Region of Campinas (MRC) through the construction and evaluation of the Economic Development Index (EDI), undertaken in the form of applied research with quantitative, exploratory and documentary approach by the type of collected data and by using statistical procedures. As a result, economic fragility was detected in the Metropolitan Region of Campinas, where only one municipality reaches an “acceptable” level of economic sustainability for a set of 34 indicators. This study is expected to serve as a reference for the formulation and application of public policies for metropolitan development, as well as making the creation of an information bank (index and indicator panel) for monitoring and evaluation from an Observatory or a Management Situation Room possible. Moreover, this index will serve as a subsidy in future research to build the Sustainable Development Index (SDI) for the MRC.

**Keywords:** Economic Sustainability, Indicator, Economic Development Index, Agenda 21, Public policies.

<sup>1</sup> Master in Environment and Regional Development (UNIDERP / 2005). Business consultant accredited to SEBRAE / MS. Studying Masters in Sustainability at PUC Campinas, Campinas - SP, Brazil. Email: celsofabricio76@gmail.com

<sup>2</sup> PhD in Philosophy and General Theory of Law (USP). Professor at the Pontifical Catholic University of Campinas, Campinas - SP, Brazil. E-mail: mastrodi@puc-campinas.edu.br

<sup>3</sup> PhD in Electrical Engineering (UNICAMP). Retired professor at the Federal University of Mato Grosso do Sul - UFMS. Professor at Anhanguera Uniderp University, Campo Grande, MS, Brazil. Email: csouza939@gmail.com

<sup>4</sup> Doctor in Economics (UFRGS). Professor at Anhanguera Uniderp University, Campo Grande, MS, Brazil. Email: danielfrainer@gmail.com

## Resumo

A construção de índices em unidades subnacionais é de extrema importância para, a partir dessas informações detalhadas, produzir, implementar e avaliar políticas públicas considerando os níveis de sustentabilidade econômica. Os índices e indicadores são fundamentais, pois servem de guia para a tomada de decisões nos diversos níveis, permitindo aferir a evolução e o alcance dos objetivos de desenvolvimento econômico estabelecidos nas ações governamentais. Esta pesquisa tem como objetivo buscar evidências sobre a sustentabilidade econômica dos municípios da Região Metropolitana de Campinas (RMC) por meio da construção e avaliação do Índice de Desenvolvimento Econômico (EDI), realizado na forma de pesquisa aplicada com abordagem quantitativa, exploratória e documental. pelo tipo de dados coletados e pelo uso de procedimentos estatísticos. Como resultado, foi detectada fragilidade econômica na Região Metropolitana de Campinas, onde apenas um município atinge nível “aceitável” de sustentabilidade econômica para um conjunto de 34 indicadores. Espera-se que este estudo sirva de referência para a formulação e aplicação de políticas públicas de desenvolvimento metropolitano, além de possibilitar a criação de um banco de informações (painel de índices e indicadores) para acompanhamento e avaliação de um Observatório ou Sala de Situação de Gestão. Além disso, esse índice servirá de subsídio em pesquisas futuras para a construção do Índice de Desenvolvimento Sustentável (IDS) da RMC.

**Palavras-chave:** Sustentabilidade Econômica, Indicador, Índice de Desenvolvimento Econômico, Agenda 21, Políticas públicas.

## Introduction

Since 1992, with the realization of ECO-92, the term Sustainable Development has been strengthened and spread, mainly through the document called Agenda 21. The effects of this report were very positive and it characterized as an instrument of participatory planning for the sustainable development, while one of the main advances was the systematization of construction and monitoring of a set of indexes and indicators that can help countries and their subnational units (states and municipalities) with information on the results of the decisions made on production and consumption that impact on the environment (UN, 2001).

With a commitment to follow the evolution of indexes and indicators in Brazil, the Brazilian Institute of Geography and Statistics (IBGE) has become the reference in its elaboration, following the guidelines of the United Nations (UN) Commission on Sustainable Development (CSD), contributing to the set of international efforts to materialize ideas and principles about the environment (IBGE, 2017).

Sustainability indexes and indicators are crucial as they serve as guides for decision making at various levels. They can identify information about the social, economic, environmental and institutional situation of a region compared to regions of higher standards, allowing to measure the progress and the achievement of the sustainable development objectives established in government actions (FRAINER et al., 2017).

Hardi and Barg (1997) show that the indicators measure reality; they cannot be considered reality itself, but they are legitimate in their consistent methodological construction of measurement. Indicators serve to monitor complex systems that society considers important and needs to monitor (MEADOWS, 1998).

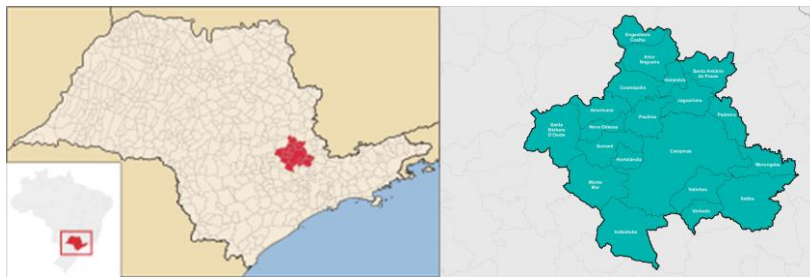
For Bellen (2006), sustainability indexes are indicators that condense information obtained by aggregating values. The most well-known indices are the Gross Domestic Product (GDP), the Human Development Index (HDI), among others.

In this context, the need for research and studies to assess the level of sustainability of subnational units emerges. The proposal in this research considers the municipalities of the MRC as an object of study.

The Metropolitan Region of Campinas (MRC), also known as Greater Campinas, was created by the State Complementary Law n° 870, of June 19, 2000, comprising 20 municipalities: Americana, Artur Nogueira, Campinas, Cosmópolis, Engenheiro Coelho, Holambra, Hortolândia, Indaiatuba,

Itatiba, Jaguariúna, Monte Mor, Morungaba, Nova Odessa, Paulínia, Pedreira, Santa Bárbara d'Oeste, Santo Antônio de Posse, Sumaré, Valinhos and Vinhedo.

**Figure 1:** Metropolitan Region of Campinas



Source: Wikipedia, Emplasa.

The MRC covers an area of 3,791 km<sup>2</sup>, which corresponds to 0.04% of the Brazilian surface and to 1.47% of São Paulo's territory. It is the second largest metropolitan region of the State of São Paulo in population, with more than 3.2 million inhabitants, according to an estimate by the Brazilian Institute of Geography and Statistics (IBGE) for 2018, and generated 8.75% of the Gross Domestic Product (GDP) of the state in 2016.

It can be assumed that the MRC municipalities have a satisfactory degree of economic development due to the local and regional dynamism. However, there is no systematic measurement, there are no policies for building indexes, whether in the public or private sphere. From these considerations, the following question arises: based on the economic dimension, what would be the level of economic sustainability of the municipalities in the MRC?

This study aims to carry out an analysis of the levels of economic sustainability of the municipalities of the MRC, by calculating the Economic Development Index (EDI), in order to establish comparisons between the municipalities. The relevance of this study is in the approach of regional (metropolitan) economic development, as well as to allow the improvement of the formulation of public policies aimed at the region. It is a series of scientific articles involving the four dimensions of sustainable development and their respective indexes: i) in the economic dimension, we have the Economic Development Index - EDI; ii) in the social dimension, the Social Development Index - SDI; iii) in the environmental dimension, the Environmental Development Index - EDI; iv) finally, in the institutional dimension, the elaboration of the Institutional Development Index. These indices, together, will consolidate the Sustainable Development Index - SDI.

## Theoretical foundation

### *Sustainable Development x Sustainability*

Agenda 21 was designed to transform sustainable development into an acceptable global goal. An important contribution was the creation of the Commission on Sustainable Development (CDS), whose purpose would be to monitor global progress on the issue of sustainability. One of the needs expressed in Agenda 21 is the development of sustainable development indicators and, in this way, create appropriate instruments for decision making.

The CDS aims to create a common basis for assessing the degree of sustainability and that most indicators are not adequate to achieve the objective. A major challenge for CDS is to initiate a project of indicators at the national level, to that end, comparability, accessibility and quality of indicators should be promoted.

It is necessary to have a unit to measure the degree of progress of society. It should encompass a range of factors related to sustainability: ecological, economic, social, cultural and institutional, among others (MOLDAN and BILHARZ, 1997).

According to Macedo (2016), the development of indexes that offer values on the degree of sustainability serves as support and reference for public and private administrations to direct attention to specific needs.

In his assessment, Boff (2016) points to a perspective that emphasizes the local, regional, national and global levels. He also comments that "*Sustainability is a way of being and living that*

*requires aligning human practices with the limited potential of each biome and the needs of present and future generations".*

In 1995, in Ghent, Belgium, a workshop called "Indicators for Sustainable Development for Decision Making" was created, to disseminate and enable greater acceptance by the scientific community and politicians about the use of sustainable development indicators. The results were positive and emphasized the need to develop sustainability indicators.

For Dahl (1997), the use of indicators is a great challenge due to the complexity and dimensions of sustainable development. The challenge is to portray the real situation of sustainability, in a simple and clear way, and that is effective in supporting and improving the decision-making process. In addition, with the incorporation of the environmental variable, the sustainability assessment has a higher level of legitimacy.

The concept of sustainable development in a more operational proportion must be transformed by sustainability indicators. It is necessary to identify key elements and select indicators that provide essential and reliable information on the viability of each component (BOSSSEL, 1999).

Hardi and Barg (1997) affirm that measurements are indispensable for the concept of sustainable development to become operational. In this way, an empirical and quantitative basis of performance evaluation is provided, which allows comparisons in time and space, and are useful to allow important correlations.

The performance evaluation of the indicators provides a basis for planning future actions. Indicators are essential elements to connect past and present while pointing out future goals.

Sustainable development, according to Luxen and Bryld (1997), is established with progressive and balanced economic development, with more social equity and increased environmental sustainability.

For Bellen (2006), the concept of sustainable development specifies a new way for society to relate to its environment in order to guarantee its own continuity and that of its external environment.

A common denominator for practitioners of ecological economics resides in the defense of sustainable (ecologically, but also socially and economically) development. Which, basically, implies qualifying something that dispenses adjectives. In fact, if development is not sustainable - which means it is unsustainable - it will not be development (CAVALCANTI, 2010).

The big question is to determine which scale of the economy is compatible with its ecological base, the so-called "optimal scale". The carrying capacity plays a key role in the macroeconomics of the environment, it is this that will delimit the scope of sustainable development. There is a constant confrontation between nature and society, environment and economy (CAVALCANTI, 2010).

Economic growth is not an end in itself, it must be related to improving people's lives and strengthening freedoms. Education and health services and civil rights are good examples of factors or agents promoting freedom. Precisely this expansion of freedoms is considered as the main means for development (SEN, 2010).

The idea of development comprises a complex action, represented by the addition of successive adjectives - economic, social, political, cultural, sustainable - and, most importantly, by the new problems (SACHS, 2008).

It is important to consider that the theme of sustainability directly confronts the "risk society" paradigm. In this case, there is a current demand for society to be more motivated and mobilized to assume a more propositional role based on community practices and on citizen participation and involvement, assuming, therefore, greater environmental awareness (JACOBI, 2003).

It is in recognizing the limits of ecosystems that the greatest possibilities for the development process are found. In addition, not the least important, is innovation. It is in this sense that we speak today of the need for innovation systems oriented towards sustainability (ABRAMOVAY, 2012).

We have to comprehend the nature of development, so it is necessary to understand the relationship between resources and achievements, between goods and potential, between our economic wealth and the ability to live as we would like (SEN, 2010).

#### *EDI and economic sustainability*

The Economic Development Index (EDI) aims to synthesize the aspects related to the economic performance of the municipalities. The EDI allows you to compare the performance of

municipalities with each other and their performance over time. It indicates that the higher the index, the higher the level of economic development of the researched municipality.

Economic sustainability can be understood as efficiently managing resources and the constant flow of public and private investments. (SACHS, 1993). According to the same author, all economic efficiency should be evaluated in macro-social terms and not through microeconomic business profitability criteria.

We can affirm that economic sustainability aims at the economic development of a country or company through economic, financial and administrative practices, preserving the environment and guaranteeing the maintenance of natural resources for future generations (SEBRAE, 2017).

Anand and Senem (2000) argue that economic sustainability is a process of relation between distribution, sustainable development, optimal growth and interest rates. Future generations should receive the same kind of attention as those of the current generation, avoid abuses and end of the stocks of resources that we enjoy today, nor should there be contamination in the environment, which violates the rights and interests of future generations.

We note that the major concern is with the general maximization of wealth, regardless of distribution, which results in a serious disregard for individual difficulties, the main reason for the most extreme deprivations. Government policies, such as taxes, subsidies and regulation, can consolidate a structure of incentives in order to protect the environment and the global resource base for people yet to be born.

Growth is not what guides the economy, but real results of social well-being and ecosystems regeneration capacity. Economic sustainability recognizes limits to the exploitation of ecosystems by society (ABRAMOVAY, 2012). The economic thinking of the twentieth century was that human intelligence and new technologies would be able to repair environmental damage, however, this dynamic proved to be erroneous. What must exist are innovations and the recognition of limits to ecosystems as described by Abramovay (2012).

The development of a social metabolism capable of regenerating constant ecosystem services and obtaining sufficient supplies to cover human needs essential to life, is what can be called "New Economy". Since economic sustainability must be directly linked to ethics, this in turn must occupy a central place in economic decisions (VEIGA, 2012).

Veiga (2012) notes that the imposition of limits on the exploitation of ecosystems directly shocks the idea of productive expansion. In addition, the real capacity of the economy to contribute positively to the eradication of poverty and to create social cohesion has been very limited.

Some advantages of economic sustainability that we can consider are: i) medium and long-term financial savings; (ii) improving the image of governments and companies before citizens and consumers; (iii) preserved environment; (iv) greater economic development; (v) guaranteeing a better life for future generations (SEBRAE, 2017)

Whether in the business or government field, the great challenge of economic sustainability is to generate economic growth, profit, income and create jobs without causing damage to the environment.

#### *Indicators x Indexes*

The term indicator originates from the Latin *indicare*, to discover, to point, to announce, to estimate ... the indicators communicate or inform about the attainment and / or direction to a determined goal, that is, its progress towards the "target". It also has an understanding as a resource that makes a trend or phenomenon that is not immediately detectable more visible (HAMMOND et al., 1995).

In other words, an indicator is a measure of the system's behavior in terms of expressive and perceptible attributes (HOLLING, 1978).

At a more concrete level, indicators should be understood as variables according to Gallopin (1996). A variable is shown as something operationally representative of an attribute - quality, characteristic, property - of a system.

Any indicator has its own significance. An important and perhaps main characteristic is that which allows comparison with other variables or forms of information, while resulting in a high degree of relevance for politics and for the decision-making process (GALLOPIN, 1996).

Indicators express a commitment and reinforce the understanding between men's relations with the environment within the field of development (JESINGHAUS, 1999).



Another point that requires more attention is the question of whether an indicator is classified as quantitative or qualitative in order to allow important strategic comparisons, in other words, data comparability.

The indicators should simplify relevant information, and that certain phenomena that occur in reality become evident mainly in the aspect of environmental management (GALLOPIN, 1996).

Gallopín (1996) comments that qualitative indicators are preferable in at least three cases: a) when quantitative information is not available; b) when the attribute of interest is not quantifiable (subjective data); c) when there are cost determinations for its preparation.

Indicators are not primary data. The data are measured, values of the variable, when these are quantitative (GALLOTI, 1996). Indicator measures the variation of the variable in relation to a specific base, that is, it already has a certain level of aggregation. In other words, variable is a function of other variables.

According to Bellen (2006), in some moments, indicators are related to different meanings, the main ones are - norms, standards, goals and objectives - however they diverge from the concept that guides an indicator: standard and norms refer to an established technical reference value within a social consensus; goals represent values to be achieved, intentions, always measurable, established within a decision-making process and which are achievable; finally, the objectives are purely qualitative, which indicate a direction, the end to be achieved, without indicating a specific form or state.

Indicators serve to monitor complex systems that society considers important and needs to monitor (MEADOWS, 1998). According to the author, the analogy of the thermometer is important, as it is capable of transmitting information. Signs, symptoms, diagnoses, data and measures are ways to name indicators.

Hardi and Barg (1997) show that indicators measure reality, but they cannot be considered reality itself, but are legitimate in their coherent methodological construction of measurement. The indicators simplify complex phenomena to make a communication model understandable and quantifiable.

Society measures what it values and learns to value what it measures, the indicators affect citizens' behavior, they are characterized by being tools for change and learning (MEADOWS, 1998).

Many indicator systems have been developed for specific reasons, are environmental or economic or social, but cannot be considered as sustainability in themselves. In order to arrive at data on the reality of sustainable development, the indicators must be linked or aggregated. Sustainability indicators are characterized by being the components of assessing progress in relation to sustainable development (GALLOPIN, 1996).

The indicators can be classified as scalar or vector (DAHL, 1997). A set of simultaneous, but not aggregated, indicators to depict an environmental condition can be called a vector, which is the generalization of a variable. A scalar index is a number generated from the aggregation of two or more variables (DAHL, 1997).

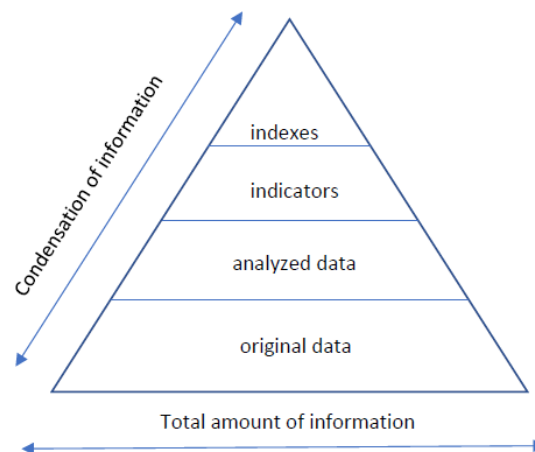
Bellen (2006) points out that part of scholars defends vectorial measures for better demonstrating the reality of the system, however, another part supports the use of indexes due to the fact of simplification, which is one of the greatest advantages in the use of scalar measures.

According to Bossel (1999), the higher the level of aggregation of the indicator, the more distant from the problems and greater the difficulty in articulating action strategies related to specific problems. Conceptual problems can appear more frequently in highly aggregated indicators.

The improvement of this comes with the aggregated indexes. However, some problems are detected in these conditions, when the aggregation leads to indices that condense different spheres of evaluation (BOSEL, 1999).

In a superficial analysis, index and indicator have the same meaning. The difference is that an index is the final added value of an entire calculation procedure in which indicators are also used as variables that compose it (KHANNA, 2000).

The indexes are indicators that condense information obtained by the aggregation of values (BELLEN, 2006). The information pyramid, adapted from Gouzee et al., (1995), illustrates the condensation (treatment) of information regarding the total amount of information.

**Figure 2: Information pyramid**

Source: Adapted from Gouzee et al. (1995).

Some researchers prefer to use a list of indicators that relate to specific problems. However, for the purpose of monitoring sustainability, the need for indicators with a certain degree of aggregation, which is able to capture problems in a clear and concise manner, is essential (BELLEN, 2006).

The indicators can be divided into two groups: systemic and of performance. The systemic or descriptive outlines individual measurements for different issues; the one of performance is an important comparison tool that incorporates the descriptive indicator. These provide relevant information to decision makers regarding the achievement of local, regional, national or international goals (BELLEN, 2006).

Bellen (2006) reports that sustainability indexes are indicators that condense information obtained by aggregating values. The most well-known indices are the Gross Domestic Product (GDP) and the Human Development Index (HDI).

Bossel (1999) argues that a simple indicator is not able to show the reality of a situation. The author exemplifies the situation of GDP, how limited this indicator is and which does not reflect all reality.

In the process of building the index, the indicators that participate in it must be weighted according to their relevance. When it comes to environmental and social indicators, the use of weights or ponderations becomes more complex when compiling and analyzing data (BELLEN, 2006).

Aggregate indexes contribute to the evaluation of progress towards sustainable development, but are still not very effective in understanding, preventing and anticipating actions (GALLOPIN, 1996).

Indicators can be used at various times as part of the process of designing public policies and programs. The cycle begins with the identification of the problem, which is the starting point for the conception, elaboration, implementation and evaluation of a public policy and ends with the evaluation of the results considering the demands of society (BRASIL, 2018).

An important medium-term regional planning tool is the Multi-Annual Plan-MAP. Thematic programs and their products are measured by indicators and are also part of annual budget laws. In general, for the programs, indicators are defined: a) of results - which measure the achievement of the objectives of the programs; b) products - which measure and qualify the delivery of public goods and / or services (ESTADO DE SÃO PAULO, 2019).

Planning, according to Sachs (2008), represents an interactive process that includes bottom-up and top-down processes within the framework of a long-term national project.

National scale indicators are highly heterogeneous due to the specificities of each country. In view of this, the development of indicators occurs mainly at subnational, regional and local levels (GALLOPIN, 1996).

Gallopín (1996) comments that, for greater acceptance and use, indicators must be means of communication, understandable, transparent and easy to understand. According to the author, the use in public policies and in civil society reinforces the legitimacy of a system of indicators.

Jesinghaus (1999) shows that the selection of sustainability indicators must occur in three stages: 1) project plan; 2) objectives and schedules; 3) institutionalization and legitimation. The author also stresses that, in the preparatory stage, the selection of indicators must be carried out by specialists.

Two dominant approaches to indicator selection: top-down and bottom-up. In the top-down method, the advantage is the most homogeneous scientific approach, however it has no power to define or modify the indicators, in addition to having no direct contact with the wishes of the community and not considering the limitations of natural resources. In the bottom-up approach, there is a participatory process in which most regional initiatives take this form. It establishes the priorities and the scarcity of the system involved, the main limitation referring to the fact that fundamental aspects of sustainability are omitted (JESINGHAUS, 1999).

For Jesinghaus (1999), the system developed by specialists in a participatory process with various actors is determined as an optimal situation, within which the community selects priority issues.

Moldan and Bilharz (1997) present the importance of indicators from the decision-making cycle, which consists of five stages: problem identification; problem recognition, increased public awareness; policy formulation; policy implementation; policy evaluation.

The so-called assessment tools are useful for decision makers and are characterized, in the planning function, useful for the development of public policies. The importance and the need to use indicators for the formulation of global policies and international agreements are clear (MOLDAN and BILHARZ, 1997).

In order to assess sustainability, one must pay attention to the best methods, if they have a high aggregation index or a range of variables, the number of indicators used must be small, and may vary over time according to problems and issues (RUTHERFORD, 1997).

For a sustainability assessment, it is necessary that the indicators are holistic, in order to consider the presence and importance of all elements of the system (BELLEN, 2006).

Bellen (2006), argues that the dimensions must be compatible with reality for a deep assessment of sustainability. It should be noted that researchers must be aware of the limits of human, financial and time resources for the construction of indicators and indexes in general.

Global sustainable development indicators are proposed in the 2030 Agenda. There are 231 indicators built to monitor and measure progress in the implementation of the 17 Sustainable Development Goals (SDGs), expressed in 169 goals, which represent the central axis of the 2030 Agenda for Sustainable Development, which entered into force on January 1, 2016, and which brings together 193 United Nations member countries. The main objective of the new global policy is to increase the development of the world and improve the quality of life for all people (UN, 2015).

## Scientific methodology

### *Research Subject / Universe:*

The methodology proposed in this research considers the municipalities of the Metropolitan Region of Campinas, SP, as an object of study, with a focus on the research of secondary data, collected for the purpose of building the EDI.

### *Variables:*

The publication "Sustainable Development Indicators: Brazil 2017" from IBGE is a guide for the elaboration of the set of variables that allows a more complete assessment of sustainability, considering the peculiarities and characteristics of the MRC.

Martins and Cândido (2008) point out the need to measure and evaluate the situation in which a municipality is in relation to sustainability.

In this research, the last available database of each variable was used, collected in the form of data for statistical treatment and later calculation of the EDI that are contained in the system of indicators of the economic dimension, as shown in table 1.

**Table 1:** Selected economic variables



nº	System of Indicators – EDI
1	Indicator – Planted area or destined for harvest
2	Indicator – Export value
3	Indicator – Import value
4	Indicator – Trade balance
5	Indicator – GDP
6	Indicator – GDP per capita
7	Indicator – Added value of agriculture
8	Indicator – Added value of industry
9	Indicator – Added value of services
10	Indicator – Tax added value
11	Indicator – Admissions
12	Indicator – Dismissals
13	Indicator – Balance of Jobs
14	Indicator – Formal employment by employer establishment
15	Indicator – Average income from total formal jobs
16	Indicator – Average income from formal jobs in agriculture, livestock, forest production, fishing and aquaculture
17	Indicator – Average income from formal jobs in industry
18	Indicator – Average income from formal jobs in construction
19	Indicator – Average income from formal jobs in wholesale in retail trade and in trade and repair of motor vehicles and motorcycles
20	Indicator – Average income from formal jobs in services
21	Indicator – Occupied population
22	Indicator – Percentage of the population with nominal monthly income per capita up to half a minimum wage
23	Indicator – Private investments made in the period of 2012-2019
24	Indicator – Gini index
25	Indicator – Electricity consumers
26	Indicator – Reason – Electricity consumption – Total / Electricity consumers – Total
27	Indicator – Reason – Electricity consumption – Residential / Electricity consumers – Residential
28	Indicator – Reason – Electricity consumption – Trade and Services / Electricity consumers – Trade and Services
29	Indicator – Reason – Electricity consumption – Industrial / Electricity consumers – Industrial
30	Indicator – Reason – Electricity consumption – Rural / Electricity consumers – Rural
31	Indicator – Reason – Electricity consumption – Lighting and utilities and others / Electricity consumers – Lighting and utilities and others
32	Indicator – Electricity – Level of Service
33	Indicator – Number of inhabitants per total of vehicles
34	Indicator – Number of inhabitants per automobile

Source: Adapted by the Author of Bellen (2006) and Martins and Cândido (2008).

#### *Type of research:*

Applied research with a quantitative approach by the type of data to be collected and by using statistical procedures. Applied research aims to acquire knowledge in order to solve identified problems (GIL, 2010).

Marconi and Lakatos (2015) characterize applied research due to its practical interest so that the results are applied immediately in the solution of problems that occur in reality.

As for the objectives, the research is characterized as exploratory because it makes the problem more explicit due to considering the most varied aspects related to the studied fact or phenomenon. The most common type of documents is those written on paper, however the availability of electronic documents in various formats is becoming more frequent (GIL, 2010).

In exploratory research, procedures are used to develop hypotheses, increasing the researcher's familiarity with a fact or phenomenon in search of more precise research (MARCONI and LAKATOS, 2015).

#### *Data Collection Instrument:*

As for the data collection instruments, it is classified as documentary research, due to the survey of materials that have not received an analytical treatment or that could be reworked according to the objectives of the project (GIL, 2002).

There is documentary research that mainly uses quantitative data in the form of records, tables, graphs or in a database, whereas in these cases the analytical process involves statistical procedures. (GIL, 2010).

Documentary research uses three variables - written or unwritten sources; primary or secondary sources; contemporary or retrospective (MARCONI and LAKATOS, 2015).

The survey was carried out by means of research with city halls, IBGE, the State System of Data Analysis Foundation (SEADE), the Campinas Metropolitan Region Agency (AGEMCAMP), among other research institutes, NGOs, etc.

According to Roldán and Valdés (2002), the proposed methodology for the selection of the set of local indicators to compare and generate a ranking of municipalities in a region, uses the following criteria as a criterion for selection:

- The availability and reliability of data sources;
- The most up-to-date data statistic possible;
- The representation in the analysis of three systems: natural, social and economic, with its regional importance;
- A holistic approach that includes both quantitative and qualitative terms.

*Data Analysis Method:*

In the data analysis procedure, it fits as descriptive statistics to summarize and represent a set of data by simple measures. Its purpose is to present forms for data collection, to highlight data presentation techniques by means of tables and graphs and to offer the proper statistical measures for numerical analysis. The need for data on a national basis was closely intertwined with the development of descriptive statistics, methods centered on the collection, presentation and characterization of a data set, in order to properly describe the various characteristics of that set (LEVINE et. Al., 2005).

For data processing, electronic spreadsheets were used to format information in the process of elaborating the EDI. It is proposed to carry out an analysis by the dimension and the general level of economic sustainability.

The proposed methodology for the elaboration of the IDE evaluates the levels of economic sustainability, considering the criteria used worldwide for the choice of indicators and the specificities of focus on local development. For Martins and Cândido (2008), when considering each of the selected indicators, one should pay attention to the following characteristics of it: a) be significant for the investigated reality and for the focus of the study; b) be relevant to the decisions that guide public policies; c) reflect the temporal changes; d) allow an integrated and systemic approach; e) use measurable variables; f) be easy to interpret and communicate and; g) have a well-defined, transparent and objective methodology for the purposes of the investigation.

The proposed method for determining and evaluating EDI was carried out in stages: (i) building a database (system of indicators) for sustainable development issues, selecting themes within the economic dimension; (ii) normalization of variables to make them comparable and amenable to aggregation; (iii) calculation of the arithmetic average to determine the economic development index; (iv) results obtained by municipality, and classified to create an EDI ranking for the evaluation and analysis of the level of economic sustainability.

The first stage of selecting the themes to generate a metropolitan database obeys national methodologies, considering the relevant variables, within each dimension, which has municipal information. In addition, the criterion of representativeness is adopted, together with the availability of information at the municipal level. For this purpose, UN indicators and international indexes are adopted as a reference, combined with the selection made by IBGE for the national Sustainable Development Index.

Once the first stage of selection of indicators has been carried out, the selected variables are normalized by the method suggested by Sepúlveda (2005), transforming the indicators into indexes, which allows the comparability of variables from different units in addition to normalizing the data in one number ranging from 0 to 1, so that the closer to 1, the better the municipality presents itself in relation to economic sustainability.

In this perspective, it should also be taken into account that there are indicators that are positively correlated, and others, negatively. To perform an aggregation, all indexes must point to a positive relationship in order to be aggregated, generating a synthetic indicator. Thus, the relationship (positive or negative) that these variables present is identified by the following relationship: positive (the bigger, the better, and the smaller, the worse) and negative (the smaller, the better, and the bigger, the worse), according to the context of their relationships.

As proposed by Sepúlveda (2005), EDI can be calculated by the weighted average of the indexes for each dimension, where they are obtained by the weighted average of the considered variables (already transformed into indexes to allow aggregation). In the present study, the same weight was applied to all variables in the calculation of the EDI due to not having clear arguments for attributing differentiated weights in order to not generate any bias or bias in the final calculation (WAQUIL et al., 2010). In this way, the EDI was calculated by the arithmetic average of the indexes of the variables that make up the economic dimension, therefore, the weighted average is identical to the arithmetic average.

The normalization procedure provides that if the indicator has a positive or negative influence on the economic dimension, it must be analyzed separately according to equations (1) and (2),

respectively. Theoretically, for a positive indicator, in (1), the maximum observed value will have a value of 1 as a score, that is, the higher the indicator, the better the index, and the lower the indicator, the worse the index. As for the negative indicator, the higher the indicator, the worse the index, and the lower the indicator, the better the index. Using equation (2), its behavior will be like that of the positive indicator, that is, the higher, the better (maximum value 1), and the lower, the worse (minimum value zero), let's see:

$$I_{(+)} = \frac{x - \text{mín}}{\text{máx} - \text{mín}} \quad (1)$$

$$I_{(-)} = \frac{\text{máx} - x}{\text{máx} - \text{mín}} \quad (2)$$

Where:

$I_{(.)}$  = normalized index, calculated for each municipality;  $x$  = value observed in each municipality;  $\text{min}$  = minimum value of the indicator for all municipalities;  $\text{max}$  = maximum value of the indicator for all municipalities.

The minimum and maximum values of each indicator under study are assigned according to each selected variable, regardless of its unit of measurement. In this way, it was possible to normalize the data to a comparable basis.

The generated index can be classified according to the level of economic sustainability. Table 1 shows the intervals for analyzing the economic dimension, using the classification adapted from Martins and Cândido (2008). It was decided to insert the "bad" degree and distribute the levels of economic sustainability in five intervals of 0.2 tenths each, so that the "alert" situation has a layer that separates it from the last and worst level, the "critical".

**Table 1:** Classification of the level of economic sustainability

Index (1 - 0)	Level
1.0000 - 0.8001	Ideal
0.8000 - 0.6001	Acceptable
0.6000 - 0.4001	Alert
0.4000 - 0.2001	Bad
0.2000 - 0.0000	Critical

Source: Adapted by the Author of Martins and Cândido (2008).

## Results obtained

To calculate the Economic Development Index (EDI), a system of 34 indicators of the theme in question was used, with a high degree of relevance, for each city in the Metropolitan Region of Campinas (MRC), thus totaling 680 data municipalized.

Initially, the indicators were normalized taking into account their polarity (greater better or lesser better). With the normalized values, the EDI was determined by the arithmetic mean, the results of which are shown in Table 2, which were classified and ranked for evaluation and analysis.

**Table 2:** Ranking of the economic development index (FDI)

MRC - Metropolitan Region of Campinas	EDI - Economic Development Index	Ranking
CAMPINAS	0.6220	1º
PAULÍNIA	0.5413	2º
INDAIATUBA	0.5025	3º
JAGUARIÚNA	0.4566	4º
SANTA BARBARA D'OESTE	0.4560	5º
AMERICANA	0.4518	6º
ITATIBA	0.4437	7º
VINHEDO	0.4358	8º
VALINHOS	0.4334	9º
NOVA ODESSA	0.4274	10º
SUMARÉ	0.4222	11º
SANTO ANTÔNIO DE POSSE	0.4159	12º
ARTUR NOGUEIRA	0.4151	13º
HORTOLÂNDIA	0.4029	14º
HOLAMBRA	0.3924	15º
PEDREIRA	0.3697	16º
COSMÓPOLIS	0.3680	17º
MONTE MOR	0.3525	18º
MORUNGABA	0.3493	19º
ENGENHEIRO COELHO	0.3490	20º
<b>DIMENSION AVERAGE</b>	<b>0.4304</b>	-

Source: Elaborated by the Author

Note that the average economic dimension reached the index of 0.4304, which determines a level of "alert" in economic sustainability to the MRC. The value of the maximum and minimum EDI reached a considerable range of about 78%, which demonstrates a wide range of economic realities. The municipality with the highest rating and with an "acceptable" level of economic sustainability, as shown in Table 2, was Campinas (0.6220). Most municipalities are found at the "alert" level, as in the case of Paulínia (0.5413), Indaiatuba (0.5025), Jaguariúna (0.4555), among others. The other municipalities of the MRC are in the range considered "bad", while some economies are in a "critical" situation, as in the case of Engenheiro Coelho (0.3490), Morungaba (0.3493), Monte Mor (0.3525).

It is worth noting that the two municipalities with the highest EDI are also listed among those with the highest GDP in the country: Campinas occupies 11th position and Paulínia is in 21st place in the Brazilian ranking. If we take into account the GDP per capita, it is observed that Paulínia holds the national leadership, the municipality has national relevance in the oil refining industry. This figure is more than ten times higher than the general GDP per capita for the average Brazilian, which was 30,407 reais, according to data from the IBGE for the year of 2016 (last publication). On the other hand, in this same aspect, the placement of Campinas oscillates downwards, placing itself in 292nd place. Engenheiro Coelho, which occupies the last position in the MRC's EDI, ranks 1.408º in the national GDP ranking, while in per capita it stands at 295º.

## Final considerations

In a specific analysis of the EDI, the economic fragility is perceived in the Metropolitan Region of Campinas. Only one municipality, Campinas, reaches an "acceptable" level of economic sustainability for a set of 34 selected indicators.

It is concluded, from the point of view of the economic dimension, that 5% of the municipalities of the MRC are in an "acceptable" situation, 65% in "alert" and 30% have a level considered "bad", in turn, in a situation far from the "ideal" level of economic sustainability.

The MRC held 8.75% of the state's Gross Domestic Product (GDP) in 2016 and comprises a modern, diversified industrial park, with a very significant agricultural and agro-industrial structure

and expressive specialization, being considered a major consumer and university center, however with peculiarities and distinct realities that determine a high economic disparity between the municipalities surveyed.

Finally, the proposal for an economic development index (EDI) aims to allow additional conditions for public managers to propose and promote preventive and corrective actions, in the short, medium and long terms, to leverage the municipal (and metropolitan) economic performance aimed at achieve ideal levels of economic sustainability. Research on other dimensions such as social, environmental and institutional is being developed as a way to complement the present study and contribute to a more comprehensive view of the theme.

**Acknowledgments:** this work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Financing Code 001.

## References

- ANAND, S.; SEN, A. *Desenvolvimento humano e sustentabilidade econômica*. Desenvolvimento Mundial, [28 vol., 12 ed.](#), Ed. Elsevier, dezembro de 2000, p. 2029-2049.
- ABRAMOVAY, R. *Muito além da economia verde*. São Paulo: Ed. Abril, 2012, 248 p.
- BELLEN, H. M. van, *Indicadores de sustentabilidade: uma análise comparativa*, 2 ed., São Paulo-SP: Editora FGV, 2006, p. 41-62.
- BOFF, L. *Sustentabilidade: o que é – o que não é*. 5 ed. Revista e ampliada, Petrópolis, RJ: Vozes, 2016, p. 17.
- BRASIL. Ministério do Planejamento, Orçamento e Gestão. Secretaria de Orçamento Federal. Secretaria de Planejamento e Investimentos Estratégicos. *Indicadores - Orientações Básicas Aplicadas à Gestão Pública*. Coordenação de Documentação e Informação – Brasília/DF: MP, 2018. 3 ed. 64 p.
- CAVALCANTI, C. *Concepções da economia ecológica: suas relações com a economia dominante e a economia ambiental*. Estud. av. vol.24 no.68 São Paulo, 2010
- ESTADO DE SÃO PAULO. *Manual para elaboração dos programas do Plano Plurianual - PPA 2020-2023*. Secretaria de Fazenda e Planejamento – São Paulo, 2019. 76 p.
- [FRAINER, D. M.](#); SOUZA, C. C.; REIS NETO, J. F.; CASTELÃO, R. A. *Uma aplicação do Índice de Desenvolvimento Sustentável aos municípios do estado de Mato Grosso do Sul*. Interações [online]. 2017, vol.18, n.2, p.145-156. Campo Grande-MS. ISSN 1518-7012.
- GIL, A. C. *Como elaborar projetos de pesquisa*, 5 ed., São Paulo-SP: Atlas, 2002, p. 45.
- GIL, A. C. *Como elaborar projetos de pesquisa*, 5 ed., São Paulo-SP: Atlas, 2010, p. 27-67.
- GOUZEE, N.; MAZIJN, B.; BILLHARZ, S. *Indicators of Sustainable Development for Decision-Making*. Federal Planning Office of Belgium, Brussels, 1995.
- HARDI, P.; BARG, S. *Measuring sustainable development: review of current practice*. Winnipeg: IISD, 1997.
- IBGE. *Indicadores de Desenvolvimento Sustentável: Brasil 2017*. Rio de Janeiro: IBGE, 2017.
- JACOBI, P. *Educação Ambiental, Cidadania e Sustentabilidade*. São Paulo-SP: Cadernos de Pesquisa USP, n. 118, março/2003, p. 189-205.
- KHANNA, N. *Measuring environmental quality: an index of pollution*. *Ecological Economics*, v. 35, n. 2, nov. 2000, p. 191-202.
- LEVINE, M. D.; STEPHAN, D. F.; SZABAT, K. A. *Estatística Teoria e Aplicação usando o Microsoft Excel em Português*, 7 ed., Tradução CURTOLO, E. B., SOUZA, T. C. P., LTC Editora, Livros técnicos científicos Editora S.A., 2005.



MACEDO, L. O. B.; CÂNDIDO, G. A.; COSTA, C. G. A.; SILVA, J. V. F. *Avaliação da sustentabilidade dos municípios do estado de Mato Grosso mediante o emprego do IDSM – índice de desenvolvimento sustentável para municípios*, Revista Brasileira de Gestão e Desenvolvimento Regional, v. 12, n. 03, p. 333-335, 2016, Taubaté-SP. ISSN 1809-239X.

MARCONI, M. A.; LAKATOS, E. M. *Técnicas de pesquisa*, 7 ed., São Paulo-SP: Atlas, 2015, p. 07-71.

MARTINS, M.F.; CÂNDIDO, G.A. *Índice de Desenvolvimento Sustentável para Municípios (IDSM): metodologia para análise e cálculo do IDSM e classificação dos níveis de sustentabilidade – uma aplicação no Estado da Paraíba*. João Pessoa-PB: SEBRAE, 2008.

MEADOWS, D. *Indicators and information systems for sustainable development*. Hartland Four Corners: The Sustainability Institute, 1988.

ONU. *Indicators of Sustainable Development: Framework and Methodologies*. New York: NU, 2001.

ONU. *Indicators of Sustainable Development: Guidelines and Methodologies*. New York: NU, 2007.

ROLDÁN, A. B.; SALDÍVAR-VALDÉS, A. *Proposal and application of a Sustainable Development Index*. Ecological Indicators, v.2, n.3, 2002, p.251-256.

SACHS, I. *Estratégias de transição para o século XXI - Desenvolvimento e meio ambiente*. São Paulo: Studio Nobel/FUNDAP, 1993, 103 p.

SACHS, I. *Desenvolvimento: incluyente, sustentável e sustentado*. Rio de Janeiro: Garamond, 2008, 151 pp.

SEN, A. *Desenvolvimento como liberdade*; tradução Laura Teixeira Motta; revisão técnica Ricardo Doninelli Mendes. São Paulo: Companhia das Letras, 2010.

SEPÚLVEDA, S. *Desenvolvimento Microrregional Sustentável: métodos para planejamento local*. Tradução de Dalton Guimarães. Brasília: IICA. 2005, 296 p.

SOUZA, C. C. et. al., *Análise de sustentabilidade em assentamentos rurais nas dimensões econômica, social e ambiental*. Revista Espacios, vol. 38, n. 26, p. 16, 2017. Caracas, Venezuela. ISSN 0798-1015.

SEBRAE - Serviço Brasileiro de Apoio às Micro e Pequenas Empresas. *Sustentabilidade econômica: como sua empresa pode ser mais lucrativa com a sustentabilidade* / Cuiabá, MT: Sebrae, 2017. 55p.:Il. Color.

VEIGA, J. E. *Resenha do livro - Muito além da economia Verde*. Jornal Valor Econômico, São Paulo, 5 de junho de 2012, disponível em: <<http://www.valor.com.br/cultura/2691664/ruptura-necessaria-para-outra-economia#ixzz1wwJfEuL>>.

WAQUIL, P. et. al. *Avaliação de desenvolvimento territorial em quatro territórios rurais no Brasil*. Redes, v.15, n.1, 2010, p.104-127.



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