

## PROPOSAL FOR THE DEVELOPMENT OF AN URBAN SUSTAINABILITY INDICATOR FOR THE MUNICIPALITY OF UMUARAMA/PR

### *PROPOSTA PARA O DESENVOLVIMENTO DE UM INDICADOR DE SUSTENTABILIDADE URBANA PARA O MUNÍCIPIO DE UMUARAMA/PR*

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**Abstract:** The current model for society's development, based on the unconscious use of natural resources, points to signs of exhaustion, requiring a reflection in order to formulate strategies that overcome the challenge of coexistence between the relationship between man and nature. The use of tools such as sustainable indicators has been shown to be effective in the identification and understanding of socio-environmental phenomena and in the subsequent decision making by public management, assisting in the resolution of problems, and consequently, acting as a resource for sustainable development. This study aims to propose the development of an urban sustainability indicator for the municipality of Umuarama, in the state of Paraná, Brazil. In order to build the indicator, municipal data and variables from the last five years linked to the multi-dimensional sustainability model proposed by Sachs will be collected, covering the social, environmental, economic, political, cultural, ethical and aesthetic dimensions. Through statistical treatments, the data and variables will be standardized, allowing their comparison and aggregation, resulting in the index of the sustainability indicator. Based on the resulting index, it is expected to analyze the current state of local sustainability, as well as its level of sustainable development. This tool will provide the public authorities and the population in general with a diagnosis capable of monitoring the present reality, and also projecting a desired future, corroborating to the ideal proposed by sustainability.

**Keywords:** Sustainability. Sustainable cities. Sustainable development. Sustainable Indicators.

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## 1 INTRODUCTION

The adaptive capacity of human beings to the natural environment proved to be fundamental for the perpetuation of their species. Throughout its evolution, mankind has always found ways to modify the environment around them, so that they build appropriate conditions for their development, adapting the space around them to their needs (DIAS, 2011).

Since prehistory, man has sought to create tools to multiply their capacity and overcome limitations, whether physical, intellectual, social or spatial, mainly affecting their way of relating to environment. Regarding the capacity for human transformation, Marx (1989, p. 202) states that man, by acting “[...] on the external nature and modifying it, at the same time modify his own nature”. Thus, anthropic interventions in the natural environment are intended not only to survive as a species, but also to maintain and improve the conditions of their existence (DIAS, 2011).

Adaptability, sociability and the improvement of their own capacities allowed man to domesticate animals and create planting techniques, putting an end to nomadism (HARARI, 2008). Humanity then began to organize itself socially into fixed conglomerations, giving rise to the first cities. The creation and occupation of these spaces has raised ever greater demands for access to natural resources, in order to meet the supply of human needs, causing, therefore, the modification and deterioration of the environment.

At the same time, the Industrial Revolution is considered a major historical landmark and was characterized by the transition from the artisanal production system to technological processing, exponentially increasing the production of goods and services on a global scale, permanently changing the structure of humanity (MIRANDA, 2012). However, since its advent, the last two hundred years have been marked by the indiscriminate access to natural – finite

– goods, as well as by disordered demographic growth, occurring in a development model that points to signs of exhaustion.

In that sense, it is noticeable that the use of natural resources in human activities has reached an unsustainable level, due to the feedback between the intensification of industrialization and the consumption habits of the population. In addition, human needs are continually growing, while the planet's ability to recover is incompatible with this exploratory course. Added to this scenario, is the frequent and growing incidence, in the second half of the twentieth century, of episodes of contamination from industrial accidents, threatening nature and human health alike (BELLEN, 2006).

With this in mind, in recent decades, nations have been articulating to be able to face this problem, resulting in conferences and treaties, which among other prerogatives, aim to incorporate the socio-environmental aspect in the development panorama.

From these discussions, the concept of sustainable development emerged, which was described in the Brundtland Report (WCED, 1987) as a model of economic development in which the exploitation of natural resources meets the needs of the current generation, without compromising, impairing or lacking in the capacity of future generations to provide for their own needs. From this visibility to the environmental aspect as a determining factor for the perpetuity of life on the planet, and concurrent to the formation of a collective awareness about the social influence in the natural environment, another precept related to sustainable development – however with different meaning – emerged in the midst of to that discourse: sustainability.

Although of an abstract nature, extensively debated and still in formation in the academic field, sustainability is considered, in general, as a concept that seeks the balance between economic growth and quality of life, represented here by social justice and environmental preservation (AYRES, 2008; ELKINGTON, 1994; LOZANO, 2012).

Regardless of the framework of these two principles, both promote efforts by various social actors to achieve an equitable society. However, so that this ideal of self-sustainability does not remain only in theoretical field, it is necessary to use management instruments that incur for its applicability and consequent achievement of this objective, such as sustainable indicators, tools that assist in the understanding of phenomena and states of environments, corroborating for urban planning.

Hence, this study aims to develop an urban sustainability indicator, in which the multidimensionality of the sustainability model addressed by Sachs (2002) is included in its structure, which covers not only the social, environmental and economic aspects, but also includes other variables that flow into an inclusive and sustained development model, such as ethics, aesthetics, politics and culture.

Furthermore, the premises discussed here contribute, internationally, to the achievement of the Sustainable Development Goals (SDGs) proposed by the Agenda 2030, which consists of a collaborative action plan between member countries of the United Nations (UN). The agenda aims to achieve, by 2030, objectives and targets related to the protection of human rights, the reduction of inequalities, and the capacity for self-sustainability of society at a global level. The corpus of this study mainly deals with the SDG 11 (Sustainable Cities and Communities), which aims to

"Making cities and human settlements inclusive, safe, resilient and sustainable [...] support positive economic, social, environmental relations between urban, peri-urban and rural areas, reinforcing national and regional development planning [...]" ( UN, 2015).

The construction of an urban sustainability indicator for the municipality of Umuarama contributes to an analysis of the current local progress of human well-being in conjunction with environmental protection, and the design of a planned future, as well as corroborating to the achievement of the proposed

ideal for sustainability, in the equitable aspects of economic growth, social and environmental justice.

## 2 DEVELOPMENT

Discussions regarding the integration of factors abstracted from the economic dimension in the construction of a development model are recent. Although social and environmental information has progressively incorporated and expanded its space in this process, the prevailing contemporary archetype still places social development and the preservation of natural environment at a level secondary to the production of consumer goods (PHILLIP JR, 2012).

Nonetheless, Sachs (2008), when stating about development, shows that in essence, its objective goes beyond multiplication of material wealth and that although necessary, it has no end in itself. In the author's own words,

[...] the idea of development implies atoning and repairing past inequalities, creating a connection capable of filling the civilizing chasm between the old metropolitan nations and their old colonial periphery, between the modernized wealth minorities and the majority still backward and exhausted from the working poor. Development brings with it the promise of everything – inclusive modernity brought about by structural change (SACHS, 2008, p. 12).

Still belonging to this situation, Sen (1989) states that the conception of economy and the generation of wealth linked to ethics refers to Aristotelian thoughts, and that its ends are directed to the common good, although economic activity is directly related to the search and accumulation of capital, at the same time, is deeply interrelated with other areas, which involve the evaluation and improvement of basic objectives of society.

Nevertheless, the author points out that economy also originates from an “engineering approach”, which, in turn, focuses primarily on the process, on logistical issues and on how to find ways to serve the ends, which are

considered simple and objective (SEN, 1989). Sen further declares that the nature of the modern economy has been substantially impoverished due to its distance from ethics, or, as Comparato ratifies (2013, p. 48), under the perspective of capitalism, “[...] the ethical principle has become the search for each individual's own material interest, leaving the common good and ethical precepts in the background”.

Still in relation to this situation, it is worth mentioning that although since the last century some countries have tried to seek alternatives to the capitalist model of production, the economic and social transformations achieved by them have not altered the predatory nature of relations with the physical environment (SILVA, 2000). These interventions, which range from meeting the basic needs of the population to the interests and strategies of companies, economic blocs or different countries, have resulted in the environmental crisis, as explained by Paula et al. (1997, p. 204)

[...] is central to the critical perspective the idea that the environmental crisis is a historical product of concrete forms of production, material reproduction, concrete forms of appropriation of nature, formation of territories, the exercise of power and social organization of modes, mentalities and cultures.

The aftermath and consequences of the unconscious and unrestrained exploration of the environment to meet demands originated by capitalism were manifested in the increasing incidence of contamination by industrial accidents around the world, starting in the 1950s. Among these events, the irregular destination of mercury in Minamata Bay, Japan, the gas leak in Bophal, India, the explosion of one of the nuclear reactors at the Chernobyl plant in Russia, and also the oil leak from the Exxon-Valdez freighter in the USA (DAYS , 2011). These events, combined with the unrestricted and irrational access to natural resources, have caused cumulative damage to the environment, and have started a critical and global reflection on the relationship between society and nature.

From the international debate on the reevaluation of development restricted to economic growth, the concepts of sustainable development and sustainability emerged, and the notions that permeated its definitions were based on discussions and documents published from the 1970s on. Published in 1972, the report *The Limits to Growth*, commissioned by the Club of Rome, used mathematical models to investigate, over medium term, five major trends in global issues: accelerated industrialization, rapid population growth, widespread malnutrition, depletion of non-renewable resources and deterioration of the environment.

As a conclusion, the report predicted a chaotic scenario: in one hundred years, absolute scarcity of natural resources, occurring in decline in industrialization and food production, and, consequently, a decrease in the population due to indigence, hunger, and contamination by pollutants, as made explicit:

[...] if current trends in world population growth, industrialization, environmental contamination, food production and depletion of resources are maintained, this planet will reach the limits of its growth over the next hundred years. The most likely result will be a sudden and uncontrollable decline in both population and industrial capacity (MEADOWS et al., 1972, p. 23).

The document was not limited to just presenting the results of its study, at the same time it sought to indicate a solution to the problem, based on the search “[...] for a model result that represents a world system that is: 1. Sustainable, without unexpected and uncontrollable breakdown; 2. Able to satisfy the basic material requirements of all its inhabitants”. (MEADOWS et al. 1972, p. 158). The publication ended up influencing the opinion of the community, as well as international organizations and the government, highlighting the discussion about the limitations of a development model based solely on economic growth, without taking into account the possibility of depletion of natural resources.

As previously discussed, the concepts of sustainable development and sustainability emerged from these arguments, which were perpetuated in subsequent years in different forums and worldwide meetings, as well as in the dissemination of documents on the environmental issue. The Brundtland report, called “Our Common Future”, defined internationally the understanding of sustainable development, being the most used concept in the literature regarding the term, expressed as a model that “[...] meets the needs of the present without compromising the possibility for future generations to meet their own needs”. (CMMAD, 1991, p. 46).

Thus, the notion of sustainable development is related to a dynamic process, in which the exploration and use of natural resources understands the present needs, without disregarding the future. Essentially, sustainable development incorporates different aspects of society, aiming at prosperous and equitable economic conditions for current and future generations, through the protection and maintenance of natural assets (KELLY et al., 2004).

With regard to sustainability, despite the plurality of approaches on the subject, there is an apparent consensus in the academic world regarding this concept, which is defined by several authors as a state of balance between economic growth, the reduction of social inequalities and the efficiency in the use of natural resources (AYRES, 2008; ELKINGTON, 1994; HORBACH, 2005; LOZANO, 2012). For Sachs (2002), on the other hand, sustainability must transcend the basic pillars to which it is linked in its classic sense, and admits a multidimensional and systematic scope to its formulation. As important as the social, economic and environmental aspects, other variables such as culture, ethics, politics and aesthetics contribute to the continuous process of sustainability, and to the achievement of sustainable development.

Despite the debates associated with sustainable development and sustainability, given the emergent and complex nature of these two terms, their operationalization has been developed through the use of indicators and indexes, due to their ability to quantify and simplify information. Therefore, it is

necessary to develop proposals that adequately represent the sustainability of a given region or location (SICHE et al. 2008).

The formulation of indicators to measure economic performance has been used around the world for a long time. However, in its elaboration, information regarding the socio-environmental transformation of the environment ends up not being considered, impairing a more complete understanding of reality.

It is in this context that sustainable indicators are inserted, mainly disseminated since the 1990s, with the signing of Agenda 21 at global and local levels, as well as through the involvement of institutions such as the UN, World Bank and European Commission.

The Organization for Economic Cooperation and Development (OECD), in general, defines an indicator as a parameter or value of a parameter that provides information about a phenomenon or state of an environment (OECD, 1993), while Adriaanse (1997) attributes greater adjectives, in a more specific sense, an indicator can be considered a quantitative model, as well as information capable of making a certain phenomenon noticeable, even when its finding is not immediately identifiable, in addition to allowing a more simplified and understandable reading of statistical data or complex phenomena.

Thus, basically, indicators are understood as a set of quantitative and qualitative information, which express the performance of a given phenomenon. From these perspectives, it is possible to notice characteristics inherent to these instruments: they originate from statistical data, have the ability to synthesize complex information in order to improve their understanding, in addition to allowing the interpretation of phenomena.

In view of this context, it is opportune to conceptualize index, a term related to the indicators, but with a different meaning, although it is commonly misinterpreted and confused with the previous one. According to the OECD (1993), an index is a set of aggregated or weighted parameters or indicators. In

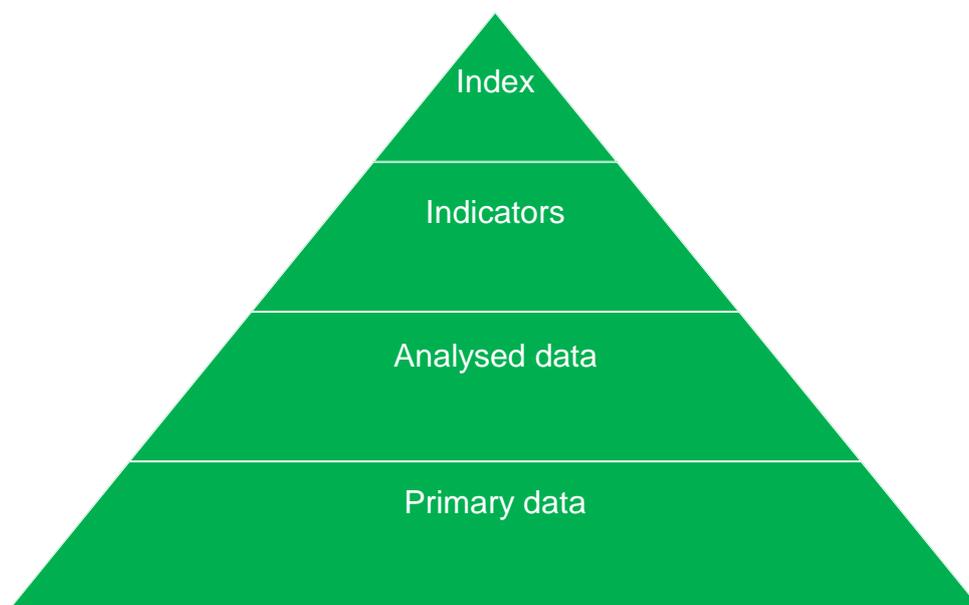
a practical way, an index is the quantification of an indicator, a numerical expression derived from the synthesis of several aggregated variables.

The objective of indicators, according to Bellen (2006, p. 42), is "[...] to aggregate and quantify information so that its significance becomes more apparent", while its main functions are:

Evaluation of conditions and trends; comparison between places and situations; assessment of conditions and trends in relation to goals and objectives; provide warning information; anticipating future conditions and trends (Tunstall apud Bellen, 2006, p. 43).

Although they are presented graphically or statistically, indicators are distinct from these representations and primary data, even though they use the latter in their construction. Hammond et al. (1995, p. 1) designate that "highly aggregated indicators and indices lead a pyramid of information whose base is primary data derived from monitoring and data analysis", as shown in Figure 1.

**Figure 1** – Information pyramid

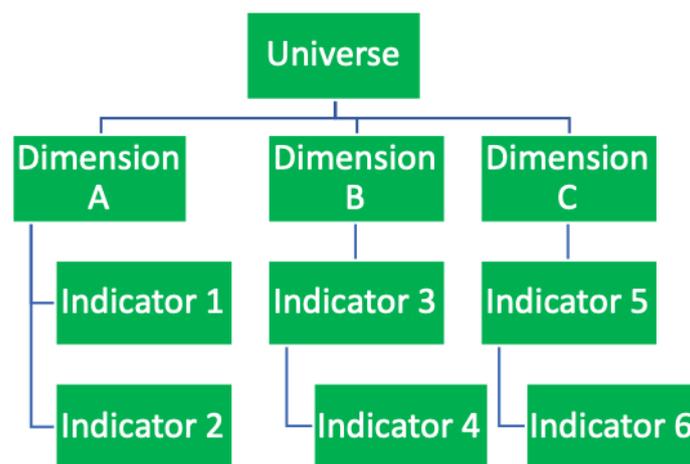


**Source:** Hammond et al. (1995, p. 1).

However, the aforementioned authors reinforce that the indicators represent an empirical model of reality, but not reality itself, and despite this, they must be analyzed analytically and have an applied measurement methodology.

Still on the selected concepts, Saaty (1991) demonstrates that the process of creating indicators also allows for the aggregation of several indicators, thus creating a hierarchical structure, composed of dimensions and universes of study, as shown in Figure 2.

**Figure 2** – Hierarchical structure of indicators



Source: Saaty (1991), adapted.

Another aspect no less relevant regarding to sustainable indicators is its importance as tools that assist in the planning of actions and decision making, based on the possibility of measuring sustainable development. Therefore, according to Philippi Jr (2012), it is necessary to establish relationships between human activities and the changes and impacts caused by them, either negatively or by enhancing the present and future quality of life.

The indicators can also constitute instruments for monitoring urban reality, guiding actions aimed at urban planning, an essential procedure for improving the physical, social, economic and cultural relations of cities, and

which, according to Duarte (2011, p. 26), is considered as "[...] the set of measures taken to achieve the desired objectives, in view of the available resources and the external factors that may influence this process".

In addition, it is imperative that sustainable development and sustainability are incorporated into discussions about urban planning, since cities represent

[...] highly polluting spaces, greater consumers of natural resources and energy, greater population concentration, greater exposure to risks and high socio-environmental vulnerability, and where socio-spatial segregation has been more explicitly spatialized. (PEREIRA; CHIARI; ACCIOLY, 2009, p. 8).

Based on these premises, sustainability can be attributed to a city when it manages to operate, according to a development model that distributes to the population all available resources, equally, so that it meets the social, environmental, political, cultural, economic objectives and physical needs of its citizens (LEITE, 2012).

As well as that, sustainable cities are supported by legal instruments, in accordance with Art. 2º of the Cities Statute (BRASIL, 2001, p. 1), which says:

Urban policy aims to order the full development of the city's social functions and urban property, through the following general guidelines:

I - guarantee of the right to sustainable cities, understood as the right to urban land, housing, environmental sanitation, urban infrastructure, transportation and public services, work and leisure, for present and future generations [...]

IV - planning the development of cities, the spatial distribution of the population and the economic activities of the Municipality and the territory under its area of influence, in order to avoid

and correct the distortions of urban growth and its negative effects on the environment [...]

Thus, the convergence between sustainability and sustainable and inclusive development must be the guiding principle for structuring urban space, in order to balance contradictory factors, such as economic growth, social justice, environmental protection and quality of life.

### 3 METHODOLOGIES

This study will analyze the municipality of Umuarama, located in the northwest of the state of Paraná, 554 km away from its capital, Curitiba. Founded on June 26, 1955, through Companhia Melhoramentos Norte do Paraná, as a district under the municipality of Cruzeiro do Oeste, the location was elevated to the category of municipality by State Law No. 4,245, of July 25, 1960 (UMUARAMA, 2015). According to data from IBGE (2019), the city currently has an area of 1,234.537 million km<sup>2</sup>, demographic density of 81.67 inhabitants / km<sup>2</sup>, and an estimated population of 111,557 inhabitants, for 2019.

For the elaboration of the Urban Sustainability Indicator (USI), a search will be carried out in databases of various entities and official institutions, in order to obtain the necessary indexes for the construction of the indicator. Among some of the agencies to be consulted are the Municipality of Umuarama, Brazilian Institute of Geography and Statistics (IBGE), National Sanitation Information System (SNIS), Sanitation Company of Paraná (SANEPAR), Paranaense Institute of Economic Development and Social (IPARDES), State Secretariat of Public Security (SESP), Department of Informatics of the Unified Health System (DATASUS), Department of Traffic of Paraná (DETRAN / PR), Civil Defense of Paraná, Environmental Institute of Paraná (IAP), and others.

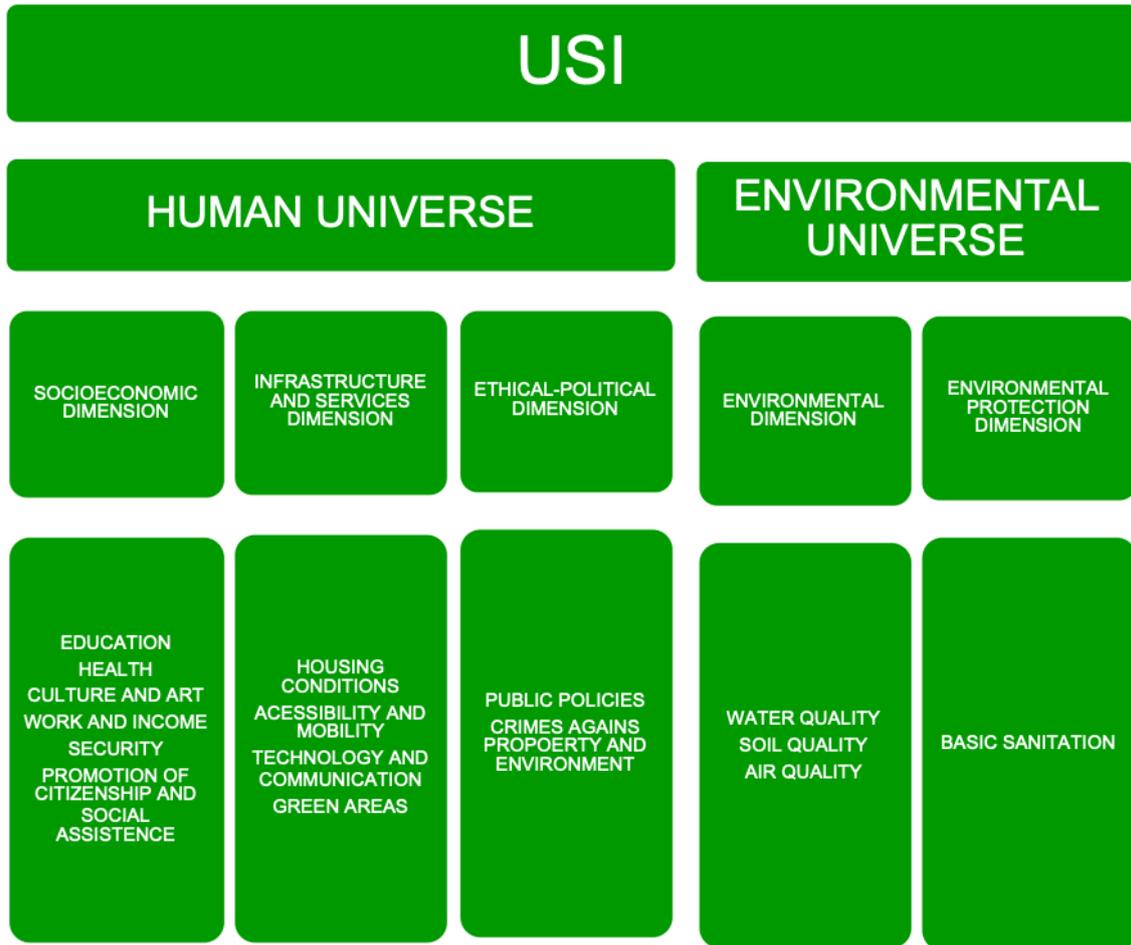
The construction of the indicator will follow the methodology applied by Pereira (2015), in which the data are statistically standardized and, later, organized and aggregated, according to common aspects, giving rise to sub-

indicators and primary indicators. The addition of primary indicators will result in different dimensions:

- Socioeconomic dimension: covers education, health, culture and art, work and income, security, and promotion of citizenship and social assistance;
- Dimension of infrastructure and services: considers housing conditions, accessibility and mobility, technology and communication, and green areas;
- Ethical-political dimension: encompasses public policies and crimes against property and environment;
- Environmental dimension: includes water quality, soil quality and atmospheric quality;
- Environmental protection dimension: covers aspects of basic sanitation (set of services, infrastructure and operationalization of water supply, sanitary sewage, urban cleaning and solid waste management, and drainage and management of urban rainwater).

The socioeconomic, infrastructure and services and ethical-political dimensions make up the Human Universe (HU), while the environmental and environmental protection dimensions complete the Environmental Universe (EU). It should be noted, according to Pereira (2015), that the term “universe” is used here only as a didactic resource, since these two aspects are inseparable. Having originated these two universes of study, from their eventual joining, the secondary indicator (USI), proposed for this study, will be derived, as shown in Figure 3.

**Figure 3 - Methodology for building the Urban Sustainability Indicator**



**Source:** Pereira (2015), adapted.

The USI index will be based on the arithmetic mean of the primary indicators belonging to the HU, plus the arithmetic mean of the indicators that make up the EU. For the formulation of the USI index equation, different weights will be assigned for each universe, being 0.6 for the HU and 0.4 for the EU, due to the number of variables analyzed, and the focus related to the social aspect, in this study. Then we have the following equation:

$$USI = 0.6HU + 0.4EU$$

The methodology for interpreting the value of the USI index remains to be defined, but it is important to emphasize that the application of the USI does not seek to measure the quality of local sustainability, but rather the level at which the variables observed in the study converge to achieve a sustainable development model, using sustainability as a process to achieve this goal.

#### 4 EXPECTED RESULTS

In short, with the application of this study is expected to verify, through the diagnosis originated by the elaboration of the USI, if the local development model promotes economic growth combined with the reduction of social exclusion, as well as contributes to the preservation and availability of natural goods.

It is also expected that the results to be obtained can serve as a source of relevant information to be used by the agencies responsible for the administration of the municipality, aiming to contribute to an improvement in the decision-making process at the strategic level, for the adoption of corrective measures in deficit areas, as well as for the creation of public policies that prioritize urban socio-environmental planning.

Furthermore, at the end of this study, it is expected to disseminate information regarding the relevance of sustainability as a process, and of sustainable development as a management paradigm.

And yet, the dissemination of the elaboration and use of sustainable indicators as tools that allow a critical and systemic analysis of phenomena, contemplating in their construction the joint participation between the public power and the community, and that from its application derive strategies that can improve the local socio-environmental conditions, and, consequently, the quality of life of the population.

## 5 CONCLUSION

The main objective from the development and subsequent calculation of the indicator is to provide the population and public authorities with information about the conditions of local sustainable development, in conjunction with the apprehensive of the process of sustainability, through the collected data.

The information obtained through the application of the indicator will be capable of measuring whether the public policies ensure the rights, access and strengthening of the qualitative conditions of education, health, culture, work, income, security, housing, accessibility, mobility, technology and communication, ethical-policies, infrastructure and services, sanitation and availability of natural resources.

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