Review

Municipal Public Budget Planning with Sustainable and Human Development Goals Integrated in a Multi-Criteria Approach

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Abstract: Government planning has a relevant role in the human development of cities, and the local public sector acts on legal regulations and budget planning to reach high levels of sustainability and human development. However, there is a gap in local governments related to the integration of decision-making preferences considering sustainability and human development in their budget planning. This work explores how the preferences of decision-makers have been considered in published research found in high-impact journals, and how they have been used in practice or not, especially in the public budget planning for the improvement of the governance of municipalities and human quality of life. The methodology integrated a literature review (by Methodi Ordinatio) with a sorting procedure (by the ELECTRE-TRI method) to categorize the selected papers, considering the level of adherence to the theme and the most relevant contributions, and also a systematic procedure organized by lenses analysis, and Simos’ procedure to define the weights for these lenses. The results that were found can help scholars to access discussions about budget planning distribution, mainly considering the aspects related to sustainable and social goals. The research also helps local public managers to make evidence-based decisions developing the city and local governance.

Keywords: public budget planning; sustainable governance; human development; indicators of sustainability; multi-criteria approach

1. Introduction

Governments play an important role in the sustainable development of cities through budget planning; however, decision maker preferences and sustainability goals are not always considered in this planning, because there is no clear understanding about decision problems, or there are not realistic or effective solutions available [1].

Da Rosa et al. [2] and Moschen et al. [3] concluded that public budget strategic distribution can promote significant developments in science and technology, and consequently in industrial structures.

The actions planned by the public sector have the potential to support decisions providing services that should be available to implement sustainable policies [4]. Government awareness becomes an important aspect to improve sustainable development processes and makes it essential to plan future activities, identify priorities, monitor progress and check the sustainability levels in the cities [5].

Raszkowski and Bartniczak [5] analyzed 57 indicators of the implementation of the 2030 Agenda Sustainable Development Goals (SDG) in Poland, and concluded that the direction of the expected changes was positive. However, among the diagnosed problems, some of them were shown to suffer impact from public budget planning and distribution, such as low incomes, government expenditure and R&D outlays in agriculture, few adults participating in education, the unfavorable ratio of disposable income in rural areas when
compared to the city, the unsatisfactory quality of the law-making, the relatively low percentage of energy from renewable sources in transport, and land requiring reclamation.

Pourshahabi et al. [6] ranked the sustainable development components that influenced and improved the development level of Sistan and Baluchestan province of Iran by using the hierarchical analysis method (AHP). The results of these ranked factors indicated that the economic dimension (public budget) had the highest effect on the improvement of the development level, and social and environmental factors were the next priorities, respectively. Therefore, according to the results, decision makers must play their role in budget planning, considering sustainable aspects to increase the development level of cities.

Thus, in order to promote sustainability in urban areas, it is necessary to involve ecological as well as social and financial aspects. The search to construct efficient solutions has become an important task for urban public policies [7]; therefore, in local governments, the integration of the sustainability concept in strategic planning to make efficient decisions is essential [4], in which it is an important dimension to promote sustainable progress for municipalities [2]. In addition, effective budget distribution planning must take into account sustainable aspects that leverage economic growth, environmental protection, social responsibility, and an efficient return of investments [8]. In this way, urban sustainability advances are also an important part of social development [9].

Over the years, sustainability has been recognized as a target to guide decision-making in all instances, mainly to preserve ecological resources [4]. However, due to the large number of factors, risks and uncertainties, it can become a barrier to the achievement of social, economic, political and environmental benefits, concomitantly [10].

In the study produced by Lin and Zhu [11], they concluded that “green economic growth” has fluctuated due to the political tournament of local governments. The search reported by De Guimarães et al. [12] considered the promotion of sustainable development as an aggregation of public resources, human capital, and communication technologies, e.g., the concept of smart cities.

Furthermore, human development is considered the core of public policies; thus, it is essential to measure the governance effectiveness. Some works have proposed indicators to measure it, such as Neumayer [13], who presented a proposal to associate the measuring of the HDI (Human Development Index) with sustainability actions. Regarding indicators associated with sustainability, Mori and Christodoulou [14] discussed the aspects and indices to measure the Ecological Footprint (EF) by using the Environmental Sustainability Index (ESI), Sustainability Dashboard (DS), Wellness Index, Genuine Progress Indicator (GPI), Wellness Index Sustainable Economic, Urban Development Index, Energy/Exergy, Environmental Vulnerability Index (EVI), Environmental Policy Index (EPI), Living Planet Index (LPI), Environmentally Adjusted Household Product (EDP), Genuine Economics (GS), and some applications of composite indices and multivariate indicators from case studies.

Costantini and Monni [15] emphasized that human development should be the first objective of public policies, as wellbeing is necessary to guide the path to sustainable management and coherent resource distribution. They also concluded that the highest level of technology can transform knowledge-based economies, which reduces the depletion and degradation of natural resources, and reinforces a virtuous cycle of economic growth and human development. In short, the millennium development goals need to be clearly integrated with human development aspects.

The economic and urban development of the current generation cannot deplete non-renewable resources and the environment, but should rather consider that the next generations will need these resources to develop their own society [5,16].

Sustainable urban development is considered to be a critical aspect of environmental protection, social cohesion and economic growth, and it is pretty essential to consider it in municipal strategy and budget planning [1].
Urban sustainability is a complex decision problem that encompasses many variables and depends mainly on the preferences of managers when they need to make decisions. Thus, the public budget is an important part as a result of prioritization and negotiation among different decision makers. However, they have limited leeway for decisions due to budget inertia. Thus, if the emphasis on municipal expenditure does not change, and the budget changes, governments will find it difficult to achieve sustainable development [17,18].

Sustainability actions require collaboration among several stakeholders and long-term, focused strategies [19]. In local public spheres, the structures that support sustainability should be part of the financial management [4].

In this study, a literature review is presented. It sought selected works in high-impact journals that described the ways in which governments consider decision makers’ preferences, and how the decisions related to the public budget were made regarding sustainability and human development planning. The research question for the gap is: What are the most adherent studies on the theme of “municipal public budget” which consider decision makers’ preferences focusing on sustainability and human development goals in the decision making process, and how is this process carried out?

This work includes an introduction section presenting the context, the gap and the theoretical foundations. In Section 2, the materials and methods used are presented, followed by the results and discussions in Sections 3 and 4, respectively. Finally, the final remarks are presented in Section 5.

2. Materials and Methods

The selection of the literature research method used to construct the theoretical foundations and the bibliographic portfolio were conducted through the analysis of some investigation methods, such as: the Management System of the Central Research Institute (MSCRI) [20], Cochrane Collaboration [21], Proknow-C [22] and Methodi Ordinatio [23].

The last one (Methodi Ordinatio) was chosen because it presents a multi-criteria approach. This method enables the ordering of scientific articles according to their relevance and impact. It also includes a protocol to rank articles by scientific relevance, through an indicator called the InOrdinatio Index, which considers the journal impact factor, the number of citations and the difference between the publication year and the research development year. The index application comprises nine phases:

1. Establishing the intention of the research: the definition of the research problem or theme.
2. Preliminary exploratory research (keywords in databases): After the research theme has been defined, the next phase is to carry out preliminary research in order to choose and test the adherence of possible keywords.
3. The definition and combination of keywords and databases.
4. Searching in the databases.
5. Filtering procedures: In this phase, the raw bibliographic portfolio is remodeled in order to exclude works that are repeated, or which do not adhere to the research theme.
6. Identifying the impact factor, year of publication and number of citations: at this stage, the data regarding the impact factor of the journal in which the work was published and the number of citations are collected. The impact factor indicates the relevance of the journal in which the work was published, and the number of citations indicates the scientific recognition of its authors [23].
7. Ranking of the papers based on the InOrdinatio Index: With data from the previous step, the Ordinatio Index (InOrdinatio) of each article is calculated, according to Equation (1):

\[
\text{InOr} = \{\text{IF/1000}\} + \{\alpha [10 - (R_y - P_y)]\} + \{N_c\}
\]

where:

\[
\alpha = \frac{1}{\text{IF}}
\]

\[
R_y = \frac{\text{year of publication}}{\text{year of research development}}
\]

\[
P_y = \text{number of citations}
\]
8. Finding the full papers: The papers are downloaded from the databases.
9. The final reading and systematic analysis of the papers: Finally, the articles selected from the bibliographic portfolio are read in full.

A summary of this stage is presented in Figure 1.

Figure 1. Structure of the methodology (Stage 1).

After finding the most relevant articles on the topic, a systemic analysis was proposed based on the results found in the selection of articles with the themes of public budget, human development and sustainability.

The systemic analysis was based on the work of Lacerda et al. [24], which sought to analyze and classify a sample of articles under the following lenses: (1) Approach, (2) Singularity, (3) Identification, (4) Measurement, (5) Integration, and (6) Management.

Thus, the existing research gaps in the literature are highlighted in this analysis, according to the theoretical affiliation adopted by the authors.

The summary of this stage is also illustrated in Figure 2.
Furthermore, in this work, the multi-criteria outranking method ELECTRE TRI was used to sort the articles based on their adherence to the theme, divided into three categories of adherence (High, Medium and Low). The ELECTRE TRI method is a multi-criterion outranking technique that allocates alternatives into predefined categories, here called the “sorting procedure”. The allocation occurs when an alternative “x” is compared with the defined profiles of the limits from the categories or boundaries $b_i$ [25,26]. It uses the concordance and discordance indices to evaluate the statement $xSb_h$ (“x outranks $b_h$”). The partial concordance $c_j(x,b_h)$, concordance $c(x,b)$ and partial discordance $d_j(x,b_h)$ are calculated by the expressions (2),(3) and (4):

\[
c_j(x,b_h) = \begin{cases} 
  0 & \text{if } g_j(b_h) - g_j(x) \geq p_j(b_h) \\
  1 & \text{if } \frac{g_j(b_h) - g_j(x)}{p_j(b_h) - q_j(b_h)} \\
  \text{otherwise} 
\end{cases}
\]

\[
c(x,b) = \frac{\sum_{j \in F} k_j c_j(x,b_h)}{\sum_{j \in F} k_j}
\]

\[
d_j(x,b_h) = \begin{cases} 
  0 & \text{if } g_j(x) \leq g_j(b_h) + p_j(b_h) \\
  1 & \text{if } g_j(x) > g_j(b_h) + v_j(b_h) \\
  \in [0,1] \text{, otherwise} 
\end{cases}
\]

An index $\sigma$ is calculated, with this being $\sigma(x,b_h) \in [0,1]$, which represents the credibility degree of the assertion in which $xSb_h$, $x \in A$, $h \in B$, as shown in Equation (5).

\[
\sigma(x,b_h) = c(x,b_h) \prod_{j \in F} \frac{1 - d_j(x,b_h)}{1 - c(x,b_h)}
\]

where $F = \{ j \in F : d_j(x,b_h) > c_j(x,b_h) \}$.

Mousseau et al. [27], presented two assignment procedures: one pessimistic, which compares x with $b_i$, to $i = p$, $p-1$, $\ldots$, $0$, $b_h$, starting with the first profile in which $xSb_h$ is the category $CL_{h+1}$ ($x \rightarrow CL_{h+1}$), and one optimistic, which compares x with $b_i$, to $i = 1$, 2,
. . . , p, bh, starting with the first profile, such that “bh is preferable to x” states the CLbh for category (x → CLbh).

The structure of the methodology developed in this work is presented in Figure 1, showing that the literature investigation was performed in Stage 1 with the Method Ordinatio; the systematic analysis was performed in Stage 2 with Lenses analysis, with the importance and the sorting procedure appearing in Stage 3 by employing Simos’ Procedure and the ELECTRE TRI method.

The Simos’ Procedure was also used in this methodology (stage 3), and was basically adapted to the ELECTRE TRI application. It provided the relative importance of each lens in order to classify the papers into the adherence classes.

The Simos’ procedure is recommended to convert the ranks into weight limits, and into the set of feasible weights, because it determines automatically the ratio between the weight of the most important criterion and the weight of the least important one in the ranking. Therefore, a complete pre-order of the whole of the n criteria is obtained. The number of ranks is n, where 1 ≤ n ≤ n. Then, it determines the importance of two successive criteria (or two successive subsets of ex aequo criteria) [28].

Simos’ procedure consists of two steps:

1. Calculate the non-normalized weights \( k = (k_1, k_2, \ldots, k_n); \) let \( e_r \) be the number of non-criteria between the ranks \( r \) and \( r + 1. \)

\[
\begin{align*}
    e_r &= e'_r + 1, \forall r = 1, 2, \ldots, \tilde{n} - 1, \\
    e'_1 &= 0
\end{align*}
\]

Next, the non-normalized k weights are calculated by Equation (7):

\[
k_r = 1 + u \sum_{i=0}^{r-1} e_i, e_0 = 0
\]

2. Calculate the normalized weights \( k^* = (k_1^*, k_2^*, \ldots, k_n^*); \) let \( c_i \) be the number of criteria in each ranking \( i, \) where 1 ≤ i ≤ \( \tilde{n}. \) The normalized weights \( k^* \) are calculated as follows in Equation (8):

\[
k^*_r = \frac{100}{\sum_{i=1}^{n} c_i k_i} \cdot k_r
\]

In addition, a normalization procedure was used as follows in Equation (9), in order to adjust the weights when the summation was > 100:

\[
w_n = \frac{k^*_r}{\sum_{r=1}^{n} k^*_r} \cdot 100
\]

Thus, it was applied according to Equations (6)–(9) and as shown in the Appendix A (Table A1). The summary of this stage is also illustrated (Figure 3).
3. Results

The instructions to perform the bibliographic resource collection were initially defined by the title, considering an unlimited period, types of review documents and original articles in the following databases: Science Direct and Scopus. It was an important phase because no relevant works were left out of the research, while works not related to the topic were not considered.

In the procedure for the combination of keywords and databases, individual and combined investigations were considered. The selection of the databases was based on knowledge areas such as Applied Social Sciences, Human Sciences (with the sub-item Political Science) and Engineering (with the sub-item Production Engineering), and Multi-disciplinary. As a result, a set of 16 bases in these knowledge areas was initially selected.

In the sequence, the databases were surveyed according to the following exclusion criteria: (i) does not support the use of Boolean expressions; (ii) does not allow the searching of the title, abstract and keywords fields; (iii) does not allow the export of results to bibliographic management software; (iv) restricts the number of articles downloaded; (v) needs special access; and (vi) is not representative of the subject of study. Finally, the bases Science Direct, Scopus, and Web of Science were selected to be included in the research.

Next, the axes and keywords were defined as follows: Budget + Public + Sustainability. Because there are several definitions for public, budget and sustainability, the terms were considered with synonyms and combinations.

In the public axis, the keywords considered were: Government*, Municipal*, Public, Poli*, Cit*, Authorit*, and Local. In the budget axis there were: Budget*, Account*, Resource*, Revenue*, Financ*, Receipt*, Council*, Expendit*, Spend*, Fund*, Allocation, and Management. In the sustainability axis, the terms Sustain* and Sustainability were
explored. The Boolean operator “AND” was used in order to consider only results with the combination of all of the words of the three axes, and the character “*” was used to cover the variations in the writing of the keywords, totaling 168 combinations.

Furthermore, the Mendeley software was used to manage the bibliographic data. Thus, the search results for the keywords in the three selected databases generated a raw bibliographic portfolio with a total of 7280 articles.

In the raw bibliographic portfolio, 3055 articles were excluded for being identified as repeated, book chapters and articles of conferences; the remaining 4225 non-repeated articles fitted into the research axes.

The publication year, impact factor of the Journal Citation Report (JCR) and Scientific Journal Rankings (SJR) portals were recorded in an electronic spreadsheet. In addition, a search in the Google Academic portal for the current number of citations of each article was performed.

As a result, all of the articles were ranked in descending order of the InOrdinatio index. Afterwards, those for which the abstract was not related to the topic were also excluded, leaving 47 articles remaining for the last analysis.

Finally, the articles selected in the bibliographic portfolio were read fully, and 15 were considered relevant and able to compose the final bibliographic portfolio.

In the sequence, the articles were ranked in descending order using the InOrdinatio Index, and those that presented an InOrdinatio index equal to or over 50 were selected. After finding the complete articles, they were ranked, and 30 papers were selected for analysis and download. Next, the final reading and systematic analysis of the works was carried out. After the reading, articles that did not have sustainability indexes or indicators in the budget were also excluded, leaving 15 articles in the final bibliographic portfolio. The results are presented in the Appendix A (Table A2).

3.1. Systemic Analysis

Lacerda et al. [24] recommend to evidence, in a sample of articles, each classification lens according to the theoretical affiliation adopted by the author, in order to find out the existing research gaps from the literature review.

Next, the 15 articles that made up the final bibliographic portfolio shown in the Appendix A (Table A3) were analyzed and classified according to the relevant lenses in the systematic analysis.

3.1.1. Approach Lens

The public budget and sustainability approach sought to identify the theoretical affiliation of the studies analyzed.

From the 15 articles in the final portfolio, according to the approach lens analysis, only two were built in one environment, and adapted and applied in another; two were built in one context and applied in another; and one was built and applied in the same context. Finally, only one article was built in an environment, but was not applied.

3.1.2. Singularity Lens

This lens verifies whether the problem in question is unique and in accordance with the values of the decision maker’s preferences.

The singularity lens allows the decision process to consider the decision maker’s values and preferences, thus creating alignment, coherence and assertiveness in the choices made; see Lacerda et al. [24].

Of the 15 articles analyzed, one article identified the decision maker, but did not consider preferences; one article explained the decision maker’s impact and took into account preferences, and 13 did not identify the decision maker or the preferences.

In the analysis of this lens, there is a research gap related to the values of decision makers, and thus in the ability to build the decision matrix and apply multi-criteria
methods to find the best budget allocation according to the preferences of decision makers and stakeholders.

3.1.3. Identification Lens

This lens analysis shows the relationship level that the articles had to the recognition of knowledge and decision maker limits.

According to the analysis of this lens, none of the articles identified the objectives partially or fully based on the decision maker’s values.

For the development of new research, knowledge limits must be recognized with the criteria definitions, not only with the identification of these elements but also with the recognition of the barriers to their application in sustainable projects.

3.1.4. Measurement Lens

According to Lacerda et al. [24], this lens evaluates the measurement performance in: (a) the number of articles in which the scales can represent all of the properties for the measurement; (b) the number of articles in which the scales cannot represent any of the properties of the measurement.

From the articles analyzed, 12 perform the measurement process according to ordinal scales, and three articles do not perform measurement according to any scale. As a research opportunity, it is possible to list the frameworks that use multi-criteria methods in budget distribution priorities, and that use them to form ordinal and cardinal measurement scales.

3.1.5. Integration Lens

The process to determine budget performance by determining the compensation rates for each distribution is analyzed in this lens.

The integration process depends on a solid measurement of the elements studied. In the Integration Lens, five of the 15 articles analyzed did not carry out any descriptive or graphical integration process, and 10 articles carried out integration with diagnoses and compensation rates.

3.1.6. Management Lens

The last lens analyzed seeks to confirm whether the knowledge generated by the study allows the manager to know the current situation and develop improvement initiatives according to the deficiencies found.

The possibility of management configures itself as a point of relevant importance, due to the possibility of identifying points for improvement and drawing up actions for the execution of effective plans for the development of needs [22,29]. Of the 15 articles analyzed, only one article did not allow the assessment of strengths and weaknesses.

In the sequence of the systematic lens analysis, the lenses were considered criteria in a sorting procedure for the ELECTRE TRI multi-criteria method. In order to define the weights for these criteria, Simos’ procedure was used. Before that, the systematic analysis was summarized, in which an assessment was performed ascribing a value to the occurrences. Those with positive aspects were scored (2) points; occurrences with partial aspects were scored (1) point, and occurrences with negative aspects were scored (0). This procedure was adopted in order to recognize the occurrence of articles from the lens analysis with adherence (positive aspects) in order to identify their importance level (weights).

Thus, we considered the maximum level of occurrences of each criteria (lens) with positive aspects in order to determine the weights. The calculations are illustrated in the Appendix A (Table A3). Considering that ELECTRE methods use a non-compensatory approach in these constructions, Simos’ procedure was used to calculate the weights [28]. These results are presented in the Appendix A (Tables A1 and A4). After the weights’ definition, adherence classes were defined for the sorting procedure, as well as the limits for these classes, which are also presented in the Appendix A (Table A5). Then, the
ELECTRE TRI method was applied, generating the results presented in the Appendix A (Table A6). It also presents a column containing InOrdinatio Index values, the sum of the positive aspects and contributions of the analyzed papers, in order to compare the sorting procedure results. The main objective of this sorting was to find articles with a high adherence to the theme, and to classify them in the high-adherence class.

4. Discussion

According to the sorting results, some of the articles were classified into the high-adherence class, and the authors in this class presented discussions about social productivity development from budget distribution to promote advances in science and technology, and industrial structures to accommodate these changes, e.g., Paper 9 (the high-adherence class) [30].

Also, sustainability has become fundamental to government policies, research projects, corporate strategies, among others, according to paper 1 (classified in the high-adherence class) [31].

Sustainable development can be defined as the integration of economic growth, the protection of natural capital and the promotion of social justice. In other words, sustainable economic development should not deplete non-renewable resources or harm the environment, but rather should consider that the next generation will need the resources to develop, representing a concept of intergenerational justice. In this case, intergenerational justice should not limit the chances of the next generation, and current problems should be resolved in a way that guarantees sustainable materials, social and environmental bases for further development; see Paper 2 (medium-adherence class) [5]. Thus, in this concept there are costs related to projects of natural capital protection and the promotion of social justice in order to generate benefits for the next generations.

Complementing this concept set out by the World Commission on Environment and Development, the sustainability goals of a city are also planned to achieve the harmonious development of the urban economy, population, resources and environment; see Paper 3 (high-adherence class) [32]. This development of the urban economy can be seen in the studies reported by Pourshahabi et al. [6], and Amin and Tamima [33], referring to the positive effects motivated by the efficient allocation of public resources, thus contributing to the literature on this subject.

Therefore, those authors pointed out that an integrated and harmonious development of the urban economy should involve the management of costs in order to generate benefits and advances in science and technology, with industrial structures to accommodate these changes.

4.1. Municipal Budget, Costs and Sustainability

Integrated with the strategy, budget planning is an important factor to promote projects and actions that enable sustainable urban development. Budgets are the result of prioritization and negotiation between different ministries; however, they have limited leeway for decisions due to budget inertia. Thus, if the emphasis of municipal spending does not change, governments will find it difficult to guarantee sustainable development; see Paper 11 (medium-adherence class) [17].

Paper 4 (high-adherence class) [9] highlighted that the assessment of sustainability is an important aspect of the city.

Paper 7 (high-adherence class) [2] reported that an adequate municipal structure and better-trained staff are essential to generate sustainable development. With regard to the budget and cost management, the population thinks that environment protection is the government’s responsibility, and is more likely to support spending on the environment in higher-quality governments.

Various others scholars (e.g., [34–36]) agree that in an issue such as sustainability, indicators can be adequate to guide the main efforts in the management of the environment and society.
These results are different from those reported by Chen et al. [37], mainly in recognizing that sustainability assessment is an important aspect of a city’s development, and in verifying that the promotion of sustainable environmental development is also a responsibility of the population in joint with the local government.

4.2. Systematic Analysis of the Lenses

This research pointed out the possibility of recognizing some research gaps. In the lens analysis approach, we observed that most of the articles did not develop models that could be used in various contexts, with these being built for specific environments. In this aspect, it is a gap related to the construction of models that cover various contexts. Furthermore, when considering that the global sustainability indicators and indices have standard values, they could be used to generalize in various contexts.

In the singularity and identification lenses, it became evident that the decision maker’s opinions were not considered in the models. Thus, considering that in public budget planning processes, the government manager is not the one who decides, it is prudent that the decision makers involved be consulted for the application of the models.

The measurement, integration and management lens analyses revealed that although some articles use scales to integrate criteria and analyze the budget weaknesses and strengths, they do not use these metrics for distribution. Thus, there is a deficiency in the offering of a model that enables decision-making by the public manager to distribute the budget, considering sustainable indicators.

The integrated lens analysis created the possibility to find the essential elements from the 15 explored articles in the bibliographic portfolio, as well as to identify the research opportunities of these studies. The possibilities for the identification of new research and adherences are sufficient to identify the strengths and weaknesses for public budgeting and sustainability.

This approach using the six lenses of systematic analysis found in Lacerda et al. [22] and Lacerda et al. [24] provided unprecedented results in the public budget theme. The simultaneous use of these methodologies proposed by Pagani et al. [23] and Lacerda et al. [24] enabled the identification of the most relevant studies on the theme, as well as relevant characteristics through the systematic analysis.

4.3. Contributions from Papers with High Adherence to the Theme

Finally, in the Appendix A (Table A6), the global results are presented along with a summary of the main contributions found for each article that makes up the bibliographic portfolio.

4.4. Sorting Procedure—ELECTRI TRI Method

The sorting procedure considered the weights of the lenses, as defined by Simos’ procedure, three classes of adherence, and their limits. The results found in the high-adherence class drove a deeper analysis into articles that discussed similar and adherent themes, enabling the recognition of gaps to be explored in future works. The ELECTRE TRI method was chosen because it is a non-compensatory multi-criteria method, attending the main characteristics of this research to sort the articles adequately.

5. Final Remarks

This study presented a literature review that demonstrates how governments consider decision making preferences towards sustainability and human development in their budget planning and distribution. In this way, the research can help scholars, decision makers, public managers, and professionals to understand how to improve decision-making in the public budget distribution, in order to achieve sustainability and human development, which could also benefit future generations.

The research was developed based on a bibliographic portfolio composed of 15 articles from journals with a high impact factor and a systematic analysis that evidenced the use of
different aspects for the planning of the local public budget. This allowed the development of an in-depth analysis with lenses focused on strategic elements of existing studies and the identification of other research gaps.

The limitation of this study concerns the small number of articles analyzed. However, this is justified by the strict focus adopted, which explored high-impact journals on sustainability and decision making aspects as integrated themes. In addition, articles that demonstrate sustainability in the planning of municipalities generally address it qualitatively and do not relate the budget to metric analysis, such as sustainability and human development indicators.

The sorting procedure performed by the ELECTE TRI method’s application and based on the weights defined by Simos’ procedure provided a view of the articles classified in classes of adherence to this theme in order to recognize the decision making aspects bringing contributions, like the recognition of gaps that could be considered for new studies.

Some gaps are related to the recognition of the decision makers’ preferences and the lack of suitable measurement systems in the models studied, and point out new directions for the development of research that is more adherent to this theme.

Thus, we can conclude that there is a deficiency in the offering of a model that fully considers decision making preferences, and how to distribute the budget in order to consider sustainable indicators. Considering the models found in the literature review, this study intends to fill the gap related to making sustainable decisions for the allocation of municipal public resources, as follows:

(a) The use of values reported by decision makers (municipal manager and population) in the construction of a decision matrix and the application of multi-criteria methods to find the best budget allocation according to these stakeholders’ preferences. The biggest challenge is the use of the opinion of the decision makers, who are representatives of the population, without political or personal interests. Considering methodologically efficient tools and scientifically strong factors for decision-making is fundamental for the achievement of the municipality’s growth and wellbeing goals. In this sense, the multi-criteria approach can offer great advantages by satisfactorily weighting the involved parts favoring the main objective.

(b) The recognition of the decision makers’ knowledge limits and aligning the recognition of these limits for application in popular participatory budget projects. The inclusion of participatory budgeting in municipalities’ decision-making encourages the creation of laws so that the population is also included, and public budget decision-making models can be developed efficiently.

(c) The development of structures that use multi-criteria methods to choose budget distribution priorities, and that use statistical elements by ordinal and cardinal measurement scales. Thus, managers could control the budget distribution and the economic crises that lead to the scarcity of resources. Multi-criteria models are recommended for their ability to integrate factors and consider several alternatives in the budget distribution problem.

The actions performed by the public management have the potential for implementation and collaboration with the goals of human and sustainable development. Thus, the planning of the actions performed by this sector has a great impact on what the environment will be like for all beings. For this, it is necessary to identify the decision makers’ preferences in order to improve the level of sustainability of cities. Thus, this work sought works selected from high-impact journals that reported how decisions related to public budget planning for sustainability and human development are made.

We believe that the article meets the sustainability purpose by providing an interdisciplinary study that encompasses the environmental, economic and social sustainability of human development. Furthermore, it is known that the discussion on sustainable development must be academic, must have robust and appropriate tools to deal with an issue as complex as this one, and must have great notoriety among cities. The article should be
used by researchers interested in sustainable human development, as well as by managers seeking to support decisions relating to public budget management. Furthermore, the identification of opportunities for the development of new research becomes an important result of this study to help and expand the limits of science.

**Author Contributions:** S.S.T. conceptualized the study. F.T. assisted in the methodology. The analysis was executed by S.S.T., F.T. and M.L. The validation was performed by S.S.T., M.L. and F.T. The original draft was written by S.S.T. and F.T. The review and editing were carried out by F.T. and S.S.T. All authors have read and agreed to the published version of the manuscript.

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## Appendix A

**Table A1.** Final bibliographic portfolio.

| Paper | (Titles/Journals/Authors) | Impact Factor | Quantity of Citations | InOrdinatio Index |
|-------|----------------------------|---------------|-----------------------|-------------------|
| 1     | • A comparison of environmental and energetic performance of European countries: A sustainability index.  
      • Renewable and Sustainable Energy Reviews  
      • Cucchiella, F., D’Adamo, I., Gastaldi, M., Koh, S.L. and Rosa, P., 2017 [31] | 10.56         | 40                    | 110               |
| 2     | • On the road to sustainability: Implementation of the 2030 Agenda sustainable development goals (SDG) in Poland  
      • Sustainability (Switzerland)  
      • Raszkowski, A. and Bartniczak, B., 2019 [5] | 2.592         | 6                     | 96                |
| 3     | • Evaluation of city sustainability using the deviation maximization method  
      • Sustainable Cities and Society  
      • Yi, P., Dong, Q. and Li, W., 2019 [32] | 1.777         | 5                     | 95                |
| 4     | • Assessment of city sustainability using MCDM with interdependent criteria weight  
      • Sustainability (Switzerland)  
      • Yi, P., Li, W. and Zhang, D., 2019 [9] | 2.592         | 3                     | 93                |
| 5     | • The importance of the public sector in sustainable development in Poland  
      • Sustainability (Switzerland)  
      • Alinska, A., Filipiak, B.Z. and Kosztowniak, A., 2018 [8] | 2.592         | 13                    | 93                |
| 6     | • Urban ecological efficiency and its influencing factors—a case study in Henan Province, China  
      • Sustainability (Switzerland)  
      • Liu, T., Li, J., Chen, J. and Yang, S., 2019 [38] | 2.592         | 2                     | 92                |
Table A1. Cont.

| Paper | (Titles/Journals/Authors)                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Impact Factor | Quantity of Citations | InOrdinatio Index |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|-------------------|
| 7     | • Effect of using public resources and training for the sustainable development of Brazilian municipalities  
• Environmental Monitoring and Assessment  
• da Rosa, F.S., Lunkes, R.J. and Saviatto, K., 2019 [2]                                                                                                                                                                                                                                                                                                                                                                             | 1.687         | 1                     | 91                |
| 8     | • Sustainable development of communities: ISO 37120 and UN goals  
• International Journal of Sustainability in Higher Education  
• Moschen, S.A., Macke, J., Bebber, S. and Benetti Correa da Silva, M., 2019 [3]                                                                                                                                                                                                                                                                                                                                                           | 1.123         | 1                     | 91                |
| 9     | • Evaluation of city sustainability from the perspective of behavioral guidance  
• Sustainability (Switzerland)  
• Zhou, Y., Li, W., Yi, P. and Gong, C., 2019 [30]                                                                                                                                                                                                                                                                                                                                                                         | 2.592         | 0                     | 90                |
| 10    | • Measuring the sustainability of Latin American capital cities  
• World Journal of Entrepreneurship, Management and Sustainable Development  
• Coronado, F., 2019 [39]                                                                                                                                                                                                                                                                                                                                                                                                               | 0             | 0                     | 90                |
| 11    | • Municipal financing for sustainable development: A case of South Africa  
• Local Economy  
• Hendriks, C.J., 2018 [17]                                                                                                                                                                                                                                                                                                                                                                                                               | 0.455         | 1                     | 81                |
| 12    | • Prioritizing the sustainable development components to improve the level of development with analytical hierarchy process (Case study: Sistan and Baluchestan Province of Iran)  
• Journal of Economic Cooperation and Development  
• Pourshahabi, V., Pourkiani, M., Roodi, M.Z. and Sheikh, A., 2018 [6]                                                                                                                                                                                                                                                                                                                                                   | 0.112         | 0                     | 80                |
| 13    | • Assessment of sustainable development: A case study of Wuhan as a pilot city in China  
• Ecological Indicators  
• Chen, X., Liu, X. and Hu, D., 2015 [37]                                                                                                                                                                                                                                                                                                                                                                                  | 3.898         | 26                    | 76                |
| 14    | • Comprehensive evaluation of resource-exhausted city sustainable development: A case of Huangshi in Hubei Province  
• RISTI—Revista Iberica de Sistemas e Tecnologias de Informação  
• Liu, C., 2016 [40]                                                                                                                                                                                                                                                                                                                                                                           | 0.217         | 0                     | 60                |
| 15    | • Spatial pattern of Sustainable urban Development indicator for the Montreal urban community  
• Journal of Architecture and Urbanism  
• Amin, S.R. and Tamima, U., 2015 [33]                                                                                                                                                                                                                                                                                                                                                                                   | 0.162         | 2                     | 52                |

Source: Survey data, February 2021.
Table A2. Papers' assessment for the weight calculation and sorting procedure.

| Papers/Authors | SUM of Values | Lens APPROACH | Lens SINGULARITY | Lens IDENTIFICATION | Lens MEASUREMENT | Lens INTEGRATION | Lens MANAGEMENT |
|----------------|---------------|---------------|------------------|---------------------|-----------------|-----------------|----------------|
| 1. Cucchiella, et al., 2017 [31] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 2. Raszkowski, A. and Baranticzak, B., 2019 [5] | 6 2 0 0 2 0 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 3. Yi, P., Dong, Q. and Li, W., 2019 [32] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 4. Yi, P., Li, W. and Zhang, D., 2019 [9] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 5. Alinska, A., Filipiak, B.Z. and Kosztowniak, A., 2018 [1] | 7 2 1 0 2 0 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 6. Liu, T., Li, J., Chen, J. and Yang, S., 2019 [31] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 7. da Rosa, F.S., Lunkes, R.J. and Saviatto, K., 2019 [2] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 8. Moschen, et al., 2019 [3] | 0 0 0 0 0 0 0 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 9. Zhou, Y., Li, W., Yi, P. and Gong, C., 2019 [30] | 7 1 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 10. Coronado, F., 2019 [39] | 4 2 0 0 0 0 0 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 11. Hendriks, C.J., 2018 [17] | 4 2 0 0 0 0 0 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 12. Poursahabadi, et al., 2018 [6] | 12 2 2 2 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 13. Chen, X., Liu, X. and Hu, D., 2015 [37] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 14. Liu, C., 2016 [40] | 7 1 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |
| 15. Amin, S.R. and Tamima, U., 2015 [33] | 8 2 0 0 2 2 2 | 1 2 3 4 1 2 3 1 2 3 1 2 1 2 1 2 |

Number of occurrences (papers in lenses) 12 2 0 1 1 1 13 1 0 14 12 3 10 5 14 1

Percentage (%) = Number of occurrences/Total of papers 80 13 0 7 7 7 86 7 0 93 80 20 67 33 93 7

Maximum percentage for the positive aspect (%)—Criterion 1 80.0% 7.0% 7.0% 80.0% 67.0% 93.0%

Source: Survey data, June 2021/Scale for the assessment values: Value (2) = Positive aspect; Value (1) = Neutral aspect; Value (0) = Negative aspect.

Table A3. Simos’ matrix for weight calculation and adjustments.

| Rank (r) | Criteria in the Rank (r) | Number of Criteria According to Rank (r) | Positions (e_r) | Non-Normalized Weights (k_r) % | Normalized Weights (k_r * e_r) % | Total (k_r * e_r) % | Adjustment (w_a) % |
|----------|--------------------------|------------------------------------------|-----------------|-------------------------------|-------------------------------|-------------------|------------------|
| 1        | 1,4,5,6                  | 4                                        | (1+2+3+4+5+6+7) | 6.00                          | 0.47                          | 1.41              | 1.39             |
| 2        | 1,4,6                    | 3                                        | (5+6+7)       | 9.50                          | 0.75                          | 2.98              | 2.93             |
| 3        | 1,4,5,6                  | 4                                        | (8+9+10+11)   | 13.50                         | 1.06                          | 4.24              | 4.17             |
| 4        | 1,4,5,6                  | 4                                        | (12+13+14+15) | 16.67                         | 1.31                          | 3.92              | 3.86             |
| 5        | 1,4,6                    | 3                                        | (16+17+18+19) | 20.50                         | 1.61                          | 4.33              | 4.32             |
| 6        | 1,4,5,6                  | 4                                        | (23+24+25+26) | 24.50                         | 1.92                          | 7.69              | 7.56             |
| 7        | 1,4,5,6                  | 4                                        | (27+28+29+30) | 29.00                         | 2.27                          | 6.82              | 6.71             |
| 8        | 4,5,6                    | 3                                        | (31+32+33)   | 31.50                         | 2.47                          | 4.94              | 4.86             |
| 9        | 1,4,5,6                  | 4                                        | (33+34+35)   | 33.50                         | 2.63                          | 5.25              | 5.17             |
| 10       | 1,4,5,6                  | 4                                        | (35+36+37+38+39+40+41) | 37.50 | 2.94 | 17.65 | 17.36 |
| 11       | 1,4,5,6                  | 4                                        | (41+42+43+44+45+46) | 42.50 | 3.33 | 13.33 | 13.12 |
| 12       | 1,4,5,6                  | 4                                        | (45+46+47+48+49+50) | 49.00 | 3.84 | 15.37 | 15.12 |
| 13       | 1,4,5,6                  | 4                                        | (50+51+52)   | 51.00                         | 3.84                          | 15.37             | 15.12            |

Sum of Positions 1275 101.65 100.00

Legend: (1) Approach, (2) Singularity, (3) Identification, (4) Measurement, (5) Integration, (6) Management.
Table A4. Adjusted weights ($w_n$).

| Legend          | $(k^*_n)\%$ | $(w_n)\%$ |
|-----------------|-------------|-----------|
| Approach        | 1           | 22.16     | 21.88 |
| Singularity     | 2           | 2.89      | 2.86  |
| Identification  | 3           | 2.89      | 2.86  |
| Measurement     | 4           | 22.93     | 22.64 |
| Integration     | 5           | 22.47     | 22.18 |
| Management      | 6           | 27.94     | 27.59 |

Table A5. Parameters for the boundaries between the classes—ELECTRE TRI.

| Classes         | Adherence | Border | Approach | Singularity | Identification | Measurement | Integration | Management | Sum |
|-----------------|-----------|--------|----------|-------------|----------------|-------------|-------------|------------|-----|
| $Class_1$       | High      | $b_1$  | 3        | 2           | 2              | 3           | 2           | 3          | 101.29 |
| $Class_2$       | Medium    | $b_2$  | 1        | 1           | 1              | 1           | 1           | 1          | 100.00 |
| $Class_3$       | Low       | $b_3$  | 0        | 0           | 0              | 0           | 0           | 0          | 100.00 |
| Number of Occurrences | 12     | 1      | 1        | 12          | 10             | 14          | 50          |            |
| Weights ($w_n$) | by Simos’ procedure | 21.88% | 2.86%   | 2.86%       | 22.64%         | 22.18%      | 27.59%      | 100%       |

Table A6. Results of the sorting from the ELECTRE TRI method and contributions.

| Papers | Pessimist Sorting | Optimist Sorting | Level of Adherence | SUM (Table A2) | Ordinatio Index | Contributions |
|--------|-------------------|------------------|--------------------|-----------------|-----------------|---------------|
| 1      | Class C           | Class A          | High               | 8               | 110             | It assessed the sustainability performance and presented a comparison among European countries from the environmental and energy perspectives using Eurostat and Analytical Hierarchy Process (AHP) method. |
| 2      | Class C           | Class B          | Medium             | 6               | 96              | It assessed the sustainability of 17 cities in Shandong Province, China. A set of 21 indicators was selected from the economic, social and environmental dimensions. The criteria weights were calculated using the deviation maximization (DM) method to highlight the overall difference between the alternatives |
| 3      | Class C           | Class A          | High               | 8               | 95              | It investigated the sustainability of 13 cities in the Capital Economic Circle using three dimensions: economy, society and environment. The Induced Ordered Weighted Average (IOWA) operator was used for aggregation of criteria |
| 4      | Class C           | Class A          | High               | 8               | 93              | It provided a method for the quantitative study of sustainable urban development, and also provided some decision-making references for improving urban ecological efficiency in Henan Province |
| 5      | Class C           | Class B          | Medium             | 7               | 93              | It analyzed the effects of the public resources uses and training for the sustainable development in Brazilian municipalities using structural equation modeling method with PLS (Partial Least Squares) |
| 6      | Class C           | Class A          | High               | 8               | 92              | |
| 7      | Class C           | Class A          | High               | 8               | 91              | |
| 8      | Class C           | Class C          | Low                | 0               | 91              | |
Table A6. Cont.

| Papers | Pessimist Sorting | Optimist Sorting | Level of Adherence | SUM (Table A2) | Ordinatio Index | Contributions |
|--------|-------------------|------------------|--------------------|----------------|-----------------|---------------|
| 9      | Class C           | Class A          | High               | 7              | 90              | It incorporated the behavior of decision makers into a model and proposed a weighting method, considering the distribution of data to guide cities to develop the goals established for sustainability. The model was applied in 14 cities in Liaoning, China from 2015 to 2017 |
| 10     | Class C           | Class B          | Medium             | 4              | 90              |               |
| 11     | Class C           | Class B          | Medium             | 4              | 81              | It identified and prioritized the components of sustainable development that influenced and improved the level of development in a case study of provinces in the Iran, using the hierarchical analysis method (AHF) |
| 12     | Class B           | Class A          | High               | 12             | 80              |               |
| 13     | Class C           | Class A          | High               | 8              | 76              | It assessed the performance of Sustainable Objectives from 2005 to 2012, considering a pilot Sustainable Objective construction city in China-Wuhan. |
| 14     | Class C           | Class A          | High               | 7              | 60              | It analyzed the key components of sustainable development in the city of Huangshi, a resource-depleted city in Hubei province between 2000 and 2014 |
| 15     | Class C           | Class A          | High               | 8              | 52              | It proposed a Sustainable Urban Development Indicator (SUDI) for each urban community of Montreal to assess sustainable development plans |

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