



Environmental and sustainability aspects in public procurements: perceptions of the Brazilian public sector

Aspectos ambientais e de sustentabilidade nas contratações públicas: percepções do setor público brasileiro

Jefferson Alves LOPES^{1*}, Armando Azevedo CALDEIRA-PIRES¹

¹ University of Brasilia (UnB), Brasília, DF, Brasil.

* Contact email: jeffersonalvesengenheiro@gmail.com

Article received on April 2, 2022, final version accepted on June 21, 2023, published on November 24, 2023.

ABSTRACT: In general, government procurement accounts for between 10% and 16% of a country's gross domestic product (GDP), making it an important part of the economy. Therefore, government procurement policies should be discussed in terms of sustainable consumption and production patterns. However, imprecision and lack of clarity regarding environmental and sustainability aspects are often seen as obstacles to their advancement. In this study, an exploratory factor analysis (EFA) is used to evaluate the perceptions of public servants working in Brazilian government bidding and contracting departments on issues related to the inclusion of environmental and sustainability aspects in public procurement procedures. Five key factors were identified – “Perspective,” “Legal and Institutional Support,” “Market Relations,” “Acquisition Costs,” and “Public Servant Participation” – of which the latter factor emerged as the most relevant according to hierarchical evaluation. In this way, the participation of public servants in this debate, associated with professional training and improvement courses, is a fundamental condition for the success of the policies proposed.

Keywords: sustainable public procurement; green public procurement; sustainable consumption and production patterns; environmental labeling.

RESUMO: De forma geral, as contratações governamentais possuem grande relevância na economia do país, representando entre 10% e 16% do Produto Interno Bruto (PIB) nacional. Assim, torna-se pertinente estimular a incorporação de padrões de produção e consumo sustentáveis no âmbito das políticas de compras do governo. No entanto, a imprecisão e a falta de clareza em relação aos aspectos ambientais e de sustentabilidade são, muitas vezes, consideradas como grandes barreiras ao seu avanço. Este estudo utilizou a Análise Fatorial Exploratória (AFE) para avaliar a percepção de servidores públicos que atuam nos departamentos de licitações e contratos de diversos órgãos do Governo Federal brasileiro sobre temas relacionados à inclusão de aspectos

ambientais e de sustentabilidade nos processos de licitações públicas. Nesta pesquisa, cinco fatores-chave foram identificados – “Perspectiva”, “Apoio Legal e Institucional”, “Relações com o Mercado”, “Custos de Aquisição” e “Participação do Servidor Público” – sendo este último considerado o mais relevante, de acordo com a avaliação hierárquica. Dessa forma, a participação dos servidores públicos nesse debate, vinculada a cursos de capacitação e de aperfeiçoamento profissional, mostrou-se como ponto fundamental para o êxito dessas políticas de contratações propostas.

Palavras-chave: contratações públicas sustentáveis; contratações públicas verdes; padrões de produção e consumo sustentáveis; rotulagem ambiental.

1. Introduction

In general, government purchases account for between 10% and 16% of a country’s gross domestic product (GDP) (Palmujoki *et al.*, 2010; Betiol *et al.*, 2012; Lundberg & Marklund, 2013; Zhu *et al.*, 2013), and constitute a significant part of the economy. Delmonico *et al.* (2018) found that public sector purchases in Brazil represent about 15% of the country’s GDP. Cheng *et al.* (2018) have pointed out that the public sector can influence procurement with a focus on the environment by creating appropriate policies and leveraging “green” markets through sizable public purchases.

Green Public Procurement (GPP) and Sustainable Public Procurement (SPP) have been highlighted as key components in promoting sustainable consumption and production patterns, as noted by Biderman *et al.* (2006), Nissinen *et al.* (2009), Preuss (2009), Walker & Brammer (2009), Bratt *et al.* (2011), Testa *et al.* (2012), Uttam *et al.* (2014), Pacheco-Blanco & Bastante-Ceca (2016), Rainville (2017), Cheng *et al.* (2018), Delmonico *et al.* (2018), and Silva *et al.* (2018).

Several studies (Nissinen *et al.*, 2009; Testa *et al.*, 2012; Fuentes-Bargues *et al.*, 2017; Alhola *et al.*, 2018) have pointed out the use of environmental criteria in government procurement, especially given the imprecision and lack of clarity. Therefore,

to strengthen the objectivity of environmental and sustainability aspects in Green Public Procurement and Sustainable Public Procurement, some studies have supported the use of environmental labeling to support the formulation of conditioning factors and technical specifications in such innovative procurements.

Uttam *et al.* (2014) note that transforming Green Public Procurement into sustainable public procurement holds challenging promises with in terms of linking acquisitions in building sustainable development. The authors also warn that because Green Public Procurement has been expanding to Sustainable Public Procurement in several countries will require a paradigm shift in planning for its expansion.

In Brazil, the advancement of Sustainable Public Procurement has gained legal and regulatory support, mainly through the Bidding and Contracts Federal Law no. 8,666 of June 21, 1993, some parts of which were later amended by Federal Law no. 12,349 of December 15, 2010, which lists the promotion of sustainable development among the objectives to be achieved in public procurement in Brazil. Federal Decree no. 7,746, dated June 5, 2012, regulated this issue, by establishing criteria and practices to promote sustainable national development in hiring carried out by the Federal Government. Furthermore, Federal Law no. 14,133

of April 1, 2021 – commonly referred to as the new Bidding and Contracts Law – maintained, in its article dedicated to principles, sustainable national development as one of the pillars to be observed in bidding processes related to public procurement.

In developing countries like Brazil, public sector budget constraints are often regarded as the biggest barrier to developing innovative Green Public Procurement policies, as described by Cheng *et al.* (2018) and Mungkung *et al.* (2018). However, to better evaluate the application of and possible advances in Sustainable Public Procurement in the country, it is also essential to analyze other parameters, such as national legal protection on the subject, and the level of preparation of public servants who work directly procurement in the respective government agencies.

In this context, the question this research aims to answer is: What parameters can be identified in a hierarchical manner, can be identified to evaluate the main points that interfere in the application of environmental and sustainability aspects in public procurement procedures, according to public servants working in the Federal Government?

The objective of this study is to evaluate the perceptions of public servants working in the bidding and contracts departments of various Federal Government bodies with regard the inclusion of environmental and sustainability aspects in public procurement procedures, knowledge of Sustainable Public Procurement, sustainable consumption and production patterns, and environmental labeling. First, the study develops a theoretical structure based on sustainable consumption and production patterns, before discussing concepts related to Green Public Procurement and Sustainable Public Procurement, both of which include environmental

criteria into their decision making. Then, it develops a theoretical framework based on sustainable consumption and production patterns, mainly drawing on Brammer & Walker's (2011) conceptual model of influences on Sustainable Public Procurement. This conceptual analysis is exemplified using an embedded case study that applies exploratory factor analysis (EFA) to the responses of the civil servants working in different Federal Government agencies regarding the issues listed above, as well as their reflections on these policies on changes in production and consumption patterns in Brazil.

2. Theoretical contextualization

The concept of sustainable consumption was presented in the Marrakech Process, a set of programs adopted at the World Summit on Sustainable Development in 2002. It was subsequently emphasized in the UN Agenda 2030 to stimulate changes in consumption and production patterns globally, especially in the 17 Sustainable Development Goals (SDGs), of which Goal 12 highlight these patterns, including in the public sector.

Previous studies have defined different approaches to the incorporating environmental concepts into government purchases, resulting in the terms Green Public Procurement and Sustainable Public Procurement. Alhola *et al.* (2018) have shown that the underlying mechanisms lead to the establishment and identification of environmental criteria in the bidding processes related to public procurement. The literature distinguishes between initiatives that incorporate the sustainability triad of – economic, social, and environmental aspects – which it considers Sustainable Public Procurement (Biderman *et*

al., 2006; Preuss, 2009; Walker & Brammer, 2009; Silva *et al.*, 2018), and initiatives that highlight only environmental aspects, which it calls Green Public Procurement (Bouwer *et al.*, 2005; Testa *et al.*, 2012; Lundberg & Marklund, 2013; Cheng *et al.*, 2018; Liu *et al.*, 2018). Cheng *et al.* (2018) have emphasized that although different terms are used by different countries, the main ideas of a political tool focused on demand for using public procurements in order to achieve desirable environmental goals and promote green services and products.

Debates on Green and Sustainable Public Procurements have also been developed in connection with the “green economy” (Betiol *et al.*, 2012; United Nations Department of Economic and

Social Affairs, UNDESA, 2012) and the “circular economy” (Witjes & Lozano, 2016; Alhola *et al.*, 2018; Mungkung *et al.*, 2018).

In the context of sustainable procurement, Brammer & Walker (2011) have developed a conceptual model, adapted from Gelderman *et al.* (2006), which presents four influences on government sustainable procurement practices, as shown in Figure 1. Brammer & Walker (2011) argue that such a proposal provides a useful framework for examining how public procurement policy translates into practice. The present article uses this model as a guide regarding the main facilitating and inhibiting aspects that interfere with the application of environmental and sustainability aspects in public procurement procedures.

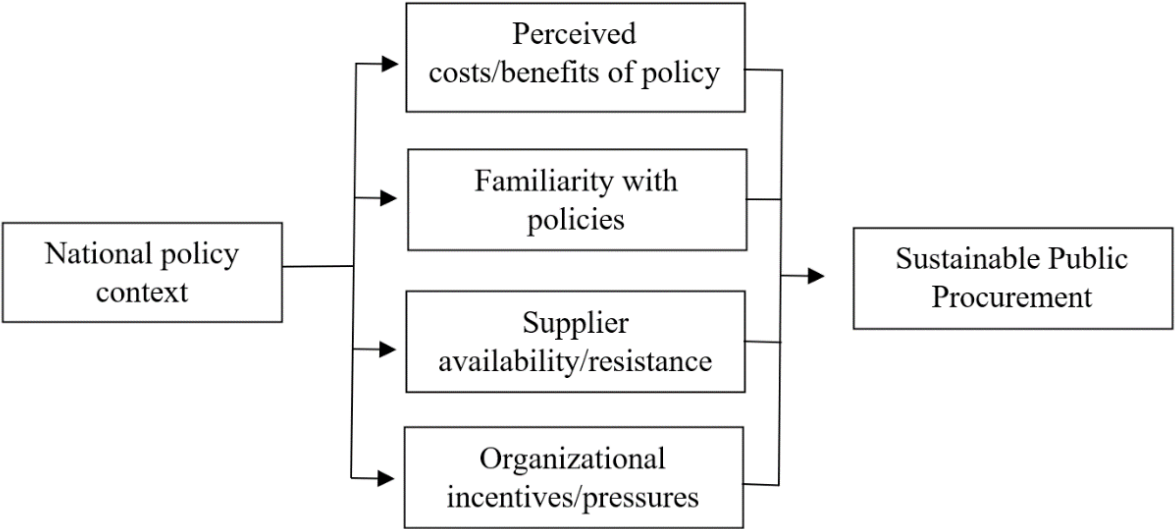


FIGURE 1 – A conceptual model of the influences on Sustainable Procurement.
 SOURCE: Brammer & Walker (2011), adapted from Gelderman *et al.* (2006).

Within the scope of sustainable procurement issues, factor analysis has also been used in research by Ribeiro & Veiga (2011), Fonseca (2013), Göçer & Oflaç (2016), Costa *et al.* (2017), and Delmonico *et al.* (2018). Reporting a proposal and empirical evaluation of a sustainable consumption scale, Ribeiro & Veiga (2011) have presented four factors based on twenty-one variables: Factor 1 – “Recycling”; Factor 2 – “Ecological awareness”; Factor 3 – “Frugality”; Factor 4 – “Economy of resources.” To investigate the suitability of the private sector to meet the requirements of public administration for sustainable products and services, Fonseca (2013) has presented a factorial analysis of fourteen variables in three factors: Factor 1 – “Knowledge on sustainability”; Factor 2 – “Business perception of government actions for sustainability”; Factor 3 – “Business capacity for sustainability.” In order to understand the trends of young consumers in relation to eco-labeled products, Göçer & Oflaç (2016) presented six factors based on twenty-two items: Factor 1 – “Purchasing trend”; Factor 2 – “Familiarity with eco-labels”; Factor 3 – “Generic attitudes”; Factor 4 – “Perceived environmental knowledge”; Factor 5 – “Attractiveness of eco-labels”; Factor 6 – “Confidence in eco-labels.” Based on an analysis of ten variables, Costa *et al.* (2017) have presented three factors: Factor 1 – “Immanent sustainability”; Factor 2 – “Sustainable strategic alignment”; Factor 3 – “Legal effectiveness.” Finally, based on twenty variables related to barriers to sustainable public procurement, Delmonico *et al.* (2018) have presented five factors: Factor 1 – “Aspects of organizational culture”; Factor 2 – “Motivational aspects”; Factor 3 – “Aspects of economic uncertainties”; Factor 4 – “Marketing aspects”; Factor 5 – “Operational aspects”.

Considering that Green Public Procurement and Sustainable Public Procurement both emphasize environmental criteria in their guidelines, the present study seeks to address aspects related to the environment and the economy, while ignoring the social factor in the sustainability triad, given that this has been included tangentially in public procurement legislation (Walker & Preuss, 2008; United Nations Office for Project Services, UNOPS, 2009; Neamtu & Dragos, 2015; Villac, 2017). As expressed by the Instituto de Pesquisa Econômica Aplicada (IPEA) (2011), the Brazilian government has a great opportunity to induce more sustainable productive processes. Sustainable Public Procurement is among the possible strategies for using environmental labeling as a public policy tool, because through these procurements, the government can create opportunities to innovate, improve technologies, and stimulate sustainable consumption and production practices in public and private affairs. United Nations Office for Project Services (UNOPS) (2009) argued that, in the context of public procurements, the advantage of using environmental labels is that the procedure for developing green specifications becomes simplified. Accordingly, Juliani (2015) has suggested the use of environmental criteria in environmental labeling programs in notices for public bidding to identify more sustainable products for purchase by public agencies. One can also observe how national and international protection on environmental labeling now includes environmental and sustainability criteria in public procurements, as shown for instance by Valkó & Kiss (2005), Bratt *et al.* (2011), Costa, (2011), Fonseca (2013), Fruntes (2014), Neamtu & Dragos (2015), Rainville (2017), and Mungkung *et al.* (2018).

In relation to Brazilian government procurement, Hoe (2016) has explained that one of the difficulties officials face in implementing sustainable procurements is identifying a sustainable product. Another difficulty is establishing the requirements to be used in the bidding notices. Hoe (2016) emphasizes that it is not possible to require certifications or seals verifying suppliers' promises, owing to the guidelines of the Federal Court of Accounts (TCU), which considers any requirement for technical patterns or specific seals to be a form of restraint of trade. Given this issue, other studies have argued that when specifying a product in the terms of reference, the government can include characteristics that compose the certificate or seal in the notice in order to select the most appropriate product, both technically and environmentally (Valkó & Kiss, 2005; Costa, 2011; Fonseca, 2013). Fuentes-Bargues *et al.* (2017) have outlined how a lack of technical means and environmental knowledge for to prepare contract documents as well as a shortage of technical guides to facilitate the use of environmental aspects in the procurement can constitute obstacles to the inclusion of environmental criteria in bidding procedures. Consequently, this conceptual study of the perceptions of public servants operating in the bids and contracts departments aims to delineate the various implicit aspects involved in the framework for adopting Sustainable Public Procurement in the Brazilian public sector.

3. Materials and methods

Exploratory methodological procedures were developed to study a bibliographic and normative structure related to the evolution of both Green

Public Procurement and Sustainable Public Procurement in the international and national scenario as a tool to formulate and strengthen environmental and sustainability aspects in government procurements. Considering this theoretical approach, an embedded case study was developed based on the EFA of the responses of public officials working in the bidding and contracts departments of several government agencies located in the Ministries Esplanade in Brasília/DF, who answered an objective questionnaire in October – November 2018. Embedded case studies integrate several units of analysis within the same context. According to Yin (2018), an embedded unit of analysis is a unit below and within the main case of a case study, from which data are also collected. Embedded case studies include more than one unit – or object – of analysis and are usually not limited to qualitative analysis (Scholz & Tietje, 2002). Statistical tests are often used in case studies. Gerring (2004) states that all empirical evidence of causal relationships is covariational in nature, and a purported cause and effect must be found to covary. Hair *et al.* (2009) have stated that, in general terms, factor analysis addresses the problem of analyzing the structure of correlations between many variables, and defines a set of common latent dimensions, called factors. For this, the answers obtained in this research were analyzed using the software IBM SPSS Statistics 23.0 and Factor Analysis 10.8.04.WIN64.

This case study evaluates the perceptions of the above-mentioned public officials toward the inclusion of environmental and sustainability aspects in public procurement procedures, knowledge of Sustainable Public Procurement, sustainable consumption and production patterns, and environmental labeling.

3.1. Empirical research tool: the form

The survey questionnaire was developed in collaboration with subject matter experts and included 14 topics (variables) in and a set of articles and other references, as shown in Table 1. A five-point Likert scale was used to measure public servants' perceptions of the 14 topics, as because such scales are reliable and can be adjusted to respondents with different skill levels (Dalmoro & Vieira, 2013). The levels corresponded to the following: 1 – “Strongly disagree”; 2 – “Somewhat disagree”; 3 – “Neither agree nor disagree”; 4 – “Somewhat agree”; 5 – “Strongly agree”. Thus, the research form was produced with the objective of evaluating the perceptions of the public servants regarding various topics, such as the applicability of environmental and sustainability aspects in government purchases and its reflexes in sustainable consumption and production patterns, information about environmental labeling, as well as aspects related to Sustainable Public Procurement.

4. Results

4.1. Statistical analysis

The main organs of the Federal Government are located in the Esplanade of Ministries in Brasília, Brazil, exemplifying the centralization of

different government activities. Each ministry is responsible for a specific area of in the public policy.

Initially, the research was conducted in person in the bids and contracts sectors from October to November 2018, with the aim of obtaining the collaboration of the following bodies: Ministry of Science, Technology, Innovation, and Communications; Ministry of Defense; Ministry of Education; Ministry of Justice; Ministry of Mines and Energy; Ministry of the Environment; Ministry of Labor; and Ministry of Transport. As a result, fifty-seven completed forms were collected. At the same time, the form was sent by e-mail to the following organs: Ministry of Finance; Ministry of Development, Industry and Commerce; Ministry of Agriculture, Livestock, and Food Supply; Ministry of Social Development; Ministry of Health; Ministry of Sports; Ministry of Planning, Budget and Management; Ministry of Cities; and Ministry of National Integration. Of these organs, the Ministry of Agriculture, Livestock, and Food Supply, the Ministry of Social Development and the Ministry of Sports agreed to collaborate in the research, resulting in the completion of five forms.

Thus, a total of 62 questionnaires were answered. A summary of the completed forms per participating ministry is shown in Table 2.

Table 3 shows the descriptive statistics of the responses to the questionnaires, indicating the agreement or disagreement of the officials participating in the study on each variable.

TABLE 1 – References applied in the survey.

| Variables | Topics | References |
|-----------|--|---|
| 1 | The Federal Government intends to include environmental criteria in the public tenders for the acquisition of goods and services more frequently every year. | Pacheco-Blanco & Bastante-Ceca, 2016; Delmonico et al., 2018; Liu et al., 2018. |

| | | |
|----|--|--|
| 2 | The inclusion of environmental criteria in the bidding notices of the Federal Government encourages a change in the production process of a company supplying the acquired goods and/or services toward sustainability. | Nissinen et al., 2009; Ribeiro & Veiga, 2011; Fonseca, 2013; Zhu et al., 2013; Delmonico et al., 2018. |
| 3 | The inclusion of environmental criteria in the bidding notices of the Federal Government encourages a change in production and consumption patterns in Brazil toward sustainability. | Nissinen et al., 2009; Ribeiro & Veiga, 2011; Fonseca, 2013; Zhu et al., 2013; Delmonico et al., 2018. |
| 4 | Federal legislation requires the government to purchase goods and services based on environmental criteria. | Brammer & Walker, 2011; Zhu et al., 2013; Costa et al., 2017; Liu et al., 2018. |
| 5 | The Federal Government is predisposed to purchase goods and services that meet environmental criteria, even at higher costs/prices. | Delmonico et al., 2018; Liu et al., 2018. |
| 6 | Public servants working in the bids and contracts departments are aware of the concept of environmental labeling (also known as “green seal” or “environmental seal”). | Brammer & Walker, 2011; Göçer & Oflaç, 2017; Liu et al., 2018. |
| 7 | Public servants working in the bids and contracts departments are interested in contributing to debates on Sustainable Public Procurement (SPP) along with the Ministry of Planning, Budget, and Management (MPOG). | Brasil, 2010; Delmonico et al., 2018. |
| 8 | The recommendations and guidelines of the legal advisory body of the Federal Government, the Attorney General’s Office (AGU), support the inclusion of environmental criteria in the bids and contracts of the government. | Brasil, 2016; Villac, 2017; Delmonico et al., 2018. |
| 9 | The recommendations and guidelines of the Federal Court of Accounts (TCU) support the inclusion of environmental criteria in the bids and contracts carried out by the Federal Government. | Costa, 2011; Delmonico et al., 2018; Silva et al., 2018. |
| 10 | In the bidding process, understanding of the “most advantageous proposal for the administration” should include environmental criteria. | Delmonico et al., 2018; Liu et al., 2018. |
| 11 | Federal Decree no. 7,746/2012 is a fundamental instrument for the concrete application of criteria and practices for promoting sustainable national development in government procurements. | Zhu et al., 2013; Costa et al., 2017; Delmonico et al., 2018; Liu et al., 2018. |
| 12 | In the supplier market, there are many companies that offer goods and services with a focus on environmental criteria in their products. | Gelderman et al., 2006; Brammer & Walker, 2011; Fonseca, 2013; Delmonico et al., 2018. |
| 13 | In general, so-called ecological, environmental or sustainable products cost more in the consumer market. | Tanner & Kast, 2003; Brammer & Walker, 2011; Delmonico et al., 2018. |
| 14 | In commercial relations, the acquisition of products identified as “ecological,” “environmental” or “sustainable” encourages practices focused on reducing environmental impacts. | Brammer & Walker, 2011; Göçer & Oflaç, 2017; Costa et al., 2017; Liu et al., 2018. |

SOURCE: elaborated by the authors.

TABLE 2 – Number of forms filled out by the respective ministries.

| Ministry | Completed forms |
|---|-----------------|
| Ministry of Agriculture, Livestock, and Food Supply | 1 |
| Ministry of Science, Technology, Innovation, and Communications | 5 |
| Ministry of Defense | 9 |
| Ministry of Education | 7 |
| Ministry of Justice | 11 |
| Ministry of Mines and Energy | 5 |
| Ministry of Social Development | 1 |
| Ministry of Sports | 3 |
| Ministry of Environment | 8 |
| Ministry of Labor | 8 |
| Ministry of Transport | 4 |
| TOTAL | 62 |

SOURCE: elaborated by the authors.

4.2. Exploratory factor analysis

From these results, Table 4 shows the Pearson's correlation matrix that is most used in EFA, according to Thompson (2004).

The 62 completed questionnaires met the minimum requirements for this type of analysis (Velicer & Fava, 1998; Hair *et al.*, 2009; de Winter *et al.*, 2009).

Next, it was necessary to determine whether the data matrix could be factorized, using the Kaiser–Meyer–Olkin (KMO) test and Bartlett sphericity test (Damásio, 2012; Beavers *et al.*, 2013). The commonalities in each variable were then assessed (Hair *et al.*, 2009).

Variables 11 and 13 had commonalities of less than 0.5 and were eliminated, as recommended by the literature (Hair *et al.*, 2009; Laros, 2012). The data were then factorized, revealing a KMO value of 0.671 (Hutcheson & Sofroniou, 1999), and a

TABLE 3 – Descriptive statistics of the responses to the forms.

| Variable | Mean | Median | Mode | Standard Deviation |
|----------|------|--------|------|--------------------|
| 1 | 4.45 | 5 | 5 | 0.72 |
| 2 | 4.16 | 4 | 5 | 1.03 |
| 3 | 3.94 | 4 | 4 | 1.02 |
| 4 | 4.32 | 4 | 5 | 0.86 |
| 5 | 3.11 | 4 | 4 | 1.31 |
| 6 | 2.71 | 2 | 2 | 1.27 |
| 7 | 4.00 | 4 | 4 | 1.04 |
| 8 | 4.18 | 5 | 5 | 1.12 |
| 9 | 4.31 | 5 | 5 | 0.97 |
| 10 | 4.26 | 4 | 5 | 0.92 |
| 11 | 4.06 | 4 | 5 | 0.97 |
| 12 | 2.73 | 2 | 2 | 1.18 |
| 13 | 4.13 | 4 | 4 | 0.82 |
| 14 | 4.53 | 5 | 5 | 0.59 |

SOURCE: elaborated by the authors.

significance of less than 0.05 according to Bartlett's test (Tabachnick & Fidell, 2007). The other variables had commonalities greater than 0.5, as shown in Table 5.

Next, principal component analysis (PCA) was used for factor extraction, as this is the most common technique (Pallant, 2007; Beavers *et al.*, 2013). PCA was integrated with the Kaiser – Guttman criterion, with eigenvalues > 1 (Pallant, 2007; Damásio, 2012). Therefore, in this study, the Kaiser – Guttman criterion to preserve the commonality of the variables and avoid interfering with data interpretation and analysis.

Table 6 shows the total matrix of explained variance, and indicates the total percentage of variance explained by the factors, demonstrating the extraction of five factors and 74.865% of the explained variance, according to the Kaiser – Guttman criterion.

TABLE 4 – Pearson's correlation matrix.

| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-----------|-------|--------|-------|--------|--------|-------|--------|--------|-------|-------|-------|-------|--------|-------|
| 1 | 1.000 | | | | | | | | | | | | | |
| 2 | 0.545 | 1.000 | | | | | | | | | | | | |
| 3 | 0.577 | 0.712 | 1.000 | | | | | | | | | | | |
| 4 | 0.237 | 0.236 | 0.432 | 1.000 | | | | | | | | | | |
| 5 | 0.102 | -0.063 | 0.042 | -0.062 | 1.000 | | | | | | | | | |
| 6 | 0.344 | 0.224 | 0.212 | 0.027 | 0.296 | 1.000 | | | | | | | | |
| 7 | 0.264 | 0.184 | 0.355 | 0.128 | -0.048 | 0.248 | 1.000 | | | | | | | |
| 8 | 0.204 | 0.032 | 0.110 | 0.362 | 0.176 | 0.472 | 0.280 | 1.000 | | | | | | |
| 9 | 0.199 | 0.131 | 0.219 | 0.507 | 0.011 | 0.153 | 0.163 | 0.672 | 1.000 | | | | | |
| 10 | 0.317 | 0.198 | 0.296 | 0.223 | 0.220 | 0.177 | 0.085 | 0.303 | 0.259 | 1.000 | | | | |
| 11 | 0.216 | 0.022 | 0.219 | 0.131 | 0.084 | 0.174 | 0.308 | 0.349 | 0.327 | 0.420 | 1.000 | | | |
| 12 | 0.091 | 0.295 | 0.312 | 0.201 | 0.148 | 0.483 | 0.107 | 0.298 | 0.262 | 0.187 | 0.274 | 1.000 | | |
| 13 | 0.039 | 0.072 | 0.069 | -0.013 | 0.109 | 0.099 | 0.135 | 0.082 | 0.177 | 0.020 | 0.113 | 0.054 | 1.000 | |
| 14 | 0.158 | 0.368 | 0.274 | -0.085 | -0.037 | 0.121 | -0.053 | -0.046 | 0.054 | 0.074 | 0.110 | 0.354 | -0.042 | 1.000 |

SOURCE: elaborated by the authors.

TABLE 5 – Commonalities in variables 1 to 14, excluding variables 11 and 13.

| Variables | Commonalities |
|-----------|---------------|
| 1 | 0.703 |
| 2 | 0.782 |
| 3 | 0.814 |
| 4 | 0.715 |
| 5 | 0.735 |
| 6 | 0.783 |
| 7 | 0.770 |
| 8 | 0.824 |
| 9 | 0.790 |
| 10 | 0.606 |
| 12 | 0.734 |
| 14 | 0.728 |

SOURCE: elaborated by the authors.

TABLE 6 – Total explained variance matrix from the eigenvalues.

| Component/ factor | Eigen value | Proportion of variance | Cumulative proportion of variance |
|----------------------|----------------|---------------------------|---|
| 1 | 3.606 | 0.30052 | 0.30052 |
| 2 | 1.760 | 0.14663 | 0.44714 |
| 3 | 1.439 | 0.11995 | 0.56710 |
| 4 | 1.145 | 0.09541 | 0.66251 |
| 5 | 1.034 | 0.08614 | 0.74865 |
| 6 | 0.717 | 0.05972 | |
| 7 | 0.651 | 0.05425 | |
| 8 | 0.571 | 0.04761 | |
| 9 | 0.367 | 0.03056 | |
| 10 | 0.305 | 0.02539 | |
| 11 | 0.211 | 0.01754 | |
| 12 | 0.195 | 0.01628 | |

SOURCE: elaborated by the authors.

Finally, Table 7 shows the result of normalized oblique promax rotation result excluding factor loadings of less than 0.400. It shows a rotated matrix and the absence of cross-factor loadings,

considering the significant factor loadings of each variable to the respective factor (Hair *et al.*, 2009; Laros, 2012; Beavers *et al.*, 2013). Therefore, the factor composition resulted in the incorporation of the following variables and their respective significant factor loadings:

a) Factor 1: variable 1 (0.780), variable 2 (0.808), and variable 3 (0.842);

b) Factor 2: variable 4 (0.804), variable 8 (0.696), and variable 9 (0.916);

c) Factor 3: variable 12 (0.773) and variable 14 (0.825);

d) Factor 4: variable 5 (0.928) and variable 10 (0.625);

e) Factor 5: variable 6 (0.560) and variable 7 (0.913).

In general, the factors were well-defined and were a good representation of the behavior of the variables, according to Hair *et al.* (2009) and Pasquali (2010).

Table 8 shows the correlation matrix between the factors from the PCA extraction and the *normalized promax* rotation.

Regarding sample reliability sample, Hair *et al.* (2009) claimed that the generally accepted lower limit for Cronbach's alpha is 0.70. In this study, the Cronbach's alpha of the twelve variables from the survey was 0.761. When analyzing the Cronbach's alpha values for the extracted factors separately, Factors 1 and 2 were 0.819 and 0.759, respectively. On the other hand, Factors 3, 4, and 5 yielded Cronbach's alpha values of less than 0.600, because they were composed of only two variables. Cortina (1993) has noted that the alpha can be affected by the number of items, average item intercorrelation, and dimensionality.

TABLE 7 – Rotated matrix of factor loadings (variable x factor).

| VARIABLES | FACTORS | | | | |
|-----------|--------------|--------------|--------------|--------------|--------------|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 0.780 | | | | |
| 2 | 0.808 | | | | |
| 3 | 0.842 | | | | |
| 4 | | 0.804 | | | |
| 5 | | | | 0.928 | |
| 6 | | | | | 0.560 |
| 7 | | | | | 0.913 |
| 8 | | 0.696 | | | |
| 9 | | 0.916 | | | |
| 10 | | | | 0.625 | |
| 12 | | | 0.773 | | |
| 14 | | | 0.825 | | |

SOURCE: elaborated by the authors.

TABLE 8 – Factor correlation matrix.

| Factors | 1 | 2 | 3 | 4 | 5 |
|---------|-------|-------|-------|-------|-------|
| 1 | 1.000 | | | | |
| 2 | 0.226 | 1.000 | | | |
| 3 | 0.153 | 0.131 | 1.000 | | |
| 4 | 0.011 | 0.289 | 0.266 | 1.000 | |
| 5 | 0.017 | 0.291 | 0.274 | 0.373 | 1.000 |

SOURCE: elaborated by the authors.

For a hierarchical factor solution, Laros (2012) found that the matrix of correlations among first-order factors, as presented in Table 8, can be subjected to factor analysis to identify the second-order factor. Thompson (2004) has clarified that when a oblique rotation is performed, the higher order factors are implicit. Gorsuch (1983) has recommended the extraction and examination of these second-order factors to obtain the best-possible understanding of the data. Wolff & Preising (2005) have stated that

variables are loaded in the first-order factors and first-order factors are loaded in the second-order factors, as shown in Figure 2. Some studies refer to such second-order factors as “general factors” (Yung *et al.*, 1999; Wolff & Preising, 2005).

Wolff & Preising (2005) highlighted factors with factor loadings greater than or equal to 0.600 in the analysis of second-order factors.

Table 9 shows the second-order factor loadings, revealing that Factor 5 has the highest factor loading, rendering it the best represents the general factor, according to Laros & Puente-Palacios (2005).

5. Discussion

Through a conceptual examination of perception, this study has sought to delineate the various implicit aspects that provide a framework for adopting Sustainable Public Procurement in the public sector. Preuss & Walker (2011) have illustrated how in studies addressing sustainable development through public procurements, a focus on psychological aspects is justified, because it is a prerequisite for knowing and understanding how individuals engage with a series of barriers, whether these be of a technological nature, or related to budgetary constraints or legislative imperatives. Thus, this research concerning the perceptions of public officials has the potential to increase, even in just a general way, understanding in the Brazilian public sector of the applicability of innovative environmental and sustainability strategies in the acquisition of goods and services.

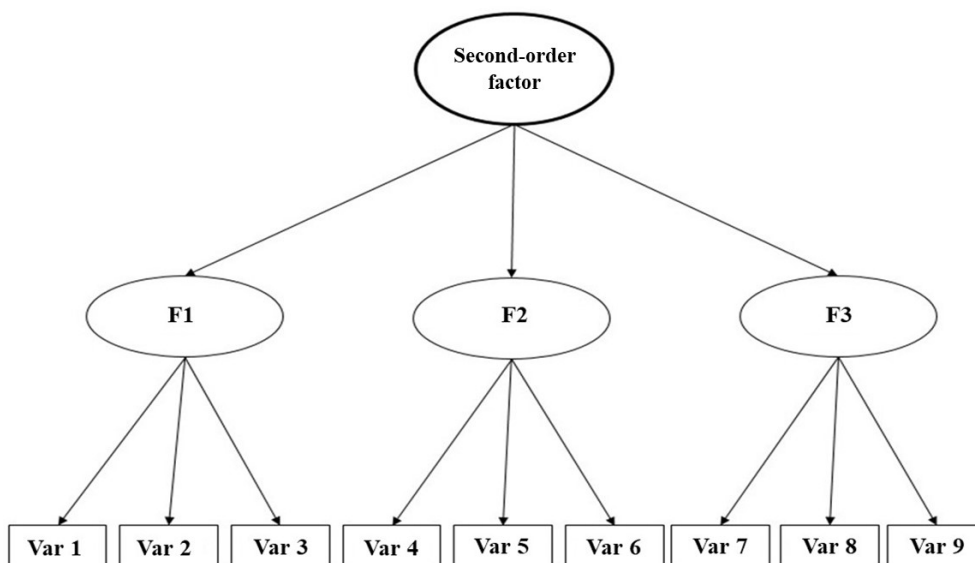


FIGURE 2 – Higher order factor analysis.

SOURCE: Yung et al. (1999) and Wolff & Preising (2005), with adaptations.

TABLE 9 – Second-order factor loadings.

| Factor | Second-order factor loading |
|--------|-----------------------------|
| 5 | 0.609 |
| 4 | 0.597 |
| 2 | 0.475 |
| 3 | 0.422 |
| 1 | 0.167 |

SOURCE: elaborated by the authors.

5.1. About the factors

Following the above discussion of the EFA results, Hair *et al.* (2009) have explained how when an acceptable factorial solution is obtained in which all variables have a significant load on a factor, the researcher must report a significance for the factor loadings. They argue that the researcher should examine all the significant variables for a given factor and, by highlighting the variables with higher loads, attempt to designate a name or label

for a factor that accurately reflects the variables with loads in that factor.

5.1.1. Factor 1 – perspective

Table 10 presents the variables of Factor 1, and outlines the expectations of the public officials involved in the study on future trends in the application of environmental criteria in government tenders, as well as providing a positive reflection on sustainable consumption and production patterns in the country. For this part of the analysis, Factor 1 is titled “Perspective”. Together with the results shown in Table 3, the items indicated in Factor 1 demonstrate optimism among the public officials regarding future progress on the inclusion of environmental criteria in the Federal Government’s bidding processes, as well as for adopting sustainable consumption and production patterns in the country.

TABLE 10 – Factor 1 – Perspective.

| FACTOR 1 | |
|---|----------------|
| Variable | Factor loading |
| 3. The inclusion of environmental criteria in the bidding notices of the Federal Government encourages a change in production and consumption patterns in Brazil toward sustainability. | 0.842 |
| 2. The inclusion of environmental criteria in the bidding notices of the Federal Government encourages a change in the production process of a company supplying the acquired goods and/or services toward sustainability. | 0.808 |
| 1. The Federal Government intends to include environmental criteria in the public tenders for the acquisition of goods and services more frequently every year. | 0.780 |

SOURCE: elaborated by the authors.

In this context, Pacheco-Blanco & Bastante-Ceca (2016) have indicated that the introduction of environmental criteria in public procurements has become increasingly important in sustainable consumption initiatives. Furthermore, Nissinen *et al.* (2009) has noted that Green Public Procurement is considered one of the most appropriate policies for changing unsustainable patterns of consumption and production.

Thus, the statistical results shown in Table 3 of variables 1, 2, and 3 indicate that the items in Factor 1 present an optimistic view of the future and gradual progress on the inclusion of environmental criteria in the bidding processes of the Federal Government, as well as its consequences as a stimulus to adapt patterns of production and consumption in the country with a view toward sustainability.

5.1.2. Factor 2 – legal and institutional support

Table 11 presents the results of Factor 2, which is similar to the influence that Brammer & Walker (2011) call “organizational incentives/pressures,” because it incorporates two institutions of relevance to the bidding and procurement sectors:

the Attorney General’s Office (AGU), which is the legal adviser to the Federal Government, and the Federal Court of Accounts (TCU), which assists the National Congress of Brazil in federal accounting, and financial, budgetary, operational, and equity supervision. In this context, Factor 2 is titled “Legal and Institutional Support” for outlining the public servants’ perceptions of the support of accounting and legal advisory agencies regarding the inclusion of environmental criteria in government bids and contracts, as well as the support of federal legislation on the subject.

It is important to note that the Attorney General’s Office (AGU) has published a National Guide to Sustainable Bidding (Brasil, 2016), which provides suggestions for the inclusion of environmental criteria in notice documents as well as the terms of reference for procurements and purchases by the public sector. Conversely, Costa (2011) has pointed out how even though the Federal Court of Accounts (TCU) – the body that judges the accounts of the Federal Government – lacks a single defined position on the implementation of Sustainable Public Procurement and instead has made scattered decisions on the subject, it recommends that federal bodies and entities gradually adopt sustainability criteria when contracting services and works or

TABLE 11 – Factor 2 – Legal and Institutional Support.

| FACTOR 2 | |
|--|----------------|
| Variable | Factor loading |
| 9. The recommendations and guidelines of the Federal Court of Accounts (TCU) support the inclusion of environmental criteria in the bids and contracts carried out by the Federal Government. | 0.916 |
| 4. Federal legislation requires the government to purchase goods and services based on environmental criteria. | 0.804 |
| 8. The recommendations and guidelines of the legal advisory body of the Federal Government, the Attorney General’s Office (AGU), support the inclusion of environmental criteria in the bids and contracts of the government. | 0.696 |

SOURCE: elaborated by the authors.

acquiring goods. Fonseca (2013), too, has emphasized that the existing Brazilian legislation provides strong support for sustainable biddings.

Regarding environmental labeling, Oliveira (2013) argues that the legislative power should advance in the debates about this tool in the existing legislation in public procurement and environmental policy. The author also claims that this would help materialize green consumption and the principle of sustainable development in accordance with Brazilian environmental standards.

In addition, Factor 2 indicates that the public officials were supportive of the compulsory inclusion of environmental criteria in federal government tenders, considering that the statistical analysis in Table 3 of variables 4, 8, and 9 (with a mode of 5) indicates total agreement on the respective items.

5.1.3. Factor 3 – market relations

Table 12 shows the variables of Factor 3, and outlines, in a general way, the assimilation of the public officials on the engagement of the private sector to comply with the directives for the acquisition of products identified as “ecological,” “environmental” or “sustainable” in commercial transactions, as well as incentives to reduce environmental impacts.

Factor 3 is termed “Market Relations”. In Table 3, variable 12 has a mean of 2.73, a median of 2.00, and a mode of 2.00, indicating considerable disagreement among the public officials (recall that on the Likert scale, 2 indicates “Somewhat disagree”). Thus, it can be inferred that the public sector recognizes that companies that supply goods and services do not contemplate compliance with environmental criteria, which may obstruct the progress of these policies. Fonseca (2013) has also highlighted that the market for sustainable products and services is not fully prepared to meet the demands of the public sector for sustainable procurements, although it is in the process of becoming adequate. Even so, Bala *et al.* (2008) have described how the barriers the suppliers face are the long duration of public contracts, the lack of mechanisms to verify compliance with green contract requirements, and the reactionary nature of the contracted companies.

As Fonseca (2013) has highlighted, sustainable bidding incentivizes suppliers to produce cleaner and with less environmental impact. Similarly, Coelho (2014) argues that the public administration must look for ways to reduce the environmental impacts from the requirements on reverse logistics, by transferring responsibility for the collection of hazardous or toxic products to suppliers.

TABLE 12 – Factor 3 – Market Relations.

| FACTOR 3 | |
|--|----------------|
| Variable | Factor loading |
| 14. In commercial relations, the acquisition of products identified as “ecological,” “environmental” or “sustainable” encourages practices focused on reducing environmental impacts. | 0.825 |
| 12. In the supplier market, there are many companies that offer goods and services with a focus on environmental criteria in their products. | 0.773 |

SOURCE: elaborated by the authors.

Regarding the use of ecolabels, Bleda & Valente (2009) have stated that negative environmental impacts can be reduced in two conceptual ways: in the short term, by reducing sales of highly polluting products in favor of products that cause less damage to the environment, and in the long term, by encouraging producers to focus their research and development on cleaner technologies.

Further, regarding the effects of commercial relations, especially regarding the supply and acquisition of products identified as “ecological”, “environmental” or “sustainable,” it is important to note that many of the public officials acknowledge that the commercial transaction of such products encourages practices focused on reducing environmental impacts. In this way, it is observed the sensitivity of public agents to consider that the commercial transaction of products produced in compliance with environmental and/or sustainable directives dictates represent a mitigating measure, since they provide the reduction of impacts to the environment. However, the public sector officials disagree on the private sector’s knowledge concerning the market of goods and services contemplating the adoption of environmental criteria, as Cheng *et al.* (2018) have also mentioned. Thus, blurring the boundary between the public sector and the business sector can be beneficial to the success of government procurement about the inclusion of environmental criteria.

5.1.4. Factor 4 – acquisition costs

Factor 4, represented in Table 13, is composed of variables 5 and 10, proved to be a common characteristic concerning the perceptions of the public officials of the costs of products that meet environmental criteria requirements. Factor 4 is called “Acquisition Costs”.

From the mean of variable 5 (3.11) shown in Table 3, it can be observed that there is no unanimity among the public officials regarding the Federal Government’s amenability to acquiring goods and services that meet environmental criteria, even if it has to bear higher costs. Accordingly, Preuss & Walker (2011) have mentioned that economic criteria inhibit purchasing managers’ motivation when faced with sustainable development challenges. However, Bleda & Valente (2009) have noted that the implementation of an ecolabel means that a market segment is willing to bear higher costs in exchange for the satisfaction it derives from knowing that its purchase will be less harmful to the environment. Furthermore, Mungkung *et al.* (2018) have described how budget allocation concerns for the purchase of eco-labeled products may be a barrier to their implementation.

TABLE 13 – Factor 4 – Acquisition Costs.

| FACTOR 4 | |
|--|----------------|
| Variable | Factor loading |
| 5. The Federal Government is predisposed to purchase goods and services that meet environmental criteria, even at higher costs/prices. | 0.928 |
| 10. In the bidding process, understanding of the “most advantageous proposal for the administration” should include environmental criteria. | 0.625 |

SOURCE: elaborated by the authors.

However, the data in Table 3 derived from variable 10 show a high degree of acquiescence on the part of the public officials to including environmental criteria in their understanding of the “most advantageous proposal for the administration”. This exemplifies a favorable attitude toward the advancement of other bidding procedures, rather than exclusively seeking the lowest price. Coelho (2014), too, has pointed out that bidding based exclusively on the lowest price gradually be substituted for ecological parameters, so that the best proposal meets the eco-responsible imperative of combining the “advantage” to the administration with minimal impact to the environment. In this way, the lowest price criterion can be replaced by the best price according to various economic, social and environmental factors.

5.1.5. Factor 5 – public servant participation

Table 14 reproduces the variables of Factor 5 to consider aspects related to the knowledge of public officials about environmental labeling and their motivation to discuss the topic of Sustainable Public Procurement along with the Brazilian Ministry of Planning, Budget, and Management (MPOG). By combining variables related to the knowledge and collaboration of the public officials in debates on environmental labeling and Sustainable Public

Procurement, Factor 5 is called “Public Servant Participation”.

Table 3 shows that variable 6 has the lowest value of all variables with a mean of 2.71, a median, and a median and mode of 2, indicating that most of the public officials recognize that the public servants working in bidding and procurement are unaware of the concept of environmental labeling. However, the administration can gradually adopt initiatives to develop knowledge of and tools for environmental labels. Regarding this topic, Fuentes-Bargues *et al.* (2017) have described how the analysis of environmental criteria is starting to be acknowledged in public procurements and sustainable development.

Conversely, the results of variable 7 show a satisfactory tendency toward the interest of public servants working in their bidding and procurement to contribute with the MPOG in debates on Sustainable Public Procurement.

In this regard, Preuss & Walker (2011), Testa *et al.* (2012), Bratt *et al.* (2013) and Aragão & Jabbour (2017) all emphasized the need to train public officials, focusing on the implementation of green and sustainable purchases. Aragão & Jabbour (2017) have described the advantages of combining human resource management practices with environmental management development in an organization, as “green human-resources management”. Furthermore, Sarkis *et al.* (2011) have

TABLE 14 – Factor 5 – Public Servant Participation.

| FACTOR 5 | |
|---|----------------|
| Variable | Factor loading |
| 7. Public servants working in the bids and contracts departments are interested in contributing to debates on Sustainable Public Procurement (SPP) along with the Ministry of Planning, Budget, and Management (MPOG). | 0.913 |
| 6. Public servants working in the bids and contracts departments are aware of the concept of environmental labeling (also known as “green seal” or “environmental seal”). | 0.560 |

SOURCE: elaborated by the authors.

presented research related to green supply chain management (GSCM).

Aragão & Jabbour (2017) argue that Sustainable Public Procurement, as one of the practices of GSCM, is essential to train managers and civil servants to critically analyze purchases, so that they can observe aspects for example the product life cycle. Sarkis *et al.* (2010) also emphasize that this human resource practice can contribute to the adoption of modern sustainability practices, including sustainable procurement. In this way, one can be optimistic that management strategies which integrate environmental and sustainability aspects in training related to government procurements are being developed and adopted by public officials.

5.2. Hierarchical analysis

A hierarchical analysis of the factors extracted from the second-order factor presented in Table 9, it can be observed that Factor 5, titled “Public Servant Participation”, is the most relevant, reflecting the importance of strengthening the organizational culture and public officials’ motivation. This finding is in line with other studies, such as Brammer & Walker (2011), Costa (2011), and Delmonico *et al.* (2018).

“Acquisition Costs” are also highlighted as relevant. Cheng *et al.* (2018) have pointed out that in the government sector, there will always be financial constraints, which are the main obstacles to acquisitions with an ecological focus, because products that are healthy to the environment tend to be more expensive, while budgetary constraints, especially during an economic crisis, do not allow for an increase in these practices in government purchases.

Related to Factor 2, titled “Legal and Institutional Support”, Brammer & Walker (2011) have demonstrated that government and legislative support influences public officials’ familiarity with sustainable purchasing policies.

In the hierarchical view of this study, the factor called “Market Relations” does not stand out as relevant according to the public officials. Indeed, as Cheng *et al.* (2018) have shown, the supplier market is for the most part ill-prepared to provide environmentally friendly products, hindering the implementation of sustainable procurements at the governmental level. Brammer & Walker (2011) have also highlighted the influence of suppliers of goods and services produced in a sustainable way to public sector purchases.

The factor titled “Perspective” can be considered supplementary to the other dimensions, as

a support for the higher levels of the hierarchical analysis.

6. Conclusion

This study has aimed to characterize the perceptions of public officials working in the bidding and contract departments regarding the applicability of environmental and sustainability aspects in the Federal Government's public procurements. To this end, it has considered Green Public Procurement and Sustainable Public Procurement in its contextual approach.

In Brazil, environmental and sustainability aspects within the scope of Sustainable Public Procurement play a fundamental role in the performance and success of this innovative government procurement policy. In general, despite a lack of knowledge of environmental labeling in the Brazilian government sector, as shown in Table 3, the advancement of policies related to public procurements and the incorporation of environmental criteria in government bidding and contract processes in future seem very plausible. This study has identified five key factors describing the relationship between the public administration and the inclusion of environmental and sustainability aspects in purchasing processes: "Perspective", "Legal and Institutional Support", "Market Relations", "Acquisition Costs", and "Public Servant Participation". The main result of this study is that the "Public Servant Participation" factor, which carries a motivating characteristic, is the most relevant in guaranteeing the success of public purchasing policies with an environmental focus, especially compared to the barriers related to "Acquisition Costs" and "Legal and Institutional Support."

This study has made an original contribution to research on Sustainable Public Procurement in Brazil and may also help stimulate similar research in other developing countries. It has been observed that the Brazilian state has a relevant legal and normative framework on sustainability in government procurements. However, the participation of public servants in this debate, linked to training and human resource management practices, is essential to ensuring that such purchases focus on environmental aspects and sustainable development in the future.

Acknowledgments

We thank the public servants who participated in this research, as well as other collaborators who contributed to this study's development.

References

- Alhola, K.; Ryding, S. O.; Salmenpera, H.; Busch, N. J. Exploiting the potential of public procurement: opportunities for circular economy. *Journal of Industrial Ecology*, 23(1), 96-109, 2018. doi: 10.1111/jiec.12770
- Aragão, C. G.; Jabbour C. J. C. Greentraining for sustainable procurement? Insights from the Brazilian public sector. *Industrial and Commercial Training*, 49(1), 48-54, 2017. doi: 10.1108/ICT-07-2016-0043
- Bala, A.; Muñoz, P.; Rieradevall, J.; Yserb, P. Experiences with greening suppliers. The Universitat Autònoma de Barcelona. *Journal of Cleaner Production*, 16(15), 1610-1619, 2008. doi: 10.1016/j.jclepro.2008.04.015
- Beavers, A.; Lounsbury, J. W.; Richards, J. K.; Huck, S. W.; Skolits, G. J.; Esquivel, S. L. Practical considerations for using exploratory factor analysis in educational research. *Practical Assessment, Research & Evaluation*, 18(6), 2013. doi: 10.7275/qv2q-rk76

- Betioli, L. S.; Uehara, T. H. K.; Laloš, F. K.; Appugliese, G. A.; Adeodato, S.; Ramos, L.; Neto, M. P. M. *Compra sustentável: a força do consumo público e empresarial para uma economia verde e inclusiva*. São Paulo: Fundação Getúlio Vargas, 2012.
- Biderman, R.; Macedo, L. S. V.; Monzoni, M.; Mazon, R. *Guia de compras públicas sustentáveis: uso do poder de compra do governo para a promoção do desenvolvimento sustentável*. ICLEI Governos Locais pela Sustentabilidade, Centro de Estudos em Sustentabilidade da Escola de Administração de Empresas de São Paulo da Fundação Getúlio Vargas (GVces), Serviço Federal, 2006. doi: 10.1787/9789264266391-es
- Bleda, M.; Valente, M. Graded eco-labels: a demand-oriented approach to reduce pollution. *Technological Forecasting & Social Change*, 76(4), 512-524, 2009. doi: 10.1016/j.techfore.2008.05.003
- Bouwer, M.; Jong, K.; Jonk, M.; Berman, T.; Bersani, R.; Lusse, H.; Nissinen, A.; Parikka, K.; Szuppinger, P. *Green public procurement in Europe 2005 – status overview*. Haarlem: Virage Milieu & Management, 2005.
- Brammer, S.; Walker, H. Sustainable procurement in the public sector: an international comparative study. *International Journal of Operations & Production Management*, 31(4), 452-476, 2011. doi: 10.1108/01443571111119551
- Brasil, Advocacia-Geral da União (AGU). *Guia nacional de licitações sustentáveis*. Brasília: AGU, 2016.
- Brasil, Ministério do Planejamento, Orçamento e Gestão (MPOG). *Guia de compras públicas sustentáveis para administração federal*. Brasília: Ministério do Planejamento, Orçamento e Gestão, 2010.
- Bratt, C.; Hallstedt, S.; Robert, K, H.; Broman, G.; Oldmark, J. Assessment of eco-labelling criteria development from a strategic sustainability perspective. *Journal of Cleaner Production*, 19(14), 1631-1638, 2011. doi: 10.1016/j.jclepro.2011.05.012
- Bratt, C.; Hallstedt, S.; Robert, K, H.; Broman, G.; Oldmark, J. Assessment of criteria development for public procurement from a strategic sustainability perspective. *Journal of Cleaner Production*, 52, 309-316, 2013. doi: 10.1016/j.jclepro.2013.02.007
- Cheng, W.; Appolloni, A.; D’Amato, A.; Zhu, Q. Green Public procurement, missing concepts and future trends - A critical review. *Journal of Cleaner Production*, 176, 770-784, 2018. doi: 10.1016/j.jclepro.2017.12.027
- Coelho, H. A. *Responsabilidade ambiental na licitação: sustentabilidade nas contratações e compras de governo*. Rio de Janeiro: Editora Lumen Juris, 2014.
- Cortina, J. M. What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, 78(1), 98-104, 1993.
- Costa, B. A.; Ferreira, Y. C. S. M. L.; Gomes, S. C.; Sobrinho, M. V. Contratações públicas sustentáveis: práticas e influências na gestão municipal. *Revista de Administração FACES Journal*, 16(2), 60-76, 2017.
- Costa, C. E. L. *As licitações sustentáveis na ótica do controle externo*. Brasília: Instituto Serzedello Corrêa, Tribunal de Contas da União, 2011.
- Dalmoro, M.; Vieira, K, M. Dilemas na construção da escala tipo Likert: o número de itens e a disposição influenciam nos resultados? *Revista Gestão Organizacional*, 6(3), 2013.
- Damáσιο, B. F. Uso da análise fatorial exploratória em psicologia. *Avaliação Psicológica*, 11(2), 213-228, 2012.
- Delmonico, D.; Jabbour, C. J. C.; Pereira, S. C. F.; Jabbour, A. B. L. S.; Renwick, D. W. S.; Thomé, A. M. T. Unveiling barriers to sustainable public procurement in emerging economies: evidence from a leading sustainable supply chain initiative in Latin America. *Resources, Conservation & Recycling*, 134, 70-79, 2018. doi: 10.1016/j.resconrec.2018.02.033
- Fonseca, R. C. P. *Compras sustentáveis: um estudo sobre a adequação de fornecedores às demandas do setor público*. Lavras, Dissertação (Mestrado em Administração Pública) – UFLA, 2013.
- Fruntes, C. Ecolabels - important tools in developing a sustainable society: A global perspective. *Bulletin of the Transilvania University of Braşov*, 7(2), 267-274, 2014.
- Fuentes-Bargues, J. L.; González-Cruz, M. C.; González-Gaya, C. Environmental criteria in the Spanish public works procurement process. *International Journal of Environmental Research and Public Health*, 14(2), 204, 2017.

doi: 10.3390/ijerph14020204

Gelderman, C. J.; Ghijzen, P. W. T.; Brugman, M. J. Public procurement and EU tendering directives - explaining non-compliance. *International Journal of Public Sector Management*, 19(7), 702-714, 2006. doi: 10.1108/09513550610704716

Göçer, A.; Oflaç, B. S. Understanding young consumers: tendencies regarding eco-labelled products. *Asia Pacific Journal of Marketing and Logistics*, 29(1), 80-97, 2017. doi: 10.1108/APJML-03-2016-0036

Gorsuch, R. L. *Factor analysis*. Hillsdale: Erlbaum, 2 ed., 1983.

Gerring, J. What is a case study and what is it good for? *American Political Science Review*, 98, 341-354, 2004. doi:10.1017/S0003055404001182; 2004.

Hair, J. F. Jr.; Black, W. C.; Barry, J. B.; Anderson, R. E.; Tatham, R. L. *Análise multivariada de dados*. Porto Alegre: Bookman, 6 ed., 2009.

Hoe, V. M. H. *A construção do sistema brasileiro de declaração ambiental de produto*. Brasília, Dissertação (Mestrado em Desenvolvimento Sustentável) — UnB, 2016.

Hutcheson, G. D.; Sofroniou, N. *The multivariate social scientist: introductory statistics using generalized linear models*. London: Sage Publications. 1999.

IPEA — Instituto de Pesquisa Econômica Aplicada. *Sustentabilidade ambiental no Brasil: biodiversidade, economia e bem-estar humano. O Uso do poder de compra para melhoria do meio ambiente, Série eixos do desenvolvimento brasileiro, Comunicados do IPEA, 82, Brasília, 2011.*

Juliani, A. J. *Aplicação da modernização ecológica no setor de papel e celulose do Brasil*. Brasília, Tese (Doutorado em Desenvolvimento Sustentável) — UnB, 2015.

Laros, J. A. O Uso da análise fatorial: algumas diretrizes para pesquisadores. In: Pasquali, L. (Ed.). *Análise fatorial para pesquisadores*. Brasília: LabPAM Saber e Tecnologia, 2012. doi: 10.1590/s1413-294x2004000100013

Laros, J. A.; Puente-Palacios, K. E. Validação cruzada de uma escala de clima organizacional. *Estudos de Psicologia*, 9(1), 113-119, 2004. doi: 10.1590/s1413-

294x2004000100013

Liu, J.; Shi, B.; Xue, J.; Wang, Q. Improving the green public procurement performance of Chinese local governments: from the perspective of officials' knowledge. *Journal of Purchasing and Supply Management*, 2018. doi: 10.1016/j.pursup.2018.05.002

Lundberg, S.; Marklund, P. Green public procurement as an environmental policy instrument: cost effectiveness. *Environmental Economics*, 4(4), 75-83, 2013.

Mungkung, R.; Sorakon, K.; Gheewala, S. H. Ecolabelling and sustainable public procurement to promote sustainable consumption and production in Thailand. *Chemical Engineering Transactions*, 63, 241-216, 2018. doi: 10.3303/CET1863041

Neamtu, B.; Dragos, D. C. Sustainable public procurement: the use of eco-labels. *European Procurement & Public Private Partnership Law Review*, 10(2), 92-101, 2015.

Nissinen, A.; Parikka-Alholaa, K.; Ritab, H. Environmental criteria in the public purchases above the EU threshold values by three Nordic countries: 2003 and 2005. *Ecological Economics*, 68, 1838-1849, 2009. doi: 10.1016/j.ecolecon.2008.12.005

Oliveira, D. A. T. Contributos (e perigos) da rotulagem ambiental para o desenvolvimento sustentável no Brasil (Parte II). *Revista do Instituto do Direito Brasileiro (RIDB)*, 2(10), 11271-11323, 2013.

Pacheco-Blanco, B; Bastante-Ceca, M. J. Green public procurement as an initiative for sustainable consumption. An exploratory study of Spanish public universities. *Journal of Cleaner Production*, 133, 648-656, 2016. doi: 10.1016/j.jclepro.2016.05.056

Pallant, J. *SPSS survival manual - A step by step guide to data analysis using IBM SPSS*. Maidenhead: Open University Press, 3 ed., 2007.

Palmujoki, A.; Parikka-Alholaa, K.; Ekross, A. Green public procurement: analysis on the use of environmental criteria in contracts. *Review of European Community & International Environmental Law (RECIEL)*, 19(2), 250-262, 2010. doi: 10.1111/j.1467-9388.2010.00681.x

Pasquali, L. *Instrumentação psicológica: fundamentos e*

práticas. Porto Alegre: Editora Artmed, 2010.

Preuss, L. *Addressing sustainable development through public procurement: the case of local government*. *Supply Chain Management*, 14, 213-223, 2009. doi: 10.1108/13598540910954557

Preuss, L.; Walker, H. Psychological barriers in the road to sustainable development: evidence from public sector procurement. *Public Administration*, 89(2), 493-521, 2011. doi: 10.1111/j.1467-9299.2010.01893.x

Rainville, A. Standards in green public procurement – a framework to enhance innovation. *Journal of Cleaner Production*, 167, 1029-1037, 2017. doi: 10.1016/j.jclepro.2016.10.088

Ribeiro, J. A.; Veiga, R. T. Proposição de uma escala de consumo sustentável. *Revista Administração*, 46(1), 45-60, 2011. doi: 10.5700/rausp0997

Sarkis, J.; Gonzalez-Torre, P.; Adenso-Diaz, B. Stakeholder pressure and the adoption of environmental practices: the mediating effect of training. *Journal of Operations Management*, 28(2), 163-176, 2010. doi: 10.1016/j.jom.2009.10.001

Sarkis, J.; Zhu, Q.; Lai, K. H. An organizational theoretic review of green supply chain management literature. *International Journal of Production Economics*, 130(1), 1-15, 2011. doi: 10.1016/j.ijpe.2010.11.010

Silva, R. C.; Betiol, L.; Villac, T.; Nonato, R. Sustainable public procurement: the Federal Public Institution's shared system. *Revista de Gestão*, 25(1), 9-24, 2018. doi: 10.1108/rege-11-2017-001

Scholz, R. W.; Tietje, O. *Embedded case study methods: integrating quantitative and qualitative knowledge*. Thousand Oaks: Sage Publications, 2002.

Tabachnick, B. G.; Fidell, L. S. *Using multivariate statistics*. Boston: Allyn and Bacon, 5 ed., 2007.

Tanner, C.; Kast, S. W. Promoting sustainable consumption: determinants of green purchases by Swiss consumers. *Psychology & Marketing*, 20(10), 883-902, 2003. doi: 10.1002/mar.10101

Testa, F.; Iraldo, F.; Frey, M.; Daddi, T. What factors influence the uptake of GPP (green public procurement) practices?

New evidence from an Italian survey. *Ecological Economics*, 82, 88-96, 2012. doi: 10.1016/j.ecolecon.2012.07.011

Thompson, B. *Exploratory and confirmatory factor analysis: understanding concepts and applications*. Washington, DC: American Psychological Association, 2004.

UNDESA — United Nations Department of Economic and Social Affairs. *A guidebook to the green economy issue I: green economy, green growth, and low-carbon development – history, definitions and a guide to recent publications*, 2012.

UNOPS — United Nations Office for Project Services. *A guide to environmental labels - for procurement practitioners of the United Nations system*, 2009. Disponível em: <https://www.ungm.org/Areas/Public/Downloads/Env_Labels_Guide.pdf>.

Uttam, K.; Balfors, B.; Faith-Ell, C. Green public procurement (GPP) of construction and building materials. In: Torgal, P.; Cabezza, L. F.; Labrincha, J.; Magalhães, A. (Eds.). *Eco-efficient construction and building materials: life cycle assessment (LCA), eco-labelling and case studies*. Woodhead Publishing, 2014. doi: 10.1533/9780857097729.1.166

Valkó, L.; Kiss, A. Eco-labels in Hungarian public procurement. *Periodica Polytechnica Social and Management Sciences*, 13(2), 107-120, 2005.

Velicer, W. F.; Fava, J. Effects of variable and subject sampling on factor pattern recovery. *Psychological Methods*, 3(2), 231-251, 1998. doi: 10.1037/1082-989X.3.2.231

Villac, T. *Sustentabilidade e contratações públicas no Brasil: direito, ética ambiental e desenvolvimento*. São Paulo, Tese (Doutorado em Ciência Ambiental) – USP, 2017.

Walker, H.; Brammer, S. Sustainable procurement in the United Kingdom public sector. *Supply Chain Management: An International Journal*, 14(2), 128-137, 2009. doi: 10.1108/13598540910941993

Walker, H.; Preuss, L. Fostering sustainability through sourcing from small businesses: public sector perspectives. *Journal of Cleaner Production*, 16, 1600-1609, 2008. doi: 10.1016/j.jclepro.2008.04.014

de Winter, J. C. F.; Dodou, D.; Wieringa, P. A. Exploratory factor analysis with small sample sizes. *Multi-*

-
- variate *Behavioral Research*, 44, 147-181, 2009. doi: 10.1080/00273170902794206
- Witjes, S.; Lozano, R. Towards a more circular economy: proposing a framework linking sustainable public procurement and sustainable business models. *Resources, Conservation and Recycling*, 112, 37-44, 2016. doi: 10.1016/j.resconrec.2016.04.015
- Wolff, H. G.; Preising, K. Exploring item and higher order factor structure with the Schmid–Leiman solution: syntax codes for SPSS and SAS. *Behavior Research Methods*, 37(1), 48-58, 2005.
- Yin, R. K. *Case study research and applications: design and methods*. Thousand Oaks: Sage, 6 ed., 2018.
- Yung, Y.; Thissen, D.; McLeod, L. D. On the relationship between the higher-order factor model and the hierarchical factor model. *Psychometrika*, 64(2), 113-128, 1999.
- Zhu, Q.; Geng, Y.; Sarkis, J. Motivating green public procurement in China: an individual level perspective. *Journal of Environmental Management*, 126, 85-95, 2013. doi: 10.1016/j.jenvman.2013.04.009