Adhesion of federal institutions of higher education to a3p

Adesão de instituições federais de ensino superior a a3p

DOI: 10.55905/oelv21n12-199

Recebimento dos originais: 11/11/2023
Aceitação para publicação: 11/12/2023

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ABSTRACT
The Environmental Agenda in Public Administration (A3P) is a program of the Ministry of the Environment to promote sustainable practices. Considering the importance of Federal Higher Education Institutions (IFES) in the training of professionals and in the construction of citizenship, it is necessary to verify their socio-environmental commitments. Objective: to identify IFES’s adhesions to A3P and their representativeness by state. Develop an index to quantify the sustainable influence of these institutions. Method: A survey of Brazilian IFES was carried out, classifying them, according to adhesion to A3P (total, partial or absent). And, based on the number of IFES and population by state, an index was created to define their socio-environmental impact. Results: The results were presented through thematic maps, using conditional renderization. The state of Rio Grande do Norte stood out with 67% of adhesion, followed by Acre, Amazonas, Santa Catarina, Sergipe, Tocantins (50%), Pernambuco (40%) and Goiás (33%). In Southeast region, no IFES obtained total adhesion. Regarding sustainable reach (index), the state of Tocantins presented better results, accompanied by Rio Grande do Norte, Santa Catarina and Acre. One of the main factors that influenced the value of sustainable reach was campus / population ratio, realizing that the Gross Domestic Product (GDP) behaves in an inversely proportional manner. Conclusion: IFES sustainability index can support the planning of public policies, since, when considering demographic, socioeconomic (GDP) parameters and reference to A3P, it allowed to outline the reality of each federative unit. Originality: This study shows the profile of the socio-environmental impact of IFES in Brazil.

Keywords: conditional renderization, sustainable reach, geographic information system.

RESUMO
A Agenda Ambiental na Administração Pública (A3P) é um programa do Ministério do Meio Ambiente para promover práticas sustentáveis. Considerando a importância das Instituições Federais de Ensino Superior (IFES) na formação de profissionais e na construção da cidadania, é necessário verificar seus compromissos socioambientais. Objetivo: identificar as adesões IFES à A3P e sua representatividade por estado. Desenvolver um índice para quantificar a influência sustentável dessas instituições. Método: Foi realizado um levantamento das IFES brasileiras, classificando-as de acordo com a adesão a A3P (total, parcial ou ausente). E, a partir do número de IFES e população por estado, foi criado um índice para definir seu impacto socioambiental. Resultados: Os resultados foram apresentados por meio de mapas temáticos, utilizando renderização condicional. O estado do Rio Grande do Norte destacou-se com 67% de adesão, seguido por Acre, Amazonas, Santa Catarina, Sergipe, Tocantins (50%), Pernambuco (40%) e Goiás (33%). Na região Sudeste, nenhuma Ifes obteve adesão total. Em relação ao alcance sustentável (índice), o estado do Tocantins apresentou melhores resultados, acompanhado por Rio Grande do Norte, Santa Catarina e Acre. Um dos principais fatores que influenciaram o valor do alcance sustentável foi o rácio campus/população, percebendo que o Produto Interno Bruto (PIB) se comporta de forma inversamente proporcional. Conclusão: O índice de sustentabilidade do IFES pode apoiar o planejamento de políticas públicas, pois, ao considerar os parâmetros demográficos, socioeconomicos (PIB) e a...
referência ao A3P, permitiu delinear a realidade de cada unidade federativa. Originalidade: Este estudo mostra o perfil do impacto socioambiental das Ifes no Brasil.

**Palavras-chave:** renderização condicional, alcance sustentável, sistema de informação geográfica.

### 1 INTRODUCTION

Concerning about environment questions has increased significantly all around the world, due to the uncontrollable use of natural resources and its consequences to humanity (Sgarbi et al., 2013). Then, environment management, social responsibility and sustainability have been frequent topics of discussions in national and international events, highlighting the important education role to spread actions that aim the environment conservation.

In this context, Higher Education Institutions (IES) are responsible for the knowledge formation of individuals and can be used as foundation to build a sustainable society, because they graduate professionals who, when carrying out their activities in the future, can insert acquired learning during the graduation. Although, to make it happens, IES need to adopt practices which involve all the academic community in their agenda, with the objective to disseminate sustainability relevance by attitudes and/or examples (Tauchen & Brandlin, 2006).

Sustainability, even though it is a topic of national interest, requires specific interventions by the government to consolidate environmentally correct practices, both from its public entities and from the private sector. In view of this need, the State has implemented, in addition to mandatory environmental laws, programs to which membership is voluntary, in order to govern the actions of society and governmental entities (Mendonça, 2015).

Then, the sustainable societies construction is linked not only to the education role, but also to the government role in the elaboration, execution and disclosure of actions which allow a sustainable development, giving ways to the ecologically correct practices concretization (Krugger et al., 2011). It is important for the State to assume the
conductor role of this process, either by drafting and implementing legislation, viabiliz-
ing research, as well as encouraging organizations (Viegas et al., 2015).

Therefore, Federal Higher Education Institutions (IFES) have an even greater en-
vironmental responsibility, because, in addition to the important role they play in profes-
sional training, as they are an integral part of public administration, they must also comply
with the legislation in force in the country and observe the government programs and
initiatives to guide its activities. A good example is the Environmental Agenda in Public
Administration Program (A3P), launched in 1999 within the scope of the Ministry of the
Environment and later extended to other agencies. A3P aims to the promotion of sustai-
nable practices in the daily routine of public entities. Although it is not mandatory to join,
the orientation of the Agenda have been widespread and recommended to every entity of
public administration (Kruger et al., 2011).

The agenda has the challenge to consolidate institutionalized practices in every
administrative sections, through the development of several activities involving different
institution areas, aiming to promote life quality and the environment preservation (Santos,
2017). Then, it won the award of "The best of examples" from the United Nations Educa-
tional, Scientific and Cultural Organization (Unesco), in 2002, in Environment cate-
gory, recognizing the importance of the work and all positive results reached by the pro-
gram (Camelo & Monteiro, 2015).

A3P seeks to insert socio-environmental responsibility into the culture of public
administration. For this, it is structured in six priority thematic axes: rational use of natural
resources and public goods; proper management of the waste generated; quality of life in
the work environment; awareness and training of civil servants; sustainable public procu-
rement; and, sustainable buildings (Brasil, 2017b). Such axes guide the application of
sustainable actions and are based on the policy of the 5 R's, that is, rethink, reduce, reuse,
recycle and refuse the consumption of products that generate social and environmental
impacts (Cavalcante, 2012).

Thus, A3P aims to raise awareness not only of managers, but of everyone involved
in the processes within the institution, including the operational, tactical and strategic
levels. This is because it considers that certain administrative and operational activities can cause environmental damage and need to be reviewed and corrected (Santos, 2017).

One of the Agenda advantages is that the Environment Ministry (MMA) provides technical support to institutions that formally adhere to A3P, by the signature of an Adhesion Contract, in which the interested assume the compromise with the MMA to implement A3P. In this way, the institution demonstrates that its management is transparent and that it is interested in meeting the socio-environmental agenda (Mendonça, 2015). The agenda also offers access to the A3P Network, a platform for exchanging information and experiences that includes public and private institutions. Formal partners and those interested in the topic can join the A3P Network. For that, it is only necessary to request access to exchange information, becoming informal partners of the program (Cavalcante, 2012).

Then, considering the importance of the IFES' role for sustainability actions to be inserted and consolidated by the society, and also, the A3P relevance to direct these actions, the following questions arise: do the Federal Higher Education Institutions adhere to the Ambiental Schedule in the Public Administration? Which states or regions stand out or deserve special attention on this topic? Facing other public institutions, proportionally, do IFES have a greater or lesser ratio of adhesion/informal partnerships?

In order to answer these questions, it is necessary to analyze the data provided by the official bodies, however, it is complicated to work with them due to Brazilian territory immensity and the number of states. Therefore, for a more dynamic, fast and effective analysis, the Geographic Information System (GIS) has been increasingly used, which is a tool that makes it possible to spatialize this information, which is often easily available.

In this way, GIS has become a tool to support management as it enables searches and data selection, as well as visualization and geographic analysis, being important to facilitate event descriptions, simulation of situations and support the planning of strategic actions that expand the possibilities of using this tool in the administration (Scheidegger et al., 2013).
Thus, this work aims to analyze how IFES adhesions/partnerships to A3P are distributed in national territory and quantify the possible representativeness that each IFES exercises.

2 MATERIALS AND METHODS

This research is classified as descriptive, as the spatial distribution of IFES is discussed together with a series of factors that condition the analysis of adhesions/partnerships to A3P, as well as the degree of influence that IFES have in each federative unit. As for the approach to the problem, it is a quantitative study with qualitative analysis at times.

The initial part of this work is basically a survey about the institutions that have joined A3P Agenda.

For this, data referring to IFES in Brazilian territory, available in Higher Education Regulation System (e-MEC) (Brazil, 2017a), and their spatial location, using the Google Earth software, were used. The data were imported into a GIS platform, software QGis 2.18, which allowed the conversion of this information to the shapefile extension.

Data regarding the institutions that joined the Environmental Agenda in Public Administration (Brasil, 2017d) and the informal partners that are part of the A3P Network were also obtained at MMA website (Brasil, 2017c). With this, columns were created with descriptions of the institutions regarding adhesion or informal partner. This information was quantitatively passed on to the information plans of Brazilian states obtained through the website of Brazilian Institute of Geography and Statistics (IBGE) (IBGE, 2017b). In this context, conditional formatting of the points was carried out in order to better visualize the IFES according to their situation of adherence and to make possible, even on a preliminary basis, inferences regarding the characteristics of the institutions within the state and regional contexts.

After that, in order to create thematic maps for Brazilian states, these points were quantified by states, through the geo-algorithm “count points in the polygon”, accessed through the toolbox and processing. Subsequently, two columns (% A3P or % NET) were made in order to represent a percentage estimate based on the quantifications performed in the previous step.
In addition, as a point of analysis, IFES were considered as a unit and their scope, represented by their campuses, as there are those that are multicampi, therefore having two ways to proceed with the study.

Finally, to analyze a socioenvironmental impact generated by the IFES in all federative units, population data from the states were obtained by IBGE from the last 2010 census (IBGE, 2017a), defining the list of institutions for each hundred thousand inhabitants (IFES/100,000) and (campuses/100,000) generating thematic maps through conditional rendering, including sustainable reach, defined by the following equation:

\[
S = \left[ \frac{IFES}{Pop} \times (A3P + 0,5NETWORK) \right] 100.000.
\]

Which means:

- **S**: Sustainable reach;
- **IFES**: Number of IFES or campuses by state;
- **Pop**: Population;
- **%A3P**: Percentage of membership by state;
- **%REDE**: Percentage of informal partnerships by state.

This sustainable reach represents an index created by the variable weighting considered (weight 1 for %A3P, and 0.5 for %NET) in order to demonstrate, comparatively, which states would have a better visibility or possible positive influence in people’s lives regarding ecologically correct questions.

In order to check if there is any influence of the socioeconomic aspect regarding the campus ratio by population and percentage of adherence to A3P, a map of the Gross Domestic Product (GDP) from Brazilian states was constructed, using values obtained at IBGE website, and was, therefore, thematically categorized.

The distribution of data was also compared, in order to check if there is any trend line and, later, it was correlated by the Pearson coefficient, which consists of interval values from -1 to 1, in which, positive values close to 1 indicate strong positive correlation (directly proportional) and those close to -1, strong negative correlation (inversely proportional) (Figueiredo Filho & Junior, 2009).
3 RESULTS E DISCUSSION

The bodies that formalized the partnership with the MMA through the Term of Adhesion and receive technical support for the implementation and operation of the agenda are a total of 175 public bodies, of these, 12 (twelve) are IFES, which represents only 6.85% of the accessions.

Figure 1 shows Brazilian IFES location and the situation regarding the partnership with A3P (formal adhesion), informal partner or non-partner, based on the principle of conditional rendering addressed in the methodology. However, a problem faced in this scale of work (1:25,000,000) is that there are sometimes overlapping points, given the relative proximity.

Figure 1 - Location of Brazilian IFES and the situation regarding the A3P partnership.

We observed that among the 103 (one hundred and three) IFES, 11.65% joined the A3P (Federal University Foundation of São Francisco Valley, Institute of Education,
Science and Technology of Acre, Federal Institute of Education, Science and Technology of Amazonas, Federal Institute of Education, Science and Technology of Goiás, Federal Institute of Education, Science and Technology of Rio Grande do Norte, Federal Institute of Education, Science and Technology of Santa Catarina, Federal Institute of Education, Science and Technology of Tocantins, Federal University Grande Dourados, Federal University of Pernambuco, Federal University of Santa Catarina, Federal University of Sergipe and Federal University of Rio Grande do Norte). In addition, another 2 (two) institutions that partially joined, that is, only one or two of their campuses are part of the program, the Federal Institute of Education, Science and Technology of Piauí, the current campus and Floriano campus, and the Federal Institute of Education, Science and Technology of Espírito Santo, Guarapari campus, however the latter, to the detriment of the scale, was overlaid.

In addition to the formal partner IFES, there are another 33 (thirty-three) which are part of the A3P Network (informal) and even more 6 (six) that participate with at least one campus, representing together with the institutions that joined to the agenda 6.55% of the total of 810 institutions participating in the A3P Network and 49.51% of the total IFES. We then noted that most institutions did not join and are not part of the A3P Network.

Figure 2 shows the classification of the States of the Federation by percentage of formal adhesions to the program.
The State of Rio Grande do Norte stands out with a membership percentage of 67%, followed by the States of Acre, Amazonas, Santa Catarina, Sergipe and Tocantins with 50% and Pernambuco with 40% of its institutions; finally, the State of Goiás with 33% of its institutions adhering to the program. Thus, we noted that in none of the states in the Southeast Region there is full adhesion of an IFES, except for Espírito Santo which Federal Institute - Guarapari campus - formally joined the A3P.

To analyze the importance/scope of IFES in the states, considering the registered population \( \left( \frac{\text{IFES}}{\text{Population}} \times 100,000 \right) \) in order to apply the methodology of sustainable reach, two maps were generated (Figure 3, items a and b) to check if there would be great variations, because depending on the institution, the number of campuses can be significant with the result.
We noted that, regardless of the adopted relationship, the State of Roraima followed by Acre and Amapá present the best ranges of indices (IFES or campus for every 100,000 inhabitants). The states of Rondônia, Tocantins, Mato Grosso do Sul and Sergipe have relatively low values, however, higher than the other federated entities, and have obtained a significant improvement when using campuses (Figure 3b) as a reference. The other States, which had the lowest intervals, in some cases, obtained different increases, with emphasis on the State of Rio Grande do Norte, the largest increase, followed by Amazonas, Pará, Mato Grosso, Piauí, Paraíba, Alagoas, Sergipe, Espírito Santo and Santa Catarina. The federated entities of São Paulo and Rio de Janeiro are other highlights which maintained the intervals at the same level, what in this case can be related to the size of their populations and the representativeness of other institutions (non-federal or private) present in the territory, as these are more economically developed.
It is relevant to point out that, apparently, the regions show characteristic behaviors regarding the distribution of campuses according to the population. This is a very relevant fact, as it may be associated to the population size, degree of economic and even cultural development of the regions. We observed that the northern region has the best relationship, followed by the Midwest with a good and homogeneous distribution, then to the northeast, with emphasis on the State of Rio Grande do Norte, and to the south. While in the southeastern region, the relationship was the least satisfactory, where the worst rates belong to the states of Rio de Janeiro and São Paulo.

It is notorious that, after applying the Sustainable Reach methodology, considering the campuses as a reference for calculations (Figure 4), the Institutions ratio for each hundred thousand inhabitants is established, multiplied by the percentage of adhesion and/or partnership with their respective weights, which generates a score that allows a "ranking", in order to demonstrate, comparatively, the sustainable influence that, in this study, refers to the IFES with the Brazilian states, where there is an appointment of those which have a better or worse ability to disseminate sustainable actions.

It is worth mentioning that this index is not an absolute definition as to the degree of sustainability of the states, that is, whether it is very or little sustainable when considering certain parameters. Even because sustainability depends on a complex relationship of other variables such as historical, cultural, economic, social and educational level in federated entities of a country. However, this method guarantees an effective comparison between those, which allows discussing or raising questions about which elements or factors, within a criterion adopted, in this case, the IFES and their adhesion to A3P, allow identifying a variation both by state, and by geographic region.
We can see, according to Figure 4, that among the federative units, the state of Tocantins was the one that stood out the most, presenting the best sustainable reach index, this is because it presented the best campus / population ratio (Table 1) (0.0000130), moderate A3P adhesion rates (50%) and informal partnerships (50%). The state of Rio Grande do Norte is in second position, which despite having a lower campus/population ratio than Acre, acquired a higher sustainable reach value, as it obtained more expressive A3P adhesion percentages (67%) . Good indexes are also considered, those presented by the States of Acre and Santa Catarina, in which the latter surpassed the former, also, due to the more significant percentage of adhesion and partnership.

Finally, when analyzing the sustainable reach map under a regional approach, the northern region contains two of the states with the best indexes (TO and AC), three have low to moderate values (AM, RR and AP) and only two with critical values (RO and PA). The Northeast has the state with the second best index (RN), three states with low to
moderate levels (MA, PB and SE) and five states with critical levels (BA, PI, CE, PE and AL). In the southern region, the state of Santa Catarina (SC) is "ranked" in third place, however it contains two states (RS and PR) with indexes considered bad. Additionally, the other regions are considered to have the worst conditions of sustainable reach, which show us, even in a preliminary way, that there is a regional profile regarding sustainability.

Table 1 - Federative Units that stood out as to the index and their equated variables.

<table>
<thead>
<tr>
<th>States</th>
<th>Population</th>
<th>Nº. Campuses</th>
<th>Campus/Population</th>
<th>A3P %</th>
<th>Network %</th>
<th>Sustainable reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO</td>
<td>1,383,453</td>
<td>18</td>
<td>0.0000130</td>
<td>50</td>
<td>50</td>
<td>97,58192002</td>
</tr>
<tr>
<td>RN</td>
<td>3,168,133</td>
<td>28</td>
<td>0.0000088</td>
<td>67</td>
<td>0</td>
<td>59,21468575</td>
</tr>
<tr>
<td>SC</td>
<td>6,249,681</td>
<td>47</td>
<td>0.0000075</td>
<td>50</td>
<td>50</td>
<td>56,4028788</td>
</tr>
<tr>
<td>AC</td>
<td>732,793</td>
<td>8</td>
<td>0.0000109</td>
<td>50</td>
<td>0</td>
<td>54,58567426</td>
</tr>
</tbody>
</table>

Source: prepared by the authors (2017).

As the objective of this study is to verify the sustainability of IFES in the states, the possibility of the influence of socioeconomic aspects cannot be ruled out, therefore a map of the Gross Domestic Product (GDP) was constructed (Figure 5) in the federative units, in order to verify whether the wealth produced in the states could, in some way, represent a relationship with the performance of the established index.
When visually comparing Figure 4, which deals with sustainable reach, with Figure 5, a moderate correlation is observed, however, when Pearson's correlation is performed from the attributes table (states' GDP columns x sustainable index) approximately $\sigma \approx -0.31$, which indicates a weak negative correlation. Figure 3b, which represents the campus/popx100k ratio, in addition to similarity, reached a correlation coefficient of -0.62 (inversely proportional of moderate intensity). In this way, a graph of distribution of values was made (Figure 6), to verify the behavior of the variables GDP x campus/popx100k.
An interesting fact of this distribution with a moderate negative correlation is that there are two trend lines, the first in the X-axis range of 0 to 200 billion and the second from there. Thus, they obtained a correlation, respectively, of -0.80 and -0.90, that is, strong and negative correlations, according to the distribution of values in Figures 7 and 8, respectively.
From the analysis of one of the factors that influence the IFES sustainability index in the states, which is the campus/popx100k ratio, it is generally known that the richer the state, the worse the campus ratio for the population. This leads us to believe that they are able to maintain themselves with less influence from the Union, as well as the existence of an economic power that justifies a wide distribution of private higher education institutions in these places.

On the other hand, the poorer the state, the better the campus-to-population ratio. This result can be justified by the fact that during the period from 2003 to 2013, there was a significant expansion of the offer in higher education in the north and northeast regions of the country, two of the most deprived regions of this type of education until then. This occurred due to investments in the interiorization of the public university and in the policies of democratization of access developed by the federal government (Brasil, 2014).

Finally, throughout the work, no significant relationship was found between the available information and the IFES A3P adhesion rate. This indicates that the local, cultural and nature of the courses present in the IFES may have some degree of influence, however, it was not possible to quantify them.
4 CONCLUSION

This work made it possible to know the distribution profile of the IFES both on a state and regional scale. The results indicated that the economically less developed states are the ones with the best campus-to-population ratios. It should be noted that these states have had greater federal support from an educational perspective in recent years. There was also less representation in wealthier states, such as São Paulo, Minas Gerais and Rio de Janeiro, among others. Another element that, concomitantly, influenced the results, was the population size of the federative units, which allowed this same prominence, mainly in the northern region, in some states in the northeast, the state of Espírito Santo in the southeast, Mato Grosso and Mato Grosso do Sul in the Midwest.

At the same time, there are some parameters that need to be studied, such as the historical/cultural context. And an example of this is the state of Santa Catarina, because among the other federated entities with some economic and population expressiveness, it is the one that stands out the most in terms of adhesions/partnerships in the IFES, placing it in the ranking of the best sustainability indexes, which denotes the existence of a special concern with environmental issues.

Upon reaching the Sustainable Reach Index, we observed that these conditions have a strong relationship with population, cultural and interventionist aspects (IFES in the least economically developed states), which makes us reflect that Brazil needs a deep analysis of its structures.

Finally, we found that geotechnologies can be very useful and important in understanding the spatial distribution of phenomena, which until then were difficult to quantify, in which, through relatively simple analyzes, extremely relevant data can be generated regarding the contextualization and representation of the objects of study.
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