This is the published version of a paper published in *Journal of Cleaner Production*.

Citation for the original published paper (version of record):

https://doi.org/10.1016/j.jclepro.2021.126320

Access to the published version may require subscription.

N.B. When citing this work, cite the original published paper.

Permanent link to this version:
http://urn.kb.se/resolve?urn=urn:nbn:se:hig:diva-35340
Sustainability practices in Spanish higher education institutions: An overview of status and implementation

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\textbf{ARTICLE INFO}

Article history:
Received 30 March 2020
Received in revised form 30 December 2020
Accepted 7 February 2021
Available online 21 February 2021

Handling editor: Dr Sandra Caeiro

Keywords:
Higher education institutions
Research for SD
Higher education for sustainable development
Sustainability science
Bibliometrics
Implementation of sustainable development

\textbf{ABSTRACT}

Higher education institutions have been steadily progressing towards the integration of sustainable practices in their university system. Consequently, an increasing number of these institutions have recognized their responsibility and are incorporating sustainability into their operations and practices, following a holistic approach. Despite these efforts in the implementation, there are still many challenges to pursue sustainability. In the Spanish framework, there is a lack of studies that investigate sustainable development in higher education by considering all the dimensions. Especially, the efforts of the Spanish Universities in research have been scarcely analysed in detail. This study analyze how Spanish Public and Private Universities (SUE) are integrating sustainability into their institutions by the following dimensions: Research (based on a search strategy proposed by considering the social, economic and environmental perspective); Internationalization (participation in GreenMetrics ranking and European Framework projects); University Governance (Strategic Plans); Assessment and Reporting (Sustainability Plans) and Campus Operations (Green offices).

The findings reveal that some institutions present a higher production of scientific activity on the topic (e.g. UAB), while others with less production are more specialized (e.g. UA). The commitment of the universities has increased over time but it varies greatly among different kind of universities, especially in favour of the public institutions. By analyzing the correlation between sustainability practice, it was found that there are high association between some of the variables i.e. sustainability plan and having a green office. However, this study clearly demonstrates that although SD is recognized as being very important to HEIs and society, it is not yet embedded in the whole system's strategies, activities, and policies.

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1. Greening higher education institutions

Achieving sustainable development is a challenge, and societal actors need to participate. In this regard, higher education institutions (HEIs) should play an active and fundamental role in promoting sustainability practices. According to Hesselbarth and Schaltegger (2014), they should be leaders in the search for solutions and alternatives to current environmental problems and agents of change. The sustainability movement in higher education has been rooted in the recognition of the greening university in the environmental education movement of the 1960s and 1970s (Corcoran et al., 2004). This movement implies that all dimensions (academic, administrative policies or facilities management) defined by Koester et al. (2006) comprise a “whole system approach”. These institutions have made great efforts to integrate sustainability into their actions. This progress is undoubtedly linked to the different conferences held and the declarations and agreements that emerged from them, especially, since 1990s (e.g. Talloires Declaration, 1990 or the Halifax Declaration, 1991) or initiatives such as partnerships or networks like the Higher Education Sustainability Initiative (HESI) in 2012 (Corcoran et al., 2004). However, it has been highly debated that this signing commitment does not ensure the implementation of SD into their systems (Grindsted, 2011).
For Velazquez et al. (2006) a sustainable university is a “HEIs that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulﬁl its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable life-styles”. Regarding the implementation of sustainability practices in higher education, no set of single criteria is provided, only recommendations. As it is stated by Corcoran et al. (2004): the ﬁeld of sustainability is complex because “there are no two institutions alike and within institutions, no two schools alike”. For instance, there are factors such as the cultural and national border that could affect the involvement in sustainability. In the literature, different aspects or tools have been identiﬁed to measure sustainability (Yarime and Tanaka, 2012). While in some universities being considered a “sustainable university is based on having an environmental plan, environmental guidelines, or a statement, others consider declarations, institutional policies, or the implementation of the ISO 140001 standard, among others” (Alshuwaikhat and Abubakar, 2008). According to Ryan et al. (2010), sustainability at HEIs reaches “beyond individual curriculums and isolated environmental practices and policies; it alienates actions in academic priorities, organizational abilities, new technologies, the ﬁnancial systems”. This is in line with Lozano (2013b, 2015), Cortese (2003) and Chambers and Walker (2016) that pointed out sustainability can be approached at HEIs in the following ﬁve dimensions: (a) education; b) research; c) campus operations; d) community outreach; e) assessment and reporting”. In other studies, participation in R&D projects or participation in rankings (e.g. GreenMetrics) is seen as an indicator of sustainability-related activities of these institutions (Bautista-Puig et al., 2019; De Filippo et al., 2019). In this sense, sustainability can be implemented in different dimensions in HEIs framework. This has led to the emergence of the concept of sustainable higher education institutions (SHEIs) (Almarshad 2017; Aleixo et al., 2017). As Caeiro et al. (2013) have stated, “the emergent ﬁelds of sustainability science and Education for Sustainable Development have advanced the efforts toward sustainability from the HEIs but despite some progress, only a few institutions follow a holistic implementation”. That is, not all the universities incorporate sustainability in all their dimensions. Moreover, for Lozano (2006a) referring to Rogers study (1962), there are ﬁve stages of implementing SD, corresponding to different groups of participants and “most HEIs are in the early stages of SD implementation”. This fact suggests the implementation is a slow procedure.

However, involvement in SD is voluntary for universities, and many studies have described their resistance, which constitutes a limiting factor. Universities are rigid structures as a result of the existence of complex bureaucracy, as well as the limited capabilities and multi-tasking responsibilities to sustainability leaders (Blanco-Portela et al., 2018). These two issues—the fact that participation is voluntary and the rigid structure of the universities—limit the expansion of these projects and a greater commitment to SD at the HEIs. Velazquez et al. (2005) have underlined certain problems, such as the lack of awareness, interest, and involvement; the organizational structure or the lack of funding or support from university administrators, among others. As pointed by Leal Filho et al. (2017, p.99), the “areas of administration and management are the greatest obstacles to SD in HEIs”. For instance, they do not have the authority to compel teachers to implement sustainability into the curriculum. Moreover, according to these authors, these obstacles have caused a lack of administrative structure for SD (e.g. environment committees). Leal Filho et al. (2018a) have analysed case studies from different countries and determined that lack of planning or ﬁnancial support is one of the drawbacks identiﬁed, but also the integration of three main components of SD that need to be holistic and comprehensive. Another argument is the fact that is mainly focused on environmental programmes, speciﬁcally as regards two issues: “ﬁrst, reducing energy consumption, waste, and integration into mainstream university operations and, second, greening the curriculum” (Roy et al. Yarrow, 2008; Larrán et al., 2015b). Amaral et al. (2020) pointed the successful implementation of sustainable initiatives in HEIs is strongly inﬂuenced by internal social and governance restraints. For other authors, the problem “engagement of all participants in the major driver” (Godemann et al., 2014) and cooperation is emphasized as one strategy towards sustainability. Precisely, the reason universities cannot fully implement SD is that SD is more than a theory: it is a call for action, a work in progress. On this regard, Sustainable Development Goals (SDGs) appears as an opportunity for those institutions.

2. Sustainability in HEIs in the Spanish context

Interest in sustainability in Spain has been mounting: many institutional statements have emphasized the need to implement SD at HEIs (Larrán et al., 2014, p.). The 2015 University Strategy (Ministerio de Educación, 2010) gave great importance to the “social responsibility of the university system” and highlighted the relationship with the environment. The main aim was to adapt the “guidelines proposed by the European Higher Education Area and [establish] a special commission responsible for the elaboration of a document titled University Social Responsibility and Sustainability” (Andrades Peña et al., 2018). At the legislative level, the Spanish government also introduced “Organic Law April 2007 on universities, which aims to incorporate sustainability in areas such as management and accountability, and Law February 2011 on Sustainable Economy” (Larrán et al., 2015b). These constitute the basis for “the implementation of sustainability at HEIs”. At the research level, the VI National Scientiﬁc Research, Development and Technological Innovation Plan (2008–2011) incorporates “strategic action about energy and climate change”. The State Plan (2013–2016) included a programme called Societal Challenges on issues such as sustainable transport, action for climate change and energy, among others; these issues are also present in the current Innovation Plan (2017–2020). This is associated with the research lines in which HEIs can apply for funding for the realization of research projects.

As highlighted by Larrán et al. (2016), Spanish HEIs has started working in sustainability issues since six years ago. The group on Evaluation of University Sustainability at the Sectoral Commission for Environmental Quality, Sustainable Development and Risk Prevention (CADEP, as per its Spanish acronym) (Conference of Spanish University Rectors, CRUE) was created in 2004 (Alba, 2007). The group established a “set of indicators to assess the progress of Spanish universities on their path to sustainability”. These indicators are grouped into three areas: (1) management, (2) teaching and research, and (3) environmental management. In 2009, they created a sectoral group on sustainability with nine working groups1 CRUE, 2018 This has also led to an auto diagnosis tool, with the participation of 33 universities. Its last report stated that HEIs have improved in these areas and great efforts have been made in environmental aspects; however, curricular sustainability has not been implemented CRUE, 2018. Moreover, there is another network in Spain that belongs to the Sustainable Development Solutions Network (SDSN) and it is called Spanish Network for

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Sustainable Development (REDS). This Spanish network was created in 2015 with a mission “to mobilize and sensitize Spanish society, public institutions and the private sector so that they know in a more rigorous and committed way the SDGs, as well as favouring their incorporation of public policies, business environment and in the behaviour of society in general.”

Various studies have analysed the commitment of Spanish HEIs towards sustainability with different approaches. According to León Fernández (2015), “Spanish HEIs are making a great effort to incorporate environmental management and sustainability into their activities and the creation of sustainable campuses”. Larrán et al. (2016a) have analysed the strategic plans of universities, and their “findings suggest that there is a low presence of sustainability strategies at Spanish universities”. According to Bieler and McKenzie (2017), strategic plans are relevant for HEIs because their offer information “on the extent to which there is a commitment towards whole institutional change”. Moreover, this value could be influenced by data availability and having their website updated. In addition, some strategic plans remain private (e.g., Fundación Compromiso y Transparencia) (Cavanna and Medina, 2017). Alba (2007) has stated that all universities have some activity related to sustainability. Other studies have focussed on the learning context or the teachers’ competences (Lesal Filho et al., 2018b; Albereda-Tiana et al., 2018), or on environmental habits (Chuvieco et al., 2018). Regarding the research on SD, bibliometrics is a research area focused on examining the scientific activity in a given subject area, institution, or country. There are different bibliometric studies that analyze sustainability or SD or sustainability science (Kajikawa et al., 2014; Olawumi and Chan, 2018) while other focus mainly on analyzing the output of sustainability in higher education (Veiga-Ávila et al., 2018; Alejandro-Cruz et al., 2019; Hallinger and Chatpinynakoop, 2019). Some studies focused on Spanish Framework: Bautista-Puig et al. (2019d) and De Filippo et al. (2019) analyze the scientific output of environmental sustainability by using a category called “Green & Sustainable Science & Technology”. Some observatories monitor the scientific activity of the Spanish HEIS. That is the case of IUNE Observatory that was created to monitor its activity and offers information on papers (as well as other dimensions) for public and private HEIs. However, as underlined by Manzano et al. (2016), in the Spanish context private universities have a higher dedication to teaching rather than research.

Although sustainability in HEIs has been studied for over 20 years, relatively little is known about the status of its implementation in Spanish HEIs and especially on the contribution towards research on SD. However, HEIs are not only a key sector for the analysis of sustainability, but also a crucial agent in the generation of knowledge. Between 2012 and 2016, the Spanish university sector (public and private) was responsible for 61% of the Spanish scientific production in the Web of Science (WoS) database. Universities constitute the first sector in terms of scientific output, followed by the health sector (28%), mainly hospitals, and the Spanish National Research Council (CSIC), responsible for 16% of the Spanish scientific production in the WoS database in that period (Bordons et al., 2017). Despite there are some studies that have approached sustainability output at HEIs to the best of our knowledge, no other study has approached the analysis of the sustainability relation in research output from the social, environmental and economic perspective from a bibliometric point of view and few studies have focused on considering multiples dimensions.

3. Objectives

Considering the importance of SD, this paper analyses the development of research on this topic in the Spanish HEIs, as well as their commitment, from 2008 through 2017. The objectives of this study are two-fold:

1) How is research on SD carried out by HEIs? This question seeks to determine the main actors in the Spanish framework and the most specialized on the research on SD. For that purpose, we designed a search strategy for collecting the output in order to analyze the research effort.

2) What is the commitment of Spanish HEIs through sustainability? This question analyses with different indicators how committed are Spanish Universities with sustainability, based on the following dimensions identified in the scientific literature (Chambers and Walker, 2016; Lozano et al., 2015): University Governance, Assessment and Reporting and Campus Operations. In contrast with other studies, we also propose the Internationalization perspective (projects and participation in rankings) associated with R&D relevance.

The other sections of the paper are organized as follows: Section 2 covers the sources and research methodology used. Section 3 introduces the most prominent findings and section 4 compares these results with earlier research. Finally, section 5 presents the main conclusions and suggestions for future research.

4. Data sources and methodology

This study focuses on the analysis of the research output of Spanish HEIs as well as the commitment based on different dimensions. The universities selected for this study are the ones from the IUNE Observatory, that comprises 50 public and 32 private universities, which conducts research activities. That is, 100% of all the private and public Universities according to the Ministry of Science, Innovation and Universities. Previous literature studies have been used for characterizing the different dimensions of sustainability at HEIs (see Supplementary Material). That is research, university or governance, assessment and reporting, and campus operations. Based on the description, some representative indicators have been selected for each one. As well, another dimension labeled ‘Internationalization’ has been included. This includes participation in GreenMetric ranking and participation in R&D projects. Information for this study was sourced from the following sources:

- For collecting the scientific output, the Web of Science (WoS) was the source for collecting SD publications studied. WoS is an international multidisciplinary database that has been indexing

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3 IUNE Observatory was created by a group of researchers from Carlos III University of Madrid, Autonomous University of Madrid, Autonomous University of Barcelona and Pompeu Fabra University, which constitutes ‘Alianza 4U’ network. This Observatory monitors the scientific output for the research output in public and private Spanish universities by analysing different dimensions. More information available in: http://www.iune.es/.
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Table 1  
Summary table of the Unidimensional Indicators of the Spanish HEIs used in this study.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research patterns</td>
<td>- Output by institutions: absolute values and “Activity Index” (AI) of their research (Eq. A.1.)</td>
</tr>
<tr>
<td>- Inclusion in GreenMetric ranking</td>
<td></td>
</tr>
<tr>
<td>- Participation in EC-funded projects related to sustainability:</td>
<td></td>
</tr>
<tr>
<td>University or governance and assessment and reporting</td>
<td>- Inclusion of sustainability in strategic plans.</td>
</tr>
<tr>
<td>- Sustainability plans.</td>
<td></td>
</tr>
<tr>
<td>- Participation in networks: CRUE and REDS.</td>
<td></td>
</tr>
<tr>
<td>Campus operations</td>
<td>- Green offices.</td>
</tr>
</tbody>
</table>

the most prominent scientific journals in science, technology, social sciences and humanities since 1945. In this study, we have used the Centre for Science and Technology Studies (CWTS) in-house WoS database. This is a version of WoS but with some enhancements (e.g. harmonization of affiliations …). A total of 5288 documents has been collected from Spanish HEIs in the period 2008–2017.

- The Community Research and Development Information Service (CORDIS) database contains information on the projects funded by the European framework programme for research and innovation. The Framework Programmes for Research and Technological Development (also known as the Framework Programmes) are funding programs created by the European Union and European Commission to support and foster research in the European Research Area (ERA). In this analysis, only projects related to FP7 and H2020 were considered. These two programmes cover the same period as the research activity. We have selected the sub-programs more linked with sustainability. These programmes selected can be summarized as follows:

- **FP7**: Cooperation-specific programme. This sub-programme constitutes one of the principal building blocks of this programme. The subprogrammes selected are as follows:
  - Environment subprogramme.
  - Energy subprogramme.
  - Transport subprogramme.
  - Social sciences and humanities subprogramme.

Within the H2020 programme, there are specific sub-programmes in which societal challenges and sustainability are addressed (called “societal challenges”). For the purposes of this study, we have selected the following ones:

- **The food security, sustainable agriculture, and forestry, marine, maritime, and inland water research, and the bioeconomy.**
- **Secure, clean, and efficient energy.**
- **Smart, green, and integrated transport.**
- **Climate action, environment, resource efficiency, and raw materials.**

- The GreenMetric World University Ranking it is a global sustainability ranking developed by the University of Indonesia (UI) in 2010. The “main purpose of the ranking is to provide the result of online survey regarding the current condition and policies related to green campus and sustainability in the universities all over the world”. It analyses six categories with its different weights: “setting and infrastructure (15%), energy and climate change (21%), waste (18%), water (10%), transportation (18%), and education (18%)”. It was not until 2012 that the education perspective was included. Despite its criticisms on the indicators and the number of participants, it is the only ranking that offers an overview of sustainability at HEIs worldwide. However, it should be considered that not all the Spanish universities of this study are participating in this ranking.

- Other sources. For the information on the other dimensions detailed on Table 1, the information has been checked on each of the websites of the Spanish HEIs. For instance, strategic plans and sustainability plans were collected, as well as the information on the Green Offices. These offices were selected because it may support institutional efforts in pursuing and implementing sustainability. Moreover, the participation in two Spanish Networks (CRUE and REDS) has been checked on its correspondent websites.

The study was developed in two stages. In the first step, the data collected provided sufficiently descriptive information to characterize the results of each of the aforementioned dimensions based on the different sources. The second stage consisted of the analysis of the relationship between variables. The steps taken to reach the objectives proposed are set out below:

- **Formulation of a search strategy**: The first step consisted of identifying the appropriate textual corpus to analyze. Drawing from an analysis of earlier bibliometric studies, a search strategy was formulated based on triple-bottom line approach (TBL). That is social, economic, and environmental pillars. For the environmental pillar, we use a well-defined WoS category (called ‘Green & Sustainable Science & Technology’). For the social and the economic pillar, we searched ‘social sustainability’ and ‘economic sustainability’ in CWTS publication-level classification (Waltman and Van Eck, 2012). More details on the search strategy are provided in the appendix and Bautista-Puig (2020). This strategy supposes a novelty in comparison with previous bibliometric approaches that capture sustainability by searching ‘sustainability’ or ‘sustainable development’. Only articles as document type were considered in the analysis from 2008 to 2017.

- **Establishment of bibliometric and commitment indicators.** We selected a group of indicators as a representativity of different dimensions. For the research patterns, traditional bibliometric indicators have been selected: scientific output and specialization index (Frame, 1977), which shows the specialization on a specific topic, in this case, sustainability. For university or governance and assessment, and reporting and, campus operations dimensions, indicators have been selected according to previous studies. Besides, ‘University or governance’ and ‘Assessment and Reporting’ has been grouped into a

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Footnotes:

6 For more information about this enrichment, the reader is referred to Waltman et al. (2012).

single category. In addition, a new category called ‘Internationalization’ has been included, which is linked to R&D and includes participation in European Commission funded projects and rankings. The following indicators were analysed for the final dataset. The different indicators allow us to obtain a picture of the efforts in Spanish HEIs towards sustainability from a holistic point of view, by considering different dimensions. In a second stage, the relations between quantitative and qualitative variables are explored with chi-square and whisker plots. A chi square test (or $\chi^2$ test) is used to determine the degree of association between variables in a contingency table. Moreover, the graphical methods box- and whisker plots were used for displaying variation in a set of data, allowing comparisons. Different categorical variables versus the numeric variables (number of documents) are explored with this technique.

5. Results

This section offers an overview of research activity in sustainability at Spanish HEIs and their commitment measured by different dimensions such as Internationalization, University or governance and assessment and reporting and Campus Operations. These four dimensions identified are analysed and their relations is latter explored:

5.1. Research patterns

Table 2 presents the most productive HEIs in Spain with sustainability research. That is the ones that presented a higher number of documents. The most productive university in this field is the UAB with 342 documents (0.98% of their total production), UPV with 250 documents (1.61%), UPM with 244 documents (1.77%), UNIZAR with 226 documents (1.20%), UPC with 219 documents (1.36%), EHU with 217 documents (1.21%) and USC with 203 documents (1.20%). For some institutions, the output in sustainability overcome the 3% of their total production (e.g. UA, URV). The size of the bubbles indicates the number of publications in WoS of each institution. Only institutions with a higher output on this topic with, at least, 100 documents on the topic are included in the figure. However, bigger universities could have a higher output than smaller. However, with the activity index, it is possible to determine the degree of specialization of these institutions in this topic. Universities such as UAB, which has a higher production (342 documents), present lower specialization (AI of 1.98%). On the other hand, universities with lower scientific output present a higher specialization: e.g. UAL with 124 documents and an AI of 6.26%, UCO with 194 documents and an AI of 4.55%; UPM with 244 documents and an AI of 3.57%.

<table>
<thead>
<tr>
<th>Position</th>
<th>HEIs</th>
<th>P</th>
<th>% P/P (Organization)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Universitat Autònoma de Barcelona (UAB)</td>
<td>342</td>
<td>0.98</td>
</tr>
<tr>
<td>2</td>
<td>Universidad Politécnica de Valencia (UPV)</td>
<td>250</td>
<td>1.61</td>
</tr>
<tr>
<td>3</td>
<td>Universidad Politécnica de Madrid (UPM)</td>
<td>244</td>
<td>1.77</td>
</tr>
<tr>
<td>4</td>
<td>Universidad de Zaragoza (UNIZAR)</td>
<td>226</td>
<td>1.20</td>
</tr>
<tr>
<td>5</td>
<td>Universitat Politècnica de Catalunya (UPC)</td>
<td>219</td>
<td>1.36</td>
</tr>
<tr>
<td>6</td>
<td>Universidad del País Vasco (EHU)</td>
<td>217</td>
<td>1.04</td>
</tr>
<tr>
<td>7</td>
<td>Universidad Santiago de Compostela (USC)</td>
<td>203</td>
<td>1.21</td>
</tr>
<tr>
<td>8</td>
<td>Universidad de Córdoba (UCO)</td>
<td>194</td>
<td>2.26</td>
</tr>
<tr>
<td>9</td>
<td>Universidad de Granada (UGR)</td>
<td>189</td>
<td>0.79</td>
</tr>
<tr>
<td>10</td>
<td>Universidad de Castilla la Mancha (UCM)</td>
<td>158</td>
<td>1.62</td>
</tr>
<tr>
<td>11</td>
<td>Universidad de Sevilla (US)</td>
<td>155</td>
<td>0.73</td>
</tr>
<tr>
<td>12</td>
<td>Universidad Autónoma de Madrid (UAM)</td>
<td>140</td>
<td>0.51</td>
</tr>
<tr>
<td>13</td>
<td>Universidad de Oviedo (UNIOVI)</td>
<td>130</td>
<td>0.97</td>
</tr>
<tr>
<td>14</td>
<td>Universidad de Alcalà (UA)</td>
<td>124</td>
<td>3.11</td>
</tr>
<tr>
<td>15</td>
<td>Universidad de Vigo (UVIGO)</td>
<td>109</td>
<td>1.20</td>
</tr>
<tr>
<td>16</td>
<td>Universitat de Barcelona (UB)</td>
<td>108</td>
<td>0.25</td>
</tr>
<tr>
<td>17</td>
<td>Universidad Complutense de Madrid (UCM)</td>
<td>107</td>
<td>0.30</td>
</tr>
<tr>
<td>18</td>
<td>Universidad de Salamanca (USAL)</td>
<td>102</td>
<td>0.84</td>
</tr>
<tr>
<td>19</td>
<td>Universitat Rovira y Virgili (URV)</td>
<td>99</td>
<td>1.08</td>
</tr>
<tr>
<td>20</td>
<td>Universidad de Extremadura (UNEX)</td>
<td>94</td>
<td>1.41</td>
</tr>
</tbody>
</table>

Source: Compiled by CORDIS.8 Acronyms of HEIs can be found in the following link: http://www.iune.es/es_ES/glosario/listado-universidades.

5.2. Internationalization

5.2.1. GreenMetric ranking

The participation of HEIs in GreenMetric Ranking9 has increased from 95 universities in 2010 to 718 in 2018 (129.47%). Thus, while in 2010 a total of five Spanish universities participated, in 2018, this figure amounts to 28, marking an increase of 460%. Table 3 shows the twenty-eight Spanish universities that are on the ranking with its position by years. Dimension 1 is the six dimensions evaluated by GreenMetric and Dimension 2 is the score of each University. In addition, it shows the evolution of the position over time. In 2010, the university with best position (16th) was the UAH, followed by UPV in 42nd, UV in 44th, UNARRA in 60th, and USC in 68th. Remarkably, at national level, the UAH maintained its leadership from 2010 to 2014 with positions between 12 (in 2013) and 31 (in 2011). While in 2015 and 2016, the Spanish HEIs in the ranking was headed by the UAB, in positions 20 and 14, respectively (Table A1). Fig. 2 shows a correspondence analysis between the Spanish universities with more than 70 documents on the six areas of the GreenMetric Ranking 2018. The size of the nodes shows the number of documents according to the search strategy developed in this study. This positioning can be interpreted as an indicator of a higher score in this area. The score is calculated as follows: Setting and

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8 Indicators considered in GreenMetric ranking are available at: http://greenmetric.ui.ac.id/criteria-indicator.
Infrastructure values 15%, Energy and Climate Change 21% and 'Waste', 'Transport' and 'Education and Research' represents 18%. Some universities, such as UJI or UNAVARRA are near to setting and infrastructure, with scores of 1150 and 1,125, respectively; UAH has a score of 1400; UIB, 50; UJAEN, 1075; and UVIC, 900, close to transportation. UDG and UMH are close to the category "water", with 600 and 775, respectively; ULPGC presents a score of 1,275, close to education and research10. UB, UV and URV, with scores of 1,200, 1425 and 1,650, respectively, are close to waste. In this framework, few universities are close to energy and climate change.

5.2.2. Participation in European projects related to sustainability

The participation of HEIs in European projects has been analysed. In this regard, two programme frameworks that coincide with the period of study have been considered: FP7 (2007–2013) and FP8, more popularly known as the H2020 programme (2014–2020). Considering that sustainability is a transdisciplinary topic, a few representative subprogrammes for its relation with the topic have been selected, in order to analyze the participation of HEIs. In the 7th FP, a total of 25,778 projects were identified.11 1,841 of them were identified as considering the selected subprogrammes. Within this group, 4,615 were coordinated or had a role as partner. The call in which HEIs have the most participation is transport, with 535 projects. If their participation is compared with the total number of projects in the call, HEIs have a significant presence in the social sciences and humanities, with 238 projects (94.07%), followed by the environment programme, with 437 projects (88.46%).

![Fig. 1. Bivariate plot of the scientific output vs AI of Spanish HEIs (2008–2017).](image)

**Table 3**

<table>
<thead>
<tr>
<th>Typology</th>
<th>Strategic plan</th>
<th>Sustainability plan</th>
<th>Network 1</th>
<th>Network 2</th>
<th>Green office</th>
<th>GreenMetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology</td>
<td>1</td>
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<td></td>
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<tr>
<td>Strategic plan</td>
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<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Sustainability plan</td>
<td>30.124*</td>
<td>2.771*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network 1</td>
<td>5.929*</td>
<td>.033*</td>
<td>5.407*</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network 2</td>
<td>5.676*</td>
<td>1.880*</td>
<td>8.567*</td>
<td>.085*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Green office</td>
<td>12.490</td>
<td>1.567*</td>
<td>17.580*</td>
<td>10.185*</td>
<td>2.200*</td>
<td>1</td>
</tr>
<tr>
<td>GreenMetric</td>
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<td>2.405*</td>
<td>11.235*</td>
<td>1.842*</td>
<td>4.615*</td>
<td>3.071*</td>
</tr>
</tbody>
</table>

H0 is rejected with $p < .05$ *.

Source: Elaborated by the author from data collected in HEIs website and SPSS.

10 For calculating the education and research (ED) dimension of GreenMetric is considered the number of courses/subjects related to sustainability, research funds dedicated to sustainability research, the total number of scholarly publications on sustainability, events related to sustainability, or sustainability reports among others.

11 The number of projects identified are from the Cords Open Data Portal. FP7 projects are collected from the following link [https://data.europa.eu/euodp/es/data/dataset/cordisfp7projects](https://data.europa.eu/euodp/es/data/dataset/cordisfp7projects); H2020 projects are from here: [https://data.europa.eu/euodp/es/data/dataset/cordish2020projects](https://data.europa.eu/euodp/es/data/dataset/cordish2020projects).

12 The query used to search the Universities involved were by searching "Univ".
Moreover, the participation of Spanish HEIs has been checked in these calls. In this regard, Spanish HEIs have participated in 292 projects, with a higher weight in the social sciences and humanities, with 74 projects (31.1%) followed by 100 projects (22.9%) in the environment programme (Fig. 3). The Spanish institutions involved with a higher number of projects are as follows: UPM with 50 projects, UAM with 30 projects, UPC with 25 projects and UB with 24 projects (Fig. 3).

Regarding the H2020 programme, 25,019 projects are identified. However, the project framework is still on-going. The differences of participation on the programmes selected, as well as the HEIs and the Spanish case, are shown in Fig. 4. From the subset of programmes selected, calls for higher HEIs participation in food security programmes with 325 projects (54.99%) and to climate action with 267 projects (45.10%); the other two programmes selected (3.3. and 3.4) present a participation of HEIs close to 40%. Spanish HEIs participated in 336 projects (21.54% of the projects with HEIs participation). Technical universities led 116 projects (UPM, UPV, UPC). Subsequently, 22 projects were led by the US, 19 by the UAB, 16 by the USC, and 12 by the ULPGC (Table A2.).

5.3. University governance and assessment and reporting

5.3.1. Integration of sustainability in strategic and sustainability plans

A strategic plan is a document that summarizes what an organization wants to accomplish in order to achieve its mission and vision. In this context, within this document HEIs are defined by not only their mission, vision, and scope but also their strategies of action. The great majority of Spanish universities have strategic plans published on their websites, more predominantly in public than in private universities. According to a Fundación Compromiso Transparencia (Cavanna and Medina, 2017) report, in 2016, 41 public universities (83.67%) had a public strategic plan, versus 12 private universities (46.15%). In our study, we have identified 58 HEIs that have strategic plans: 14 are private and 44 are public. Of those, 41 universities mentioned sustainability (Table A1.). In public universities, more commitment can be observed than in private ones (35 public and 6 private). Some of them included this information in the sections devoted to their missions (UA, UMU), Values (UBU, UBU, UV, UNED), or as strategic axes (UCO, UAB). Sustainability is mentioned in different ways: some highlighted environmental sustainability (UC3M, UAH, UCO); others, economic sustainability (UJI). Still others mentioned the three pillars of sustainability. By searching which type of sustainability is explicitly mentioned in the documents, it was found the most often mentioned concept is environmental pillar. Another fact that should be highlighted is the limited mentions of the SDGs from some universities (e.g., UNED). (Table A3.).

Regarding assessment and reporting, Table A.4. summarizes sustainability plans collected from public and private Spanish universities. Only official documents on the universities’ websites were considered. 36 public universities (72%) have sustainability plans, versus six private universities, denoting the increased activity of public universities on this topic. Regarding sustainability plans in public universities, there are different typologies: sustainability plans or action sustainability plans (UAH, USAL, UPM, UAB, UCA, UAL, UB); transport or mobility plans (UGR, UPV, UNAVARRA); energy plans (UPC, UNIOVI); declarations from deans about university commitments (UC3M); and best practices guidelines (UIB, URJC). As in strategic plans, the main focus and actions are related to environmental sustainability. Examples of documents from private universities documents are as follows: “Declaration of Environmental Sustainability of the University of Deusto”
(DEUSTO), the framework document for the sustainability and commitment from UIC in sustainability policy, the Memory for sustainability (URL), and a sustainability plan (UVIC).

5.3.2. Network participation

Table A.5. summarizes the participation of public universities in two Spanish networks: CRUE and REDS. According to León-Fernández (2015), apart from CRUE there are also other networks like the Catalan Network of Education for Sustainability Research (EduSost), but such alternatives have not been considered in this study due their regional level. In the first network (CRUE), 52 (78.78%) HEIs belong to this; in the second network (REDS), this value rises to 36 (54.54%).

5.4. Campus operations

5.4.1. Green offices

Another important aspect that shows university commitment is to have a “green” office or environmental office. In the Spanish public universities analysed by SUE (INAECU, 2020), 31 (62%) have this kind of office. Each is called the “Green Office” (UNIZAR, USAL), “Environment Office” (UAB, UVIGO), or “Sustainability Office” (UCA, UNIRIOJA). However, 19 of the universities do not have this kind of office, although some of these have a “Sustainability Classroom” (UHU), UIA). Only three private universities (9.1%) have green offices (DEUSTO, USJ, UVIC) (Fig. 5).
5.5. Relation analysis between variables in the HEIs in Spain

For analysing the relation between variables, Table 3 shows the test results of the chi-square values and their p-value of the 21 categorical values. Each test represents a 2 × 2 table with Yates correction and is calculated with contingency tables. Considering the abuses of the p-value, in this section this value was not used as an inequality but by expressing its exact value and to validate the degree of association from the value obtained for chi-square. This type of contingency table allows to identify whether the differences between two categorical variables are or not random. For instance, there are strong associations (p = .00) between the following variables: sustainability plan versus typology; green office versus typology; sustainability plan versus green office. The following variables has also associations: strategic plan versus typology (p = .04); typology versus GreenMetric (p = .01); sustainability plan versus network 2 (REDS); sustainability plan versus GreenMetric (p = .01); and network 1 versus green office (p = .01). A. It should be considered that in Table 3, only 66 Spanish HEIs have been considered (only the ones with publications data retrieved by the search strategy).

Figure A2 shows the box-and-whisker plots of the different categorical variables (strategic plan, sustainability plan, network 1, network 2, green office and GreenMetric) versus the numeric variables (number of documents). Major variability exists between the public universities in all the categories analysed, revealing differences between public and private universities in all categories. Certain HEIs are commonly outliers (e.g. UAB, UNIZAR in public universities; URL, UNAV, in private universities). Considering the numeric variable “number of documents” with the categorical variables selected, the median is higher in public documents, especially in the affirmative part (e.g. having a sustainability plan, the inclusion of sustainability in the strategic plan, belongs to a network ...) in all the variables. That is, when public universities have a higher number of documents, when mentioning sustainability in their strategic plans and when they have a sustainability plan, they are linked to a network (CRUE and REDS), have a Green office or campus or participate in GreenMetric ranking.

6. Discussion

This section focuses on the discussion of the research results obtained from the sustainability scientific output and the indicators collected from this study.

6.1. RQ1. How is research on SD carried out by HEIs?

For analyzing the research on SD, in this study, we have proposed a bibliometric delineation procedure based on the traditional triple bottom line (TBL) (Elkington, 1998). With the application of our methodology, we have collected a total of 5288 publications from 68 Spanish universities in the period 2008–2017. Previous bibliometric studies that focused on the scientific activity at HEIs presented a lower number of documents than the ones identified in this study in a 10-year period: 1228 in Scopus from 2004 to 2015 (Bizerril, 2018); 1459 documents from 1998 to 2018 in Scopus (Hallinger and Chatpinyakoop, 2019); 5074 documents from 1991 to 2018 in WoS and Scopus (Alejandro-Cruz et al., 2019); and 5924 documents from 2005 to 2014 in WoS (Veiga-Avila et al., 2018). The search strategy of those studies is different (by searching “higher education”, “sustainable development” and “sustainability” in titles, abstracts and keywords) than the approach we presented. Despite the growing interest in this subject, we find that there is very little analysis of sustainability at HEIs in Spain from a bibliometric point of view. The bibliometric study by De Filippo et al. (2019) that analyses scientific activity at Spanish Universities retrieved a total of 3956 Spanish publications in the same period as the present study. Bautista-Puig et al. (2019) identified 2965 papers from Spanish Universities in the same period. The reason for this difference in those studies is linked with the fact that only consider the environmental pillar (by considering the category ‘Green & Sustainable Science & Technology Studies’). In the approach of this study, we also have incorporated the social and the economic pillars as well as a methodology based on seed and expansion by direct citation.

In previous studies, the scientific output of HEIs in Spain has been specifically addressed (e.g. in De Filippo et al., 2019). The results of this study are in line with De Filippo et al. (2019) which identified as the main producers UAB (235 docs.) and technical universities (UPV with 217 docs., UPM with 213 docs., UPC with 203 docs.) similar to top 5 obtained in our study. Bautista-Puig et al.

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The findings of this study suggest an increase in the participation of the Spanish HEIs in GreenMetric ranking over time. This fact denotes the interest of these HEIs in assessing their policies and actions in relation to their efforts towards sustainability and green campuses. However, these results should be taken cautiously. Some studies have criticized this ranking by arguing the low participation of the universities and that is less empirical than other systems (Lauder et al., 2015) and the biases presented. From the results obtained, it can be observed the effort of Spanish HEIs towards areas such as Transportation or Waste. This is in agreement with Hidalgo et al. (2012) that pointed, Spanish Universities have made greater progress in actions related to waste and teaching and, to a lesser extent, have implemented measures on social responsibility, environmental impact assessment, water, and green purchasing.

The commitment of the universities towards sustainability in EC-funded projects is also observed during the period studied. HEIs located in large cities (UAB, UB) and highly specialized (technical universities such as UPM, UPC, UPV) (Manzano et al., 2016) are participating in a major number of European projects related to sustainability. While the strategy is different in comparison with previous studies (Bautista-Puig et al., 2019; De Filippo et al., 2019), the HEIs coincide with the findings presented.

In the ‘university and governance’ and ‘assessment and reporting’ dimension, our results present a higher number of strategic plans (58 vs 45) in comparison with Larrán et al. (2015a) study. This fact suggests an increase in the availability of this document at Spanish HEIs since 2015. Differently to Larrán et al. (2015a, p1) which mentioned there is a “scarcely presence of sustainability initiatives in the strategic plans in Spanish HEIs” (less than 40% of the strategic plans identified), we have found an increase in mentioning sustainability on the plans collected (70.69%). This fact denotes an increase in the commitment and awareness on this topic recently. As stated by Lozano et al. (2015) HEIs that have incorporated SD into their institutional framework can be interpreted as an “official commitment to SD”. In contrast with previous studies, commitment has been expanded in all institutions. For instance, Larrán et al. (2015a) found stronger engagement amongst larger institutions, while our study showed different university profiles, from smaller universities (e.g. UDL, UJI) to larger (UAB, UAH). In addition, despite previous studies analyze if the size of the universities is associated with the implementation of sustainability practices (Siboni et al., 2013), we have observed the interest is higher in public than private universities. Another interesting aspect is the ways in which sustainability is addressed in strategic plans vary: very few included the three pillars of sustainability. This fact coincides with previous studies which stated sustainability is addressed through compartmentalization based on single dimensions of the triple-bottom line (Lozano and Huisingsh, 2011).

Our results also resonate with studies like Aleixo et al. (2016) in the Portuguese HEIs framework: all universities use their webpages to include this information and disseminate SD practices while, in other HEIs systems such as Canada it is not common (Garde Sánchez et al., 2013). Moreover, the great majority of the universities presented in this study, have shown a commitment to SD with its inclusion in strategic plans or sustainability reports. As stated by Lozano (2011) in the Spanish context, USC was pioneering in 2006 in publishing sustainability reports, followed by UCA and UMH in 2007 (Zorio-Grima et al., 2018). This study confirms the observation by Lozano et al. (2013a), who stated there is a tendency towards a growing number of HEIs’ sustainability reports each year. As well, as it is observed, these commitments towards sustainability is also quite recent, in line with the growing awareness of this topic. Another important aspect is the increase in green offices. From the results obtained in this study, 31 institutions (62%) included in the present study have these offices while in previous studies this value is lower (23 technical units) (Alba and Blanco, 2008). However, as it is mentioned by Alba (2006), the creation of these units was the first initiatives in Spanish HEIs.

At the international level, HEIs are experiencing a growing tendency to redefine their strategies regarding the implementation of sustainability in their organizations. As recommended by previous reports, it is needed to advocate for national support and coordination (SDSN Australia/Pacific, 2017). One example that illustrates this fact is the participation in networks. According to Bieler and McKenzie’s (2017) finding, institutional membership to a sustainability association may be a significant factor in progressive engagements with sustainability at the strategic planning level. We observed that all Spanish HEIs that have a sustainability plan also participated within a network, especially in the national network CRUE. This commitment is a sign of this progress, in working collaboratively towards this challenge. However, international efforts are still far. For instance, In Latin-American countries, a group of 65 universities from 10 countries, established a group of indicators to evaluate the sustainability of Universities within RISU project.

7. Concluding remarks

The purpose of this study was to address a gap in the overview of HEIs in Spain. Nowadays, little is known about studies focusing on sustainability research and few studies follow a holistic approach. Transformation in HEIs has emphasized the importance of the third mission, and “social and sustainability values are as important as human, relational or structural capital” (Brusca et al., 2018). According to León Fernández (2015), referring to other authors “the incorporation of sustainable development in the programmes of the university must be accompanied with the structural measures, such as campus environmentalisation and other related actions, that are accompanied by initiatives aimed at involving the university community” (Leal-Filho, 2019). It is related to a new paradigm shift. The results of this section show there has been a stronger interest in SD integration in Spanish HEIs, which accords with previous studies. This shows that sustainability crosses all boundaries in university activities; however, ‘there should be a greater commitment to SD by university leaders in order to create a holistic system’.

The results of this study suggest considerable implications for university planners and decision-makers in HEIs. First, there should be a greater interest by university leaders to get an overview of Spanish HEIs in different dimensions. Findings suggest the need for Spanish Universities to increase their commitment to sustainability, and to foster other dimensions (social and economic) in different aspects (strategic plans, sustainability plans ...). Second, it is needed a variety of policy instruments to evaluate and assure sustainability. For instance, the auto-evaluation tool from CRUE (as well as other tools) is really valuable but other actions could be
promoted (for instance, incentives to increase awareness). Setting benchmarks and establish a common framework for continuous monitoring would be fundamental to a better understanding of the current situation. In addition, it would be relevant to publicly share this information and provide public access of this information to help decision-making. Third, working collaboratively in national/international networks with other countries in order to establish a common framework and sharing practices should be promoted. The participation in these networks would be crucial (e.g. to centralize information, procedures, etc.). These findings seem to suggest that there has been a considerable effort from HEIs in recent years, however, there is still a long path to go for Spanish HEIs to be adapted to sustainability.

Some limitations of this study should be highlighted. Moreover, participation in GreenMetric is voluntary, so their results have biases. Only a few universities are participating and this seems to be biased in favour of their strong commitment towards sustainability. Regarding university and governance, and assessment and campus operations, despite that the websites relate all the procedures and activities that are relevant, it is not possible to collect complete information on the initiatives that have been carried in SD. As well, different nomenclature in the plans was identified with different criteria. Another important limitation is the lack of Teaching dimension in this study. This has not been approached due to its difficulty in collecting the information from the courses in all Spanish Universities as well as the complexity in determining its relatedness. Future studies on the topic might be complemented by means of qualitative research methods to uncover motivations and drivers for policies in HEIs contexts.

CRediT authorship contribution statement

**Núria Bautista-Puig:** Conceptualization, Investigation, Methodology, Software, Data curation, Formal analysis, Writing - original draft. **Elías Sanz-Casado:** Investigation, Supervision, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

This work was supported by the predoctoral contract BES-2015-075461.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2021.126320.

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