

1 **Discussing a challenging document focused on Land Use: The first bibliometric analysis of**  
2 **Laudato Si'**

3 **Authors:**

4 [Corresponding Author] : Paulo Reis Mourao (email: paulom@eeg.uminho.pt). Dept  
5 Economics; University of Minho; 4700 Braga, Portugal – telephone number:  
6 00351965823442

7 Vítor Domingues Martinho (vdmartinho@gmail.com).Polytechnic Institute of Viseu;  
8 3500 Viseu, Portugal

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15 **Abstract**

16 We live challenging times on several levels, and in this context the second encyclical, Laudato  
17 Si' (LS), of Pope Francis, published in 2015, has provided a special challenge for academics. As  
18 Pope Francis suggested in 2015, societies are challenged to modify the paradigms of life to  
19 achieve more sustainable development. LS has quickly become a widely quoted document,  
20 even by academics. This paper is the first bibliometric research about LS aiming to analyze this  
21 encyclical and explore several works published about LS between 2015 and 2020. To this end,  
22 we studied all documents published in the Web of Science Core Collection (238) and Scopus  
23 (222) about the topic "Laudato Si'" in depth and analyzed them using bibliometric methods.  
24 The results show that there are scientific fields focused on studying LS in particular, namely  
25 Religious Sciences and the fields of Sustainability and Environment Studies. We also observed a  
26 small amount of networking among the authors publishing about LS.

27  
28 **Keywords:** Bibliometric research; Laudato Si; Development; Global issues

29  
30 **Introduction**

31 Laudato Si (LS) is an encyclical signed by Pope Francis that was published in 2015. At the time,  
32 several sources identified it as a pontifical document with an ecological focus. Little by little,  
33 however, it has become clear that this encyclical called for sustainability not only of the planet  
34 but also of the relationships between people in order to generate a sense of justice, a

35 guarantee of transmission of the natural heritage and a belief in economic and social equity,  
36 within the communities and also among various countries.

37 As this is a document signed by a religious figure, one could suppose that scientific publications  
38 would not include quotes from the LS. However, as this document will show, this did not occur.  
39 LS, in the five years since its publication, has been cited in 238 documents identified by the  
40 Web of Science (WoS). Furthermore, these scientific publications are not restricted to journals  
41 focused on religious or theological studies, but gradually the fields of natural sciences,  
42 sustainability, ecology and forest sciences have also read, studied and discussed the LS.

43 On the one hand, it may be assumed that the citations of the LS in such diverse areas of  
44 scientific study reveal the success of the scope of this document. However, this work will show  
45 that the majority of the references still come from documents in religious and theological  
46 fields, which proves to be a serious challenge if we consider that the encyclical's stated  
47 intention has been to reach the majority of scientific fields involved in current social and  
48 political action. Finally, using P1 models (probability of citation between journals), we  
49 demonstrate that the articles that cite the LS are more likely to cite works from other journals  
50 in the same scientific field, which can delay the LS's ability to be analyzed in several other  
51 academic and bibliometric fields.

52 The next chapters have the following structure. Section 2 revisits the LS and its content.  
53 Section 3 details our bibliometric effort and the surrounding debate. Section 4 concludes the  
54 paper, raising some promising challenges for future avenues of study.

55

56

57

## 58 **2. LS as an encyclical that (also) engages academic debate: From a description of the** 59 **structure to a justification of the current analysis**

60 Works such as those by Kerber (2018) or Bavaresco (2016) detail the contents of the LS. We do  
61 not intend to replicate the framework analysis of the LS that has been completed in areas as  
62 diverse as environmental policy, theological reflection, sustainability or international relations.  
63 For these debates, we suggest the works of Capaldi (2017), Neves et al. (2016), Muscolini  
64 (2016), Peppard (2016) and/or Thomasset (2019).

65 However, we consider it relevant to briefly present the LS's content in order to better  
66 understand the scope of the literature as well as the potential that it has presented for many  
67 of the works that we will analyze in our bibliometric effort.

68

69 Chapter 1 serves as an introduction to the main dimensions of the LS. It starts with the  
70 responsibility of the human species to end its violent transformation of the natural  
71 environment and moves towards the need for action to repair and recover the earth based on  
72 the 3Rs: Reduce, Reuse, and Recycle.

73 Chapter 1 also identifies how human's current impact on the environment and the planet's  
74 resources has led to growing weaknesses, especially affecting the communities that mostly  
75 dependent on natural resources (especially rural and fishing communities) while also harming  
76 communities with more consumption capacity through the practice of superfluous  
77 consumption or an addictions to the so-called 'waste disposal'. The combination of these  
78 factors means that we are faced with the threat of a reduced legacy for future generations.

79 Chapter 1 is further developed based on a call to action/conversion, manifested in a change in  
80 behaviors, lifestyle, forms and methods of production, and consumption practices. In addition  
81 to touching on dimensions such as water management, Pope Francis mentions the need for a  
82 different view of the economy, calling for more solidarity and less focused on immediate  
83 profits or outcomes. It also recognizes that current economic models have been generating an  
84 enormous amount of suffering (albeit silent), a suffering affecting millions of human beings  
85 mired in poverty, pollution, loss of biodiversity, and social degradation.

86 Chapter 2 develops the theological foundation of the LS. Reinforcing the idea that the present  
87 requires action, it denounces the prevalence in current international relations of the 'law of  
88 the strongest'. It is in this chapter that we can see, more clearly, that this document aims to  
89 reach everyone, following a precedent used by, for example, John XXIII, which tended to sign  
90 documents addressed to 'all men of goodwill'.

91 Chapter 2 signals the importance of the dialogue of the faith with other dimensions of human  
92 life, such as poetry and other forms of art but also with regards to scientific knowledge. Even  
93 so, in Chapter 2, it becomes apparent that the renewed vision of creation proposed in the LS is  
94 an important vision for everyone. Evoking the message of the human being 'created in the  
95 image and likeness of God', Chapter 2 also reminds readers of the idea that the planet is a part  
96 of the common good, where private property exists only to contribute to a balanced  
97 management of our 'common home '. Chapter 2 cites several figures and personalities from  
98 the Christian tradition as those who have shared in the vision of the LS from the figure of St.  
99 Francis of Assisi to St. Bonaventure or even the biblical Daniel.

100 Finally, Chapter 2 also points out that the deep wound found in human relationships with  
101 nature must not be compensated for by an exaggerated appreciation of the environmental  
102 realities to the detriment of human relationships, especially detrimental to the most  
103 vulnerable human beings, such as the communities directly dependent on nature for their  
104 survival or the elderly and children of the more industrialized countries.

105

106 Chapter 3 refocuses the discussion on the responsibility of the human being in the face of the  
107 profound changes that have occurred in the natural environment. However, it co-blames the  
108 human beings' output, their means, their tools, and technologies that have contributed to this  
109 transformation. Thus, the absolutization of technology is seen as a cause for the loss felt in the  
110 environment, for global warming and for the threat of impoverishing future generations.

111 Chapter 3 is also a chapter in which the need for a balanced ecology is emphasized, recognizing  
112 the value of human beings in all their characteristics and ages, especially those who are

113 sometimes valued less than certain environmental movements. Thus, stressing the need for  
114 humanity's values not to be tied to technological success, Chapter 3 calls for a critical reading  
115 of technological evolutions and how the pace of technological progress is itself consuming the  
116 planet's capacity for regeneration.

117

118 The (central) concept of 'integral ecology' is developed in Chapter 4 where authors like DiLeo  
119 (2018) explain the presence of the influence of Leonardo Boff and other (heterodox) authors  
120 (Sadowski, 2016). It is a chapter that reinforces the interconnectedness of creation; that is, all  
121 living beings and non-living beings are interconnected. Thus, it is no longer possible for  
122 someone or some community to feel isolated from what happens to another being or another  
123 community. In keeping with the encyclical 'Evangelii Gaudium' and DiLeo's reading (2018),  
124 there is an "invitation to dialogue with all persons and concern for the vulnerability of creation  
125 to sociopolitical and economic systems that value only profit and power". As DiLeo (2018)  
126 points out, "an integral ecology calls for openness to categories that transcend the language of  
127 mathematics and biology and take us to the heart of what it is to be human." Thus, Chapter 4  
128 calls for a greater look at communities (including the scientific community) and calls for a  
129 transcendent viewpoint. Regarding the concept of 'integral ecology', there is also an  
130 appreciation of human labor, especially the work of farmers and owners of small agricultural  
131 spaces, emphasizing the importance of small-family farming for the value of the products  
132 created for consumption and for an approximation between the role of producers and the role  
133 of consumers (Sommerville et al., 2019).

134

135 Chapter 5 looks for solutions to some of the environmental problems mentioned. While it  
136 assumes that the analyses are not sufficient, it reinforces the need for dialogue and action. The  
137 need for dialogue is extended to all options (religious, political, economic, etc.) This chapter  
138 emphasizes that the Catholic Church does not replace the evidence of scientific debate, but  
139 that it cannot deny the possibility of promoting concerned debated and, above all, action.

140

141 Chapter 5 is a critical chapter for the results achieved, particularly at international summits on  
142 the environment. Thus, recognizing that market mechanisms are not sufficient to guarantee  
143 the answers to the problems of our "Common Home," Chapter 5 again identifies some of the  
144 current problems (in keeping with what was seen in Chapter 1), such as the exaggerated  
145 consumption, the corruption, or the short-term thinking. It claims for the need for  
146 transparency in decision-making processes, and remembering that everyone saves what is  
147 most important to them (criticizing the priority given to banks' financial rescues). It is a chapter  
148 that ends by showing how there is less and less space for the weakest and the least productive,  
149 emphasizing that each and every human being is indispensable to changing the world.

150

151 The last chapter (Chapter 6) reinforces the human beings' role as guests in a "common home."  
152 It is made explicit in this chapter that there must be an individual and community ecological

153 conversion (Crabbé, 2016) and that all people must be guardians of creation. Thus, nobody can  
154 be excused from that responsibility. Returning to a language of the influence of authors like  
155 Boff (Coatanea, 2016), Chapter 6 points out transformative steps, including the reduction of  
156 plastics as a key material for current production processes, the planting of trees, the care of  
157 others, and even increased recognition of the transcendence of creation through prayer and  
158 poetry motivated by Nature (in line with the expression of Saint Francis of Assisi). Using a  
159 biblical foundation, similar to Chapter 2, it appeals to an ethics of sobriety and gratitude  
160 (Crabbé, 2016).

161

162 **The motivations for this work: The importance of LS within encyclicals focused on the**  
163 **environment and ecology**

164

165 In the first paragraphs of the encyclical LS we realized how this document seeks to follow a  
166 series of documents developed by the previous Popes over the last fifty years focused on the  
167 environment and ecology. In particular, between numbers three and six, we see the  
168 identification of the following documents that have somehow influenced the LS: *Pacem in*  
169 *Terris* (John XXIII), *Octogesima adveniens* (Paul VI), *Redemptor hominis* (John Paul II),  
170 *Centesimus annus* (John Paul II), *Sollicitudo rei socialis* (John Paul II), and *Caritas in veritate*  
171 (Benedictus XVI).

172

173 However, performing a descriptive analysis clearly demonstrates how the LS has imposed itself  
174 on the academic discussion published and located by the Web of Science databases (SCI-  
175 EXPANDED, SSCI, A & HCI, CPCI-S, CPCI-SSH, ESCI, CCR- EXPANDED, and IC). The number of  
176 documents referring to each of those encyclicals identified by the Web of Science (as of July  
177 23, 2020) is as follows:

178 *Pacem in Terris* (1963): 23

179 *Octogesima adveniens* (1971): 4

180 *Redemptor hominis* (1979): 4

181 *Sollicitudo rei socialis* (1987): 11

182 *Centesimus annus* (1991): 37

183 *Caritas in veritate* (2009): 47

184 *Laudato Si* (2015): 222

185

186

187 Although other encyclicals have stimulated scientific insights, the LS has sparked relevant  
188 academic debate, as seen above. A bibliometric analysis on the LS is therefore essential for the  
189 following five reasons which, as seen in Ferreira et al. (2020), Kadam (2020) or Pinto et al.  
190 (2019), are the requisite reasons for conducting a bibliometric analysis.

191

192 First, bibliometric analysis allows researchers to 'mark' the evolution of scientific reflection on  
193 a given topic; this markup will be very useful for comparative purposes of analyzing the  
194 subsequent evolution of the topic, in accordance with the discussion by Garcia et al (2019).  
195 Second, the current year, 2020, was considered by the Dicastery for Promoting Integral Human  
196 Development as a Special Year for the LS, which may indicate the need to reinforce the  
197 message with the target audiences already identified in 2015 (Zagonari, 2019) . Taking  
198 advantage of reference years like 2020 is a useful tool to guide the evolution of the scientific  
199 literature on a particular topic (Mourao and Martinho, 2020). Third, we intend to analyze what  
200 the scientific community—one of the 'partners' invoked in the LS document—has been doing  
201 since the LS. Thus, we intend to analyze what the academy has published as a result of  
202 individual reflections and of the academic community on the issue. Fourth and linked to the  
203 previous justification, we have to recognize that the LS is not an encyclical that particularly  
204 focuses on academic and scientific behavior 'per se', as for example the 'Fides et Ratio' by John  
205 Paul II does. In spite of this, such evidence arouses even more interest in analyzing the LS and  
206 the extent to which the LS is an encyclical that also concerns many academic communities. As  
207 Zagonari (2019) recognizes, however, the LS is based on “an inter-disciplinary perspective that  
208 combines science and ethics, and theoretically and empirically assesses its scientific and ethical  
209 statements in terms of their ability to achieve global environmental sustainability.” Finally, we  
210 intend to examine, in the wake of Linneluecke et al. (2020), what trends have been defined,  
211 both in terms of focused scientific fields (Are, for example, the fields of natural sciences citing  
212 the LS more than the theological or economic sciences?) and which universities/institutions  
213 have positioned themselves with greater interest in this debate as so far.

214

215

216 The sections that follow will provide answers to these questions.

217

218

### 219 **3. The bibliometric analysis of Laudato Si' 2015-2020**

220 This research was performed considering documents obtained from the WoS Core Collection  
221 (Web of Science, 2020) and Scopus (Scopus, 2020) databases for the period of 2015 to July  
222 2020 using the search term “Laudato Si.” A total of 238 documents were considered from the

223 WoS database, and 222 documents were considered from Scopus (searching within titles,  
224 abstracts and keywords).

225 In this way, the sample has a total of 460 documents. The year 2018 had the most documents  
226 in the two analyzed databases (figure 1). Additionally, the English language was used for the  
227 majority of the published documents (figure 2). In general, the number of works published in  
228 most other languages was similar for the two databases; however, we also identified a higher  
229 number of studies listed by Scopus written in French, Portuguese and Spanish.

230

231 In the following subsections, we will discuss the distribution of these papers. We will  
232 particularly focus on the following filters: keywords, authors, organizations (i.e. affiliations),  
233 countries, and sources (i.e. journals). For the analysis performed in these subsections, we also  
234 considered the results from the VOSviewer software (VOSviewer, 2020; van Eck and Waltman,  
235 2020).

236

237

### 238 **3.1. Keywords**

239

240 Let us start our bibliometric analysis by paying special attention to the keywords of the  
241 identified works. The keywords are very important elements in a bibliometric analysis because,  
242 according to Pesta et al. (2018), they are terms that the authors consider central to link the  
243 work in question to search engines and to bibliographic search algorithms. Thus, keywords  
244 reveal a commitment on the part of the authors between the core themes of the work in  
245 question with the main topics that the scientific literature is currently considering. Finally,  
246 these words are an identification of the work with the target audience of a specific reading  
247 public.

248

249 Figure 3 and Table 1 present the results obtained through the VOSviewer software for the link  
250 co-occurrence with the item keyword (considering one to be the minimum number of  
251 occurrences of a keyword). The results show that beyond the expected keywords 'Laudato Si'  
252 and 'Pope Francis,' the keywords that occurred more frequently are 'ecology,' 'climate

253 change,' 'environment,' 'sustainability,' 'ethics,' 'justice,' and 'leadership'. In turn, keywords as  
254 'integral ecology,' 'ethics,' 'Catholicism,' and 'justice' are among the earlier occurrences (with  
255 an average publication year of 2016). It is highly relevant (and challenging) that these  
256 keywords are clearly more related to ecological issues than with theological topics; however,  
257 as we will demonstrate later, there have been more articles published in theological journals  
258 than in ecological publications.

259

260 [Insert here Figures 1, 2, and 3]

261

262 [Insert here Table 1]

263

264 Table 1 shows two aspects that are also relevant. The first aspect concerns the observation  
265 that the oldest keywords were more focused on religious subjects. This explains why the  
266 'Average Publication Year' of 'Catholicism,' 'Religion' or 'Incarnation' is 2016. In contrast,  
267 keywords like 'Ecology,' 'Climate Change,' or 'Environment' are associated with later years.  
268 This aspect shows that there is an evolutionary reading of the LS by the identified authors; we  
269 can thus observe that the LS started to be approached within religious studies first and that in  
270 more recent publications it has been increasingly cited as an important document for the  
271 consideration of other fields of the academy, namely the field of climate change and global  
272 problems.

273

274

### 275 **3.2. Authors, affiliations, countries and journals publishing about the LS**

276 Reflecting the output of the VOSviewer, Figure 4 shows that our sample has a total of 323  
277 authors affiliated with 230 organizations, from 36 countries and publishing in 114  
278 journals/sources from the WoS platform. From the Scopus database, results were obtained  
279 from 292 authors, 240 organizations, 35 countries and 112 sources.

280

281 [Insert here Figure 4]

282

283 [Insert here Table 2]

284

285 Taking into account this information, Table 2 reveals that the majority of the authors have  
286 published one document about the LS. Some authors—like Denis Edwards (with four articles)  
287 —have published two or more documents, for a maximum of four documents among the  
288 authors and eight for organizations (with Australian Catholic University publishing the most).

289 The USA (with about seventy documents in both databases) and Italy (with thirty-two  
290 documents in WoS and thirty-six in Scopus) are the leading countries according to Table 2.  
291 Some journals that are more focused on religious issues are among the leading sources (this is  
292 the case of titles like *Theological Studies*, *The Journal of Religious Ethics* or *Heythrop*). It is also  
293 worth mentioning that a book called *Integrated evaluation for the management of*  
294 *contemporary cities* appears among the top sources in this list.

295

### 296 **3.3. Authors, organizations, countries and sources according to the number of citations**

297 The number of citations of the previously identified documents are detailed in Table 3. The  
298 results presented in this table show that, in general, there are higher frequencies identified in  
299 the Scopus database than in WoS.

300

301 [Insert here Table 3]

302

303 On the other hand, authors Heather Akin, Ariel Hasell, Kathleen Hall Jamieson, Asheley R.  
304 Landrum and Robert B. Lull have more than ten citation in both databases. Regarding the  
305 number of citations for several organizations, there are relevant differences between the two  
306 databases. For example, for WoS, the organizations whose works reported a higher number of  
307 citations (more than ten citations) are Australian Catholic University, the University of Notre  
308 Dame, Fordham University, California State University–Fresno, Texas Tech University, and the  
309 University of Pennsylvania. For Scopus, the institutions with the highest number of citations of  
310 works about the LS are the University of Pennsylvania, Texas Tech University, and California  
311 State University.

312 The USA and Italy are, again, the countries with the most citations. The journals *Theological*  
313 *Studies*, *Cognition* and *Quarterly Review of Biology* are among the most cited sources identified  
314 by both databases.

### 315 3.4. Testing the hypothesis of homophily among citations

316

317 At this point, we consider it particularly relevant to investigate whether journals publishing  
318 articles about the LS tend to cite works on the LS published in other journals of the same  
319 scientific field—supporting the hypothesis of homophily—or of a different field. Namely, we  
320 intend to investigate whether journals focused on biology are also able to publish articles  
321 about the LS that quote works from journals focused on theology, for example. As one of the  
322 objectives of the LS was to spread its influence over the highest number of scientific areas  
323 possible, testing the homophily hypothesis will demonstrate whether it is a latent barrier to  
324 the objective of enlarged influence.

325

326 The patterns of identified citations tend to present statistical regularities, which can be  
327 disclosed by a probabilistic model ( $p_1$ ).

328

329 Following Uddin and Hossain (2013) and Mourao (2020), we can classify all dyads of identified  
330 sources/journals ( $i, j$ ) as mutual ( $x_{ij} = x_{ji} = 1$ ), asymmetric ( $x_{ij}$  not equal to  $x_{ji}$ ), or null ( $x_{ij} = x_{ji} =$   
331  $0$ ). The probabilities of each type of dyad are modelled as a function of three sets of  
332 parameters: the expansiveness of the journal (i.e., the capacity of mainly citing other journals),  
333 the popularity of each journal (i.e., the capacity of being quoted by a majority of sources), and  
334 reciprocity (the capacity of simultaneously citing and being cited). The probabilities of mutual,  
335 asymmetric and null dyads, denoted as  $m_{ij}$ ,  $a_{ij}$ , and  $n_{ij}$ , respectively, are modelled as follows:

336

$$337 \quad m_{ij} = \lambda_{ij} \exp(\rho + 2\theta + \alpha_i + \alpha_j + \beta_i + \beta_j) \quad (\text{Equation 2})$$

$$338 \quad a_{ij} = \lambda_{ij} \exp(\theta + \alpha_i + \beta_j) \quad (\text{Equation 3})$$

$$339 \quad n_{ij} = \lambda_{ij} \quad (\text{Equation 4})$$

340

341

342 In Equations 2–4, and according to Mourao (2020), the  $\alpha$  parameters are interpreted as  
343 "expansiveness" measures for each node (in our case, for each journal). The  $\beta$  parameters are  
344 interpreted as "popularity" measures. The  $\rho$  parameter is related to a general measure of the  
345 tendency towards "reciprocity" within the network. The  $\theta$  parameter is a function of the  
346 density of the network, reflecting the total number of observed arcs (an arc is defined as a  
347 citation in our network). Finally, the  $\lambda$  parameters are normalizing constants used to guarantee  
348 that the modelled probabilities add up to one for any given dyad.

349

350 Following Holland and Leinhardt (1981), positive values for each parameter provide statistical  
351 evidence of how the studied effects reflect the established relationships between journals. A  
352 positive  $\theta$  indicates that if the density of the net increases (i.e., as the amount of connections  
353 between journals grows), it will be expected that any particular journal may establish a greater  
354 number of connections with other sectors. In contrast, when  $\theta$  is negative, the interpretation  
355 of Holland and Leinhardt (1981) suggests that the number of connections in the net does not  
356 help explain the density of citations among the journals. In practical terms, this implies that,  
357 independent of the density, existing ties tend to be explained by certain latent trends of  
358 selectivity assumed by the journals. Additionally, a positive  $\rho$  implies that any journal is likely  
359 to establish reciprocal connections with other journals.

360

361 The estimates for the observed network from WoS are as follows (given its similarities with the  
362 Scopus' observed network, we will omit Scopus' estimates, but they are available upon  
363 request):

364

- 365 - A negative value was found for the  $\theta$  parameter (-0.9538), which was interpreted as  
366 suggested— the trend of this network is not to have random citations. This means that  
367 the existing arcs are defined by exogenous dimensions.
- 368 - Also, a negative value has been found for the reciprocity parameter  $\rho$  (-0.4769),  
369 suggesting that when there is a citation of one journal in another, it should not be  
370 expected that there will be citations of the quoting journal in the originally citing  
371 journal.

372

373

374 In order to avoid exhibiting extensive matrices containing the estimated probabilities of  
375 citations of one journal in another, we opted for a common figure—the dendrogram of  
376 probabilities, which clarifies the different groups of journals considering the estimates of the  
377 P1 parameters. Figure 5 reveals the estimated linkages.

378

379 Some more immediate observations made upon the generation of Figure 5 relate to the  
380 following two statements:

381 - Despite the LS's focuses on ecology and sustainability, there is a strong resistance of journals  
382 outside the range of the religious/theological field to cite or publish works on the Laudate Si;

383 - the probability of citations is higher among journals in the same scientific area (e.g. *Filozofska*  
384 *Istrazivanja* citing *Horizons* and vice-versa, *The Journal of Religious Ethics* citing *Religions* and  
385 vice-versa, or *Biological Conservation* most-likely citing *The Quarterly Review of Biology* and  
386 vice-versa) , which must be realized as an obstacle for the LS reaching a wider academic  
387 audience.

388

389

390 [Insert here Figure 5]

391

392



394 **Discussion**

395 The encyclical LS contains demanding reflections about human life and environmental  
396 challenges through the lens of sustainable development, where justice, ethics, religion and  
397 leadership all play an important role.

398 The journal articles collected by in WoS and Scopus since 2015, about this encyclical highlight  
399 these dimensions. First, we have to emphasize the attention paid by the scientific community  
400 to this encyclical, comparatively higher than that given to previous encyclicals. The studies  
401 published earlier, namely, around 2016, focused more on religious debate about the LS. In any  
402 case, despite the focus given by the studies published in more recent years for the ecologic,  
403 climatic and environmental aspects, we have to recognize that most of the documents and  
404 citations regarding the LS appeared in articles related to religious domains.

405 The analysis performed about the most productive and impacted authors, affiliations,  
406 countries and sources confirms this trend. However, this analysis also reveals that there are  
407 opportunities to create more networking among the international scientific communities for  
408 enlarging the discussion concerning the LS. Additionally, the published documents seem to  
409 center around authors from the USA, Italy, the UK and Brazil, which confirms the attention  
410 provided by some of these countries' university departments to expand the study of the LS.

411 **5. Conclusion**

412 This work was the first bibliometric exercise carried out on the encyclical Laudato Si, occurring  
413 five years after its publication. If the objectives of the LS at the time of its publication were to  
414 reach a greater height of reading and influence, this bibliometric work revealed some  
415 challenges for accomplishing this goal.

416

417 Most of the keywords in these works identified by WoS and Scopus are words that point to  
418 terms like 'ecology', 'climate change', 'environment', 'sustainability', 'ethics', which, to some  
419 extent, reveals how the LS motivated academic works related to its own concerns.

420

421 We also found that there is a predominance of academic work from the fields of religious  
422 sciences and theology on the topic of the LS. The number of works of the scientific areas of  
423 biology and sustainable development follows. Although there are not yet significant numbers

424 of works regarding authorship/co-authorship, most teams of authors are from universities in  
425 the USA and Italy, with some emerging in countries like Brazil.

426

427 The five years between this study and the publication of the LS in 2015 thus contain emerging  
428 challenges. As of now, we account for three emerging challenges. The first is related to the  
429 need to continue to observe the evolution of the reach of the LS and to diversify the focus of  
430 academic attention beyond religious sciences, who, in an expected way, were the first  
431 scientific field to analyze the LS. The second challenge is related to the perception of the  
432 popularity of the LS compared to previous encyclicals—are we facing a new trend (of scientific  
433 attention) on papal documents or is the popularity of LS mainly due to the popularity of Pope?  
434 The third challenge is related to a deeper epistemological question. Our estimations of the  
435 citation probability model highlighted a clear trend of homophily—authors and journals tend  
436 to cite authors and journals from the same scientific field. Although this behavior is expected  
437 due to current methodological approaches, from the restricted space for publication and to  
438 the need for scientific focus, the same behavior can pose a serious challenge for  
439 interdisciplinary studies and the discussion of cross-cutting documents as the LS intends to be.  
440 Thus, the aforementioned concentration of the focus of debate around the LS can also be  
441 explained by the epistemological practices underway in nowadays' academic institutions.

442

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444

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524 **Table 1.** Keywords with five or more occurrences

Keyword	Occurrences	Avg. pub. Year
laudato si'	59	2017.614
pope francis	55	2017.782
ecology	32	2017.156
laudato si	25	2017.28
climate change	22	2017
environment	22	2017.667
integral ecology	18	2016.941
creation	16	2017.133
sustainability	16	2017.6
ethics	11	2016.889
catholicism	10	2016.8
ecological conversion	10	2017.2
justice	10	2016.8
anthropocene	8	2017.286
environmental ethics	8	2018
leadership	8	2017.125
anthropocentrism	7	2017.429
catholic social teaching	7	2017.429
poverty	7	2017.286
religion	7	2016.5
sustainable development	7	2016.286
theology	7	2018
care	6	2016.833
consumerism	6	2017.833
encyclical	6	2017
spirituality	6	2018.167
attitudes	5	2017.4
christianity	5	2017.4
common home	5	2017
ecological crisis	5	2017
environmental crisis	5	2018.8
incarnation	5	2016.4
laudato si'	5	2017.6
responsibility	5	2016.6
science	5	2017.75

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529 **Table 2.** Number of identified documents about LS (2015–2020), according to WoS and Scopus databases

WoS		Scopus		WoS		Scopus	
Authors	Documents	Authors	Documents	Organizations	Documents	Organizations	Documents
edwards, denis	4	mckim r.	3	australian catholic univ	8	university of florence	3
dileo, daniel r.	3	zsolnai l.	3	boston coll	5	university of illinois at urbana-champaign	3
albareda tiana, silvia	2	abastante f.	2	univ notre dame	5	boston college	2
briola, lucas	2	carroll j.e.	2	catholic univ amer	4	corvinus university of budapest	2
diniz alves, jose eustaquio	2	deane-drummond c.	2	fordham univ	4	university of palermo	2
franc, jaroslav	2	dileo d.r.	2	marquette univ	4	university of catania	2
gabriel, ingeborg	2	edwards d.	2	politecn milan	4	university of salerno	2
hrynkow, christopher	2	jenkins w.	2	univ durham	4	mediterranea university of Reggio Calabria	2
hutter, reinhard	2	löwy m.	2	univ florence	4	university of virginia	2
jenkins, willis	2	malerba a.	2	politecn torino	3	university of ljubljana	2
kelly, anthony j.	2	massimo d.e.	2	santa clara univ	3	university of notre dame	2
malerba, alessandro	2	musolino m.	2	st vincent coll	3		
massimo, domenico enrico	2	nesticó a.	2	univ catania	3		
musolino, mariangela	2	peppard c.z.	2	univ virginia	3		
nestico, antonio	2	platovnjak i.	2	fac jesuita filosofia & teol	2		
peppard, christiana z.	2	scherz p.	2	fu jen catholic univ	2		
platovnjak, ivan	2			imed	2		
scherz, paul	2			katholieke univ leuven	2		
zambam, neuro jose	2			mediterranea univ Reggio Calabria	2		
				pontificia univ catolica parana pucpr	2		
				pontificia univ javeriana	2		
				st louis univ	2		
				sun aversa	2		
				univ fed minas gerais	2		
				univ int catalunya	2		
				univ ljubljana	2		
				univ navarra	2		
				univ palermo	2		
				univ pontificia bolivariana	2		
				univ portland	2		
				univ ramon llull	2		
				univ salerno	2		
				univ wien	2		
				villanova univ	2		
Total	41		34		97		24

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533 **Table 2.** Number of identified documents about LS (2015–2020), according to WoS and Scopus databases (continuation)

WoS Countries	Documents	Scopus Countries	Documents	WoS Sources	Documents	Scopus Sources	Documents
usa	73	united states	69	integrated evaluation for the management of contemporary cities	25	green energy and technology	25
italy	32	italy	36	theological studies	22	theological studies	18
		united kingdom	16	heythrop journal	8	laudato si' and the environment: pope francis' green encyclical	14
brazil	19	australia	8	journal of religious ethics	7	heythrop journal - quarterly review of philosophy and theology	8
england	18	canada	8	philippiniana sacra	7	journal of religious ethics	7
australia	13	germany	8	environment	5	environment	5
spain	8	spain	8	new blackfriars	5	religions	5
argentina	6	belgium	5	religions	5	bulletin de litterature ecclesiastique	4
canada	6	poland	5	nova et vetera-english edition	4	contributions to conflict management, peace economics and development	3
germany	6	brazil	4	perspectiva teologica	4	independent review	3
colombia	5	colombia	3	australasian catholic record	3	pensamiento	3
philippines	4	france	3	horizons	3	quarterly review of biology	3
austria	3	hungary	3	horizonte-revista de estudos de teologia e ciencias da religiao	3	sustainability and the humanities	3
czech republic	3	argentina	2	internationale katholische zeitschrift communio	3	tijdschrift voor theologie	3
india	3	chile	2	pensamiento	3	valori e valutazioni	3
portugal	3	china	2	quarterly review of biology	3	bogoslovni vestnik	2
belgium	2	czech republic	2	revista de cultura teologica	3	cauriensia	2
croatia	2	india	2	revista perseitas	3	church, communication and culture	2
france	2	ireland	2	scripta theologica	3	communio	2
ireland	2	netherlands	2	studia theologica-czech republic	3	environmental ethics	2
japan	2	portugal	2	teologia	3	health progress (saint louis, mo.)	2
mexico	2	slovenia	2	trumpeter-journal of ecosophy	3	horizons	2
peoples r china	2	south africa	2	veredas do direito	3	ideals and ideologies: a reader	2
slovenia	2			worldviews-global religions culture and ecology	3	international bulletin of mission research	2
switzerland	2			bogoslovni vestnik-theological quarterly-ephemerides theologicae	2	journal of agricultural and environmental ethics	2
taiwan	2			cauriensia-revista anual de ciencias eclesiasiticas	2	journal of jesuit studies	2
				environmental ethics	2	perseitas	2
				environmental humanities	2	scripta theologica	2
				international bulletin of mission research	2	sophia	2
				irish theological quarterly	2	studia theologica	2
				journal of agricultural & environmental ethics	2	verbum vitae	2
				journal of jesuit studies	2	worldviews: environment, culture, religion	2
				pacifica	2	zygon	2
				reveleto-revista electronica espacio teologico	2		
				revista pistis & praxis-teologia e pastoral	2		
				sophia	2		
				world heritage and degradation: smart design, planning and technologies	2		
				zygon	2		
Total	222		196		162		143

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536 **Table 3.** Items with five or more citations, for WoS and Scopus databases

WoS		Scopus		WoS		Scopus	
Authors	Citations	Authors	Citations	Organizations	Citations	Organizations	Citations
akin, heather	12	akin h.	17	australian catholic univ	17	university of pennsylvania	17
hasell, ariel	12	hasell a.	17	univ notre dame	15	texas tech university	17
jamieson, kathleen hall	12	jamieson k.h.	17	fordham univ calif state univ	12	california state university	17
landrum, asheley r.	12	landrum a.r.	17	fresno	12	community of sant-egidio	9
lull, robert b.	12	lull r.b.	17	texas tech univ	12	leuphana university lüneburg	9
caniglia, guido	10	peppard c.z.	9	univ penn	12	arizona state university	9
herberg, jeremias	10	caniglia g.	9	arizona state univ leuphana univ	10	cornell university	7
hoerl, erich	10	herberg j.	9	luneburg	10	columbia university	7
lang, daniel laubichler, manfred	10	hörl e.	9	univ durham	9	environmental defense fund	7
meyer, esther	10	lang d.	9	st jeromes univ	9	pomona college	7
schmieg, gregor	10	laubichler m.	9	politecn milan	6	university of notre dame	7
schrickel, isabell	10	meyer e.	9	columbia univ	6	macquarie university	6
		penza g.	9	cornell univ	6	politecnico di milano	6
				environm def fund	6	enea (italian national agency for new technologies)	6
vilsmaier, ulli peppard, christiana z.	10	schmieg g.	9	pomona coll	6	university of wollongong	6
deane-drummond, celia	9	schrickel i.	9	santa clara univ	5	university of genoa	5
ormerod, neil	9	vilsmaier u. deane- drummond c.	7	univ virginia	5	missouri botanical garden	5
vanin, cristina	9	laron-konar d.	7	loyola univ maryland	5	fordham university	5
edwards, denis	7	pearson a.r.	7	missouri bot garden	5	loyola university	5
larson-konar, dylan	6	romero-canyas r.	7			australian catholic university wuppertal institute for climate, environment and energy	5
pearson, adam r. romero-canyas, rainer	6	schuldt j.p.	7				5
schuldt, jonathon p.	6	borrelli g.	6				
castillo, daniel p.	5	buffoli m.	6				
globokar, roman	5	capolongo s.	6				
green, brian	5	citterio m.	6				
patrick	5	favotto a.	6				
raven, peter h.	5	gola m.	6				
rowlands, anna	5	perkiss s.	6				
		procopio g.p.	6				
		rebecchi a.	6				
		tweedie d.	6				
		edwards d.	5				
		castillo d.p.	5				
		globokar r.	5				
		magoni s.	5				
		raven p.h.	5				
		rosasco p.	5				
		sachs w.	5				
		sdino l.	5				
Total	242		319		168		167

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538 **Table 3.** Items with five or more citations, for WoS and Scopus databases (Continued)

WoS Countr ies	Citati ons	Scopus Countries	Citati ons	WoS Sources	Citati ons	Scopus Sources	Citati ons
usa	113	united states	104	theological studies integrated evaluation for the management of contemporary cities	42	theological studies	35
italy	23	italy	55		20	green energy and technology	34
austral ia	20	germany	20	cognition	12	cognition	17
englan d	19	australia	19	sustainability science	10	valori e valutazioni	15
germa ny	17	united kingdom	10	quarterly review of biology	9	quarterly review of biology	10

canada	9	canada	5	journal of religious ethics	6	sustainability science	9
brazil	6			environment	6	climatic change	7
				climatic change	6	journal of religious ethics	6
				religions	5	environment	6
				bogoslovni vestnik-theological quarterly-		social and environmental	
				ephemerides theologicae	5	accountability journal	6
				political theology	5	bogoslovni vestnik	5
Total	207		213		126		155

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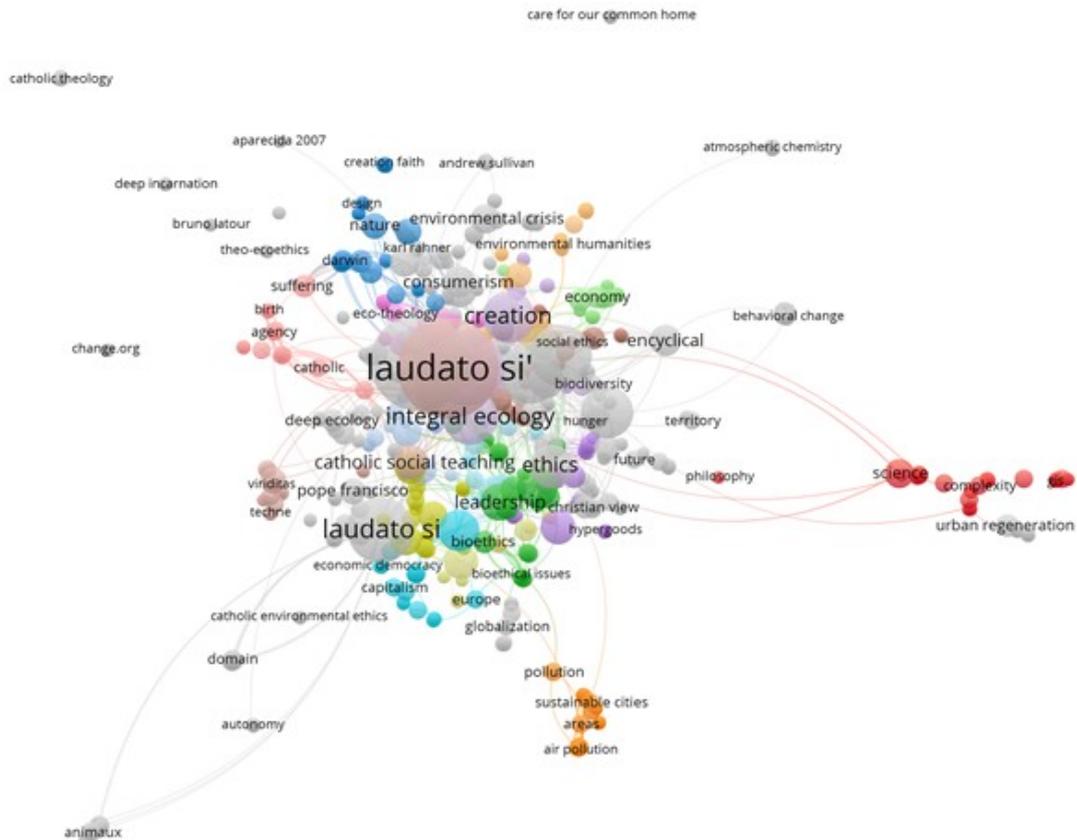
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549 **Figure 1.** Distribution of the documents by years in the WoS and Scopus databases

550 **Figure 2.** Distribution of the documents by main languages in the WoS and Scopus databases

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553 **Figure 3.** Network visualization map for link co-occurrence and item keywords

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563 **Figure 4.** Number of authors, organizations, countries and sources, for WoS and Scopus  
 564 databases

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567 Figure 5 – Dendrogram of journals publishing works about the LS according to their probability of citing articles from other sources

