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Title:

To dam or not to dam? A genealogy of media discourses to highlight human-river relationships in the Anthropocene

Authors' names and addresses:

Silvia Flaminio^{1,2}, Hervé Piégay¹, Yves-François Le Lay¹

1 Université de Lyon, Laboratoire Environnement Ville Société
ENS de Lyon - UMR 5600 EVS
Site Descartes
15 parvis René Descartes
BP 7000, 69342 Lyon Cedex 07 France

2 Université de Lausanne, Institut de Géographie et durabilité
Géopolis - CH-1015 Lausanne Suisse

Institution and address where the work was conducted:

Université de Lyon, Laboratoire Environnement Ville Société
ENS de Lyon - UMR 5600 EVS
Site Descartes
15 parvis René Descartes
BP 7000, 69342 Lyon Cedex 07 France

Corresponding author:

Silvia Flaminio silvia.flaminio@unil.ch

+33 6 61 04 66 98

Author contributions:

S.F. designed the study with input from H.P. and Y.F.L.L. S.F. built and analysed the corpus. S.F. wrote the article with contributions from H.P. and Y.F.L.L.

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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.

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1 **Title**

2 To dam or not to dam in an age of anthropocene: Insights from a genealogy of media discourses

3 **Abstract**

4 Numerous studies have highlighted the negative consequences of dams (long-term alterations of
5 Earth systems and social and economic injustices), and have questioned the sustainability of dams,
6 i.e., the capacity of dams to meet the social, economic, and environmental needs of the current
7 generation without compromising the needs of future generations. After having stalled in the 1990s,
8 dam construction has entered a new period of growth. Recent research has shown that this new
9 phase in dam building can be explained by the promotion of hydropower as clean energy. To clarify
10 the continuing debate on the construction of dams, particularly on their impacts and sustainability
11 into the future, this paper examines the discourses on dams within the public domain. We used a
12 collection of newspaper articles published in *Le Monde* from 1945 to 2019 on dams that were
13 planned and built throughout the world (n=1,471). Results show a rise of different discourses on
14 water infrastructure, which with time deal less with positive technical appraisals and more with
15 controversies. Since the mid-2000s, new arguments are defended (green energy) and new
16 controversial discourses on the social and economic sustainability of dams (bearability, equitability)
17 have emerged along with environmental questions (greenhouse gas footprint). These discourses
18 reveal different understandings of sustainability which increase the complexity of the debate on
19 dams. Results from this study suggest a need for a stronger dialogue between the scientific and
20 public domains on the impacts of dams. Knowledge transfer and exchange would be particularly
21 beneficial on ‘renewable energy’ and ‘green energy,’ and alternative modes of governance regarding
22 dams.

23

24 **Keywords**

25

26 Dams

27 Discourse

28 Genealogical approach

29 Hydropower

30 Sustainability

31

32 **1. Introduction**

33 During the past century, numerous dams have been built throughout the world (Roe, 2012), with

34 purposes that include irrigation, hydropower, water supply, flood prevention and navigation. These

35 hydraulic infrastructures interrupted the flow of water and created reservoirs upstream. Dam
36 construction stalled during the 1990s, leading some to conclude that the era of big dams was over
37 (e.g., Graf, 1999; McCully, 2001). This decline may be explainable by the reduction of attractive
38 sites for dams, by changing water paradigms (Gleick, 2000) and by the progressive adoption by the
39 water sector of the principles of sustainable development (Allan, 2003), whereby the needs of the
40 current generation are met without compromising the needs of future generations (Brundtland,
41 1987, p. 37).

42

43 Nevertheless, since the end of the 2000s, dam construction has entered a new period of growth.
44 Plans for ‘mega-dams’ (Best, 2019) and for smaller dams (Fung et al., 2018) have multiplied,
45 coupled with schemes for hydropower. Currently, 3,700 major hydropower dams are planned or
46 under construction in the world (Zarfl et al., 2015). Even so, the amount of power produced, given
47 the projected growth demand, is likely insufficient to replace non-renewable electricity resources
48 (Zarfl et al., 2015, p. 167). Such a rebound in dam-building raises environmental questions that are
49 both social and ecological. It feeds the scientific debate on long-term environmental degradation in
50 the context of global environmental change, especially within an anthropocene era of accelerated
51 human interactions with Earth systems (Chin et al., 2013). The consequences of constructing dams
52 remain diverse (e.g., social, economic, ecological, and geomorphological), at different scales (local,
53 corridor, regional, and even global) (Baghel, 2010; Gross, 2016; Skalak et al., 2013; Williams et al.,
54 2014; World Commission on Dams, 2000). As numerous studies have demonstrated, dams have
55 profoundly affected flow conditions, channel morphology and river ecosystems (e.g., Power et al.,
56 1996; Poff et al., 1997; Rollet et al. 2014). They have even been described as an example of the
57 “exploitation of Earth’s resources” which characterises the “Anthropocene” (Crutzen, 2002), and
58 due to the drastic alteration of the world’s river systems they have caused, dams have been depicted
59 as characteristic of the human domination of the Earth (Nüsser and Baghel, 2017). Recent research
60 has shown that dams may not always be an advantageous option considering climate change. The
61 reliance on reservoirs can worsen water and energy shortages (Di Baldassarre et al., 2018). Plans for
62 hydropower dams in Eastern and Southern Africa, for example, will increase some countries’
63 dependence on hydroelectricity and therefore their exposure to the “risk of climate-induced
64 electricity disruption” (Conway et al., 2017, p. 949). Moreover, not only can the resurgence of dam
65 building lead to the disappearance of the last free-flowing rivers (Grill et al., 2019; Nilsson, 2005),
66 the impact of climate change will also be greater on impounded rivers than on free-flowing rivers,
67 which are expected to be more resilient (Palmer et al., 2008). Furthermore, during the past years,
68 restoration ecology and other environmental fields have promoted dam removal to prevent further

69 biodiversity loss and ‘reconnect’ watersheds (Magilligan et al., 2016). Among social scientists,
70 debates regarding dam-building and the impact of dams are also strong, as they have shown how a
71 new discourse on climate change and sustainability (Crow-Miller et al., 2017) is fuelling dam-
72 building for hydropower or multipurpose reservoirs. Some states and institutions are framing
73 hydroelectricity, for example, as renewable, ‘clean’, ‘green’ energy (Ahlers et al., 2015; Fletcher,
74 2010; Warner et al., 2017). Altogether, scholars in different scientific fields are questioning the
75 sustainability of dams (Di Baldassarre et al., 2021).

76

77 To clarify the continuing debate on the construction of dams, particularly on their impacts and
78 sustainability into the future, this paper examines the discourses on dams within the public domain.
79 We focus on the public due to the relevance of dams on people’s lives, such as in relation to water
80 resource management and energy production, and since the public often exerts political power for
81 decisions concerning dam-building. We also focus on the public discourses on dams since the mid-
82 20th century, because this period includes the peak in dam building and the development of
83 controversies regarding the negative impacts of dams (Roe, 2012). In this paper, we therefore
84 address the following research questions. First, how have the discourses and debates on dams, and
85 notably on the sustainability of dams, developed within the public domain? Second, how can tracing
86 a ‘genealogy’ of discourses on dams inform their sustainability into the future?

87

88 **2. Approach, material and methods**

89

90 *2.1 General Approach*

91 This paper approaches the research questions with a Foucauldian perspective. Foucault promoted a
92 ‘genealogical’ approach that examines “how series of discourse are formed [...]; what are their
93 specific norms, and what are their conditions of emergence, growth and variation” and a critical
94 approach that “distinguishes forms of exclusion, limitation and appropriation” (Foucault, 1971, p.
95 62–63). Accordingly, we investigate not only the genealogy of discourses relating to dams, but also
96 the controversies at work during different periods. This post-structuralist framework invites us to
97 question and highlight the emergence and the development of new discourses regarding dams. It
98 also helps to reveal how older discourses may still be present and are adaptable to current issues.
99 We consider a discourse is made of oral or written statements (Adger et al., 2001). It is also “a
100 shared way of apprehending the world. Embedded in language, it enables those who subscribe to it
101 to interpret bits of information and tie them together into coherent stories or accounts” (Dryzek,

102 2012, p. 9). Following Foucault, previous studies on water and hydraulic infrastructure have
103 illustrated the role and power of discourse, and notably its political ramifications (e.g., Duarte-
104 Abadía et al., 2015; Boelens et al., 2016; Boelens et al., 2019).

105 In a nutshell, the relevance of studying discourses is twofold. On one hand, the study of discourses
106 allows documentation of the relationship between society and dams, because discourses materialise
107 this relationship in oral and written statements. On the other hand, since discourses have a
108 performative value, studying discourses also allows better understanding of how planning choices
109 regarding dams are made, and more generally how “political decision-making takes place” (Hajer,
110 1995: 44). While studies in natural sciences have increasingly highlighted the ecological impacts of
111 dams since the 1960s (e.g., Scope, 1972), social sciences have often focused on controversies
112 related to dam-building and their social consequences (e.g., Kaika, 2006; Hommes et al., 2016).
113 Such research has focused on case studies situated in specific timeframes and socio-political
114 contexts.

115 To consider more generally the public debate on dams and build a genealogy of discourses on dams,
116 we used media as a primary source. Media capture the public domain well as places or forums in
117 which individuals “engage each other about subjects of shared concern” (Pezzullo and Cox 2017, p.
118 20). Media and newspaper accounts also present many biases, as they personalise information,
119 dramatise events, and tend toward novelty (Boykoff and Boykoff, 2007). Nevertheless, media play a
120 role in political agenda setting (Downs, 2016) and reflect social concerns (de Loë, 1999). They are
121 arenas among which new economic and environmental models can be produced (Burgess, 1990).
122 Previous studies have highlighted the ‘centrality’ (Foxwell-Norton and Lester, 2017) of media in
123 the communication of environmental issues and have recognised their value as a valid source to
124 study environmental conflicts and as a stakeholder in environmental politics (e.g., Lester, 2010;
125 Hansen, 2015). For these reasons, they can be valid for the study of environmental topics and
126 controversies and their evolution over time. In other words, media allow study of the progression of
127 “environmental issues in the public sphere” (Hansen, 2015, p. 217). In the social sciences and
128 environmental studies, media sources have been successful to identify and distinguish different
129 periods in water management on national scales (Wei et al., 2017, 2015).

130 In this study, we focus on both national and international news. This paper is based on media
131 narratives from *Le Monde*, a French newspaper with a strong interest in international news and
132 global socio-political debates (in a similar way to *The New York Times* or *The Guardian*). This
133 source is particularly useful as *Le Monde* has digital archives dating back to the newspaper’s

134 foundation in 1944. Although previous studies have largely relied on content analysis (Wei et al.,
135 2017), we implemented a method based on textual data analysis (also often called ‘text mining’).
136 This study therefore details the evolution of discourses on dams (between 1945 and 2019). It
137 situates in time the integration of social, economic, and ecological issues within the debate on dams.
138 We then discuss results within the international scientific literature and debates on dams into the
139 future.

140

141 2.2. *Material*

142

143 We targeted the newspaper *Le Monde* for the history of the debate on dams, tracing the genealogy
144 of discourses on dams and the framing of dams as sustainable levers. Although a French newspaper
145 may suggest a Franco-centred perspective, *Le Monde* pays much attention to international news and
146 its reporting considers different and often diverging points of view. It is also one of the few major
147 daily newspapers with archives available in formatted text. Notably, it is accessible through
148 university library subscriptions (through its website, www.lemonde.fr or through online platforms
149 such as www.europresse.com). *Le Monde*’s archives go back to the newspaper’s foundation in
150 1944. Therefore, this source allows a longitudinal approach. Only a few other newspapers provide
151 digitised archives over such a time span. For such reasons, *Le Monde* has been useful beyond
152 francophone scholarship (Brossard et al., 2004).

153

154 2.3. *Data collection*

155 We combined different queries to avoid collecting articles that did not focus on hydraulic dams.
156 The terms included “dam & river” (“*barrage & rivière*”, “*barrage & fleuve*”), “dam & lake”
157 (“*barrage & lac*”), “dam & reservoir” (“*barrage & réservoir*”), “dam & licence” (“*barrage &*
158 *concession*”). These queries produced over 6,000 articles. Many duplicates were automatically
159 excluded from the corpus. We then read and examined the articles individually. We excluded from
160 the corpus articles that only briefly evoked dams. This process led to inclusion in the corpus of
161 1,471 articles published between 1945 and 2019.

162

163 2.4. *Data preparation*

164 We collected and tabulated metadata on each article (publication date, author, article title). We also
165 carried out a basic content analysis from the reading of the articles, focusing on information such as
166 the dam site, the river or the river basin, and the country on which the article was centred. When the
167 article only concerned one site, river, river basin or country, we also recorded this information in the

168 metadata table. Moreover, for each article, we determined if the newspaper mentioned a
169 controversy, i.e., an opposition or a disagreement between different stakeholders or communities
170 involving the dam. Finally, using the scale elaborated by de Lœe (1999), we determined whether the
171 newspaper adopted a pro- or anti-dam tone, a neutral tone, and whether it presented both the pros
172 and cons or simply whether the dam played a marginal role in the article.

173

174 2.5. Data analysis

175 To explore and analyse the data in the metadata table, we firstly summarised and plotted several key
176 characteristics. The number of articles published per year, for example, identified periods of over
177 and under news coverage. We also considered the evolution of dam building in the world between
178 1945 and 2020, based on the *World Register of Dams* (ICOLD, 2018), which represents dam
179 builders and managers, and the International Commission on Large Dams (ICOLD), and which
180 contained information on the building date of 51,514 dams throughout the world. After culling the
181 data for the building of dams per year, we also measured the ratio between the dam coverage by *Le*
182 *Monde* between January 1945 and December 2019, according to our corpus, and the total number of
183 articles published each year in the newspaper. We further identified the countries and dams that
184 benefited from a broad coverage by *Le Monde*: we were able to attribute countries to 1,425 articles
185 out of 1,471.

186

187 Secondly, we performed a quantitative textual data analysis with the open-source programs
188 Iramuteq (Ratinaud and Déjean, 2009) and TXM (Heiden et al., 2010). Textual data analysis, also
189 often called ‘text mining’, is definable as a set of methods that rest on statistics to analyse text
190 corpora (Beaudouin, 2016; Heiden et al., 2010). Iramuteq relies on R software and Python language
191 to perform analyses such as the classification algorithm (Reinert, 1990, 1983), which comprises five
192 main phases (Cottet et al., 2015). The classification algorithm proceeds through several steps. First,
193 it segments the corpus into phrases (of 40 words approximately). Second, it lemmatises¹ the words
194 using a grammatical dictionary. Third, it produces a contingency table between the lemma and other
195 forms such as the metadata and the text segments. Fourth, it builds a top-down hierarchical
196 classification based on the contingency table (using χ^2 metrics). Fifth, it leads to the description of
197 different lexical classes that present the degree of association between each class and the different

¹ In linguistics, a lemma is generally defined as “a set of lexical forms having the same stem and belonging to the same major word class, differing only in inflection and / or spelling” (Francis and Kucera, 1982: 1). In general, a lemma is the standard dictionary entry of a word. To lemmatise means to tag words of a corpus according to their stem. In this case, the software we use matches each word of the corpus to a dictionary entry.

198 forms (also using χ^2 metrics). Recent studies have used this method to identify discourses on
199 different environmental subjects, such as invasive species (Cottet et al., 2015), rivers (Comby et al.,
200 2019), and water conservation (Boyer et al., 2021). In this case, the classification algorithm allowed
201 for the identification of 12 different lexical classes. We then considered the degree of association
202 between the different classes and the decade of publication of the texts. We used the open-source
203 data visualisation framework RAW Graphs (Mauri et al., 2017), and in particular the ‘area graph’,
204 to represent the χ^2 for each class according to the different decades.

205

206 In parallel, we used the ‘progression’ function of TXM (which also relies on R statistical libraries)
207 to examine the evolution of specific words and expressions within the corpus, according to the
208 publication year of the newspaper articles. We produced graphs displaying the cumulative
209 frequencies of different expressions such as “wild river” (“*rivière|fleuve sauvage*”) and “living
210 river” (“*rivière|fleuve vivant*”) or “greenhouse gas” (“*gaz à effet de serre*”).

211

212 Thirdly, we conducted a qualitative and interpretative analysis. We read all 1,471 articles comprised
213 in the corpus. Based on the reading of the corpus and keyword searches performed in TXM, we
214 identified quotes reflecting evolutions that we had previously statistically observed.

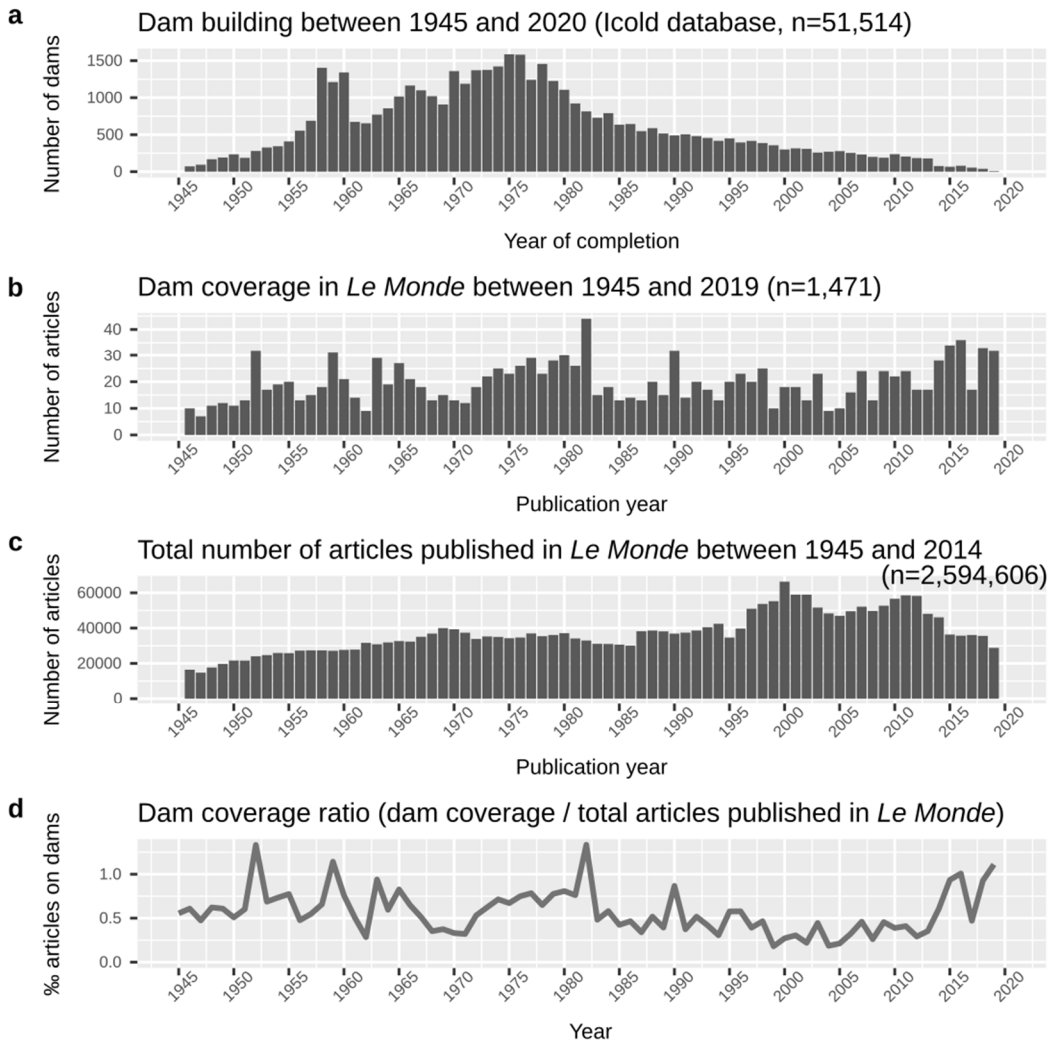
215

216 **3. Results**

217 **3.1 Characteristics of coverage by *Le Monde***

218 The coverage by *Le Monde* was mostly strong during the main period of dam building throughout
219 the world, i.e., between the 1950s and the 1970s (Fig. 1). The coverage was characterised by
220 various peaks (e.g., 1952, 1959, 1982, 1990). The qualitative analysis allowed us to link some of
221 these peaks to specific dam projects and controversies: the building of Tignes Dam in France
222 received much attention in 1952; in 1959, *Le Monde* published a series of articles on the Malpasset
223 disaster (Southern France); other peaks such as the 1982 and 1990 ones did not coincide with a
224 single project event or controversy. After 1980, and during a period in which less dams were being
225 built, *Le Monde* paid less attention to dams (Fig. 1). However, after 2010, the coverage of dams
226 increased again.

227



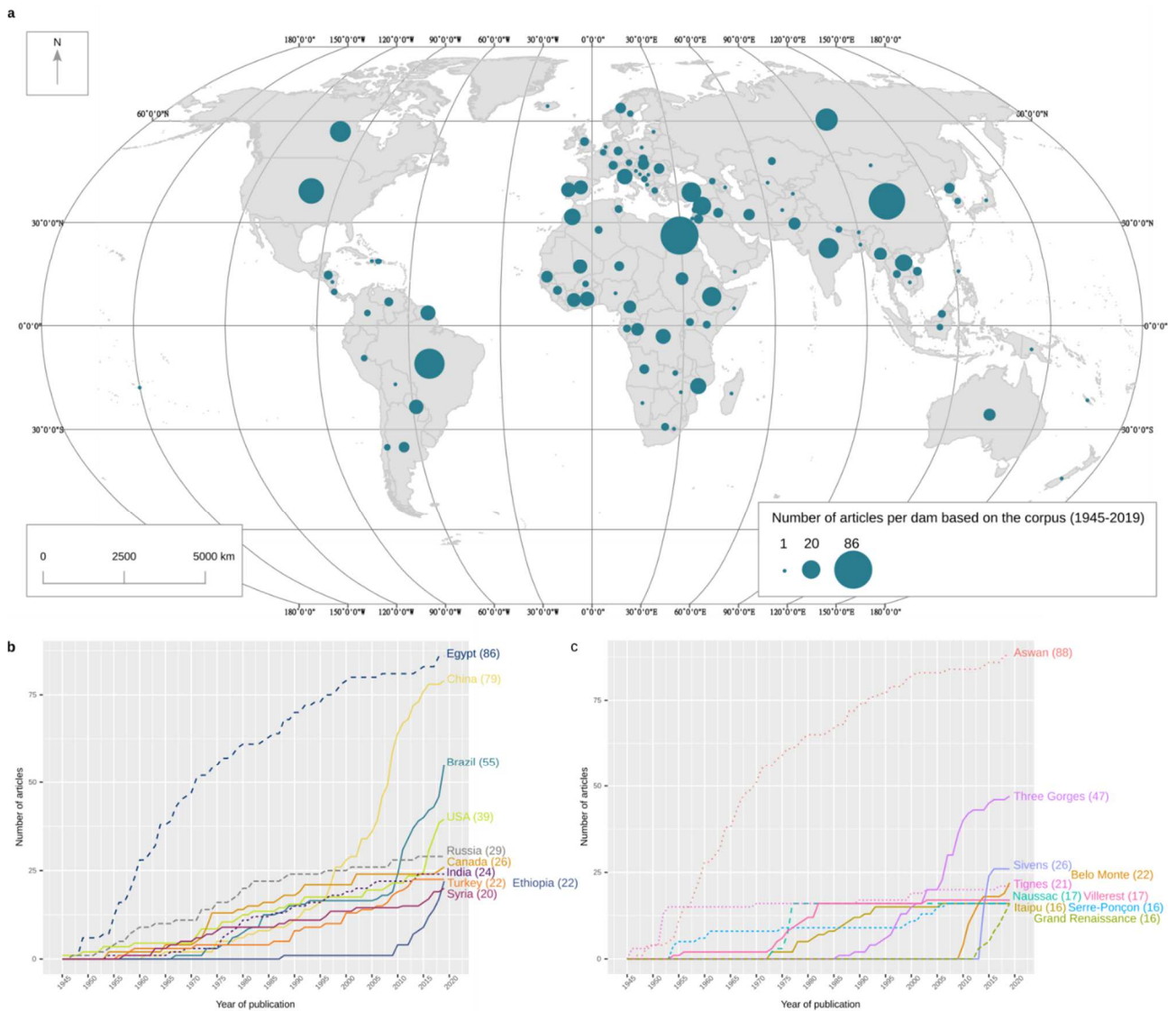
248

249 **Fig. 1.** Dam building in the world and dam coverage in *Le Monde* (1945-2019). a, Number of dams
 250 built between 1945 and 2020 according to the World Register of Dams database (n=51,514). b,
 251 Number of articles in the corpus on dams published between 1945 and 2019 in *Le Monde*
 252 (n=1,471). c, Total number of articles published in *Le Monde* between 1945 and 2019
 253 (n=2,594,606). d, Ratio between the number of articles on dams published in year in *Le Monde*, and
 254 the total number of articles published per year by the newspaper (per mille).

255

256 *Le Monde's* coverage was both international and Franco-centred. The corpus included 582 articles
 257 focused on France (40,1%). It also encompassed articles on 105 other countries (Fig. 2). Much
 258 attention was paid to dams planned or built in Egypt and China, and in particular to the Aswan High
 259 Dam (with some articles also focused on Sudan) and the Three Gorges Dam (Fig. 2).

260



261

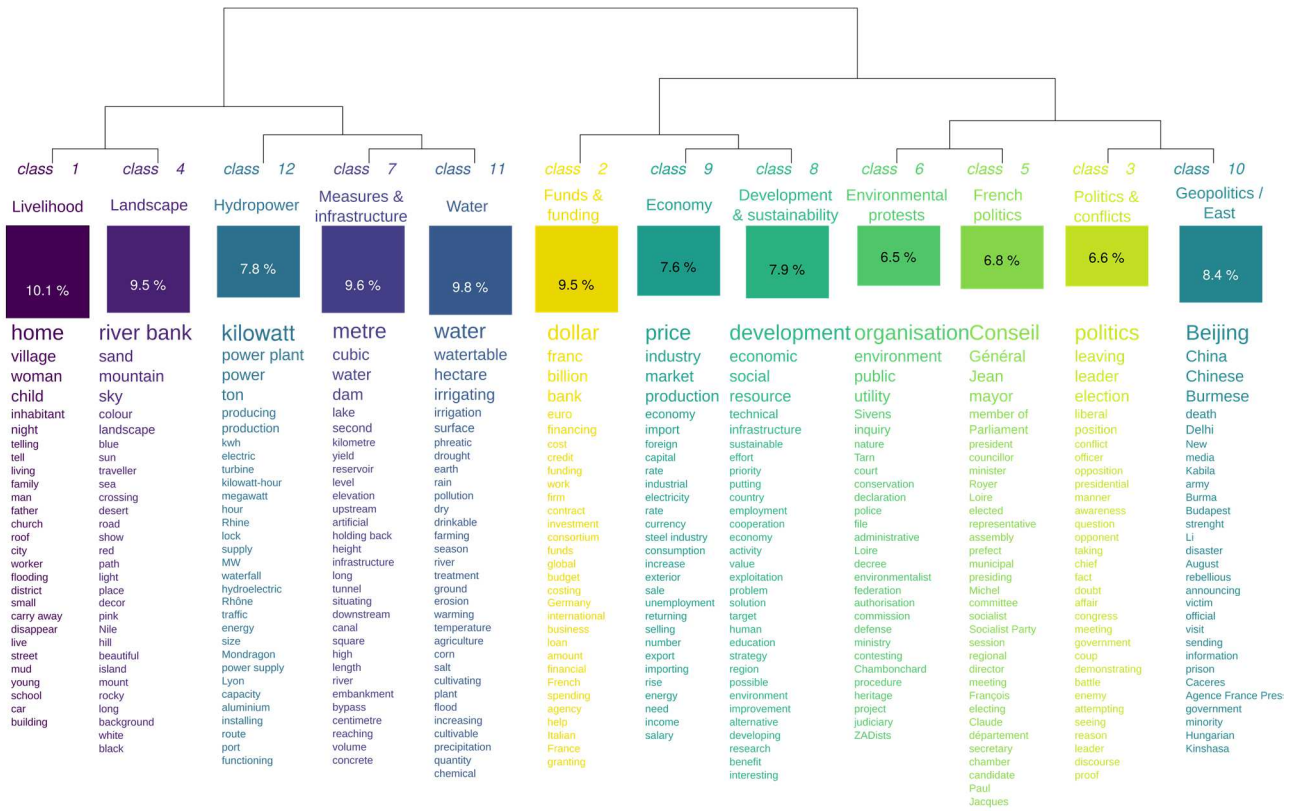
262 **Fig. 2. Spatial characteristics of *Le Monde*'s coverage of dams (1945-2019).** a, Articles on dams
 263 per country (excluding France). b, Cumulative frequency of the number of articles published on the
 264 ten main countries based on the corpus (excluding France). c, Cumulative frequency of the number
 265 of articles published on the ten main dams based on the corpus.

266

267 **3.2. From economics to livelihoods: Twelve themes relating to dam-building (1945-2019)**

268 Twelve major themes that relate to dams appeared in *Le Monde* (Fig. 3). Politics and geopolitics
 269 represented 1/5 of the newspaper articles' content (classes 3, 5 and 10). Journalists also lengthily
 270 described the landscape and the populations affected by dam-building (classes 1 and 4). Technical
 271 characteristics of the infrastructures, rivers and lakes, also often appeared (classes 7, 11 and 12).
 272 Industry and economy, as well as the funding issue, were also topical issues (classes 2 and 9).
 273 Whereas environmental protests represented one of the smallest classes of the corpus (class 6,

274 6.5%), development and sustainability played a relatively important role in the articles (circa 8%).
 275 These themes related to discourses held on dams that have evolved through time.



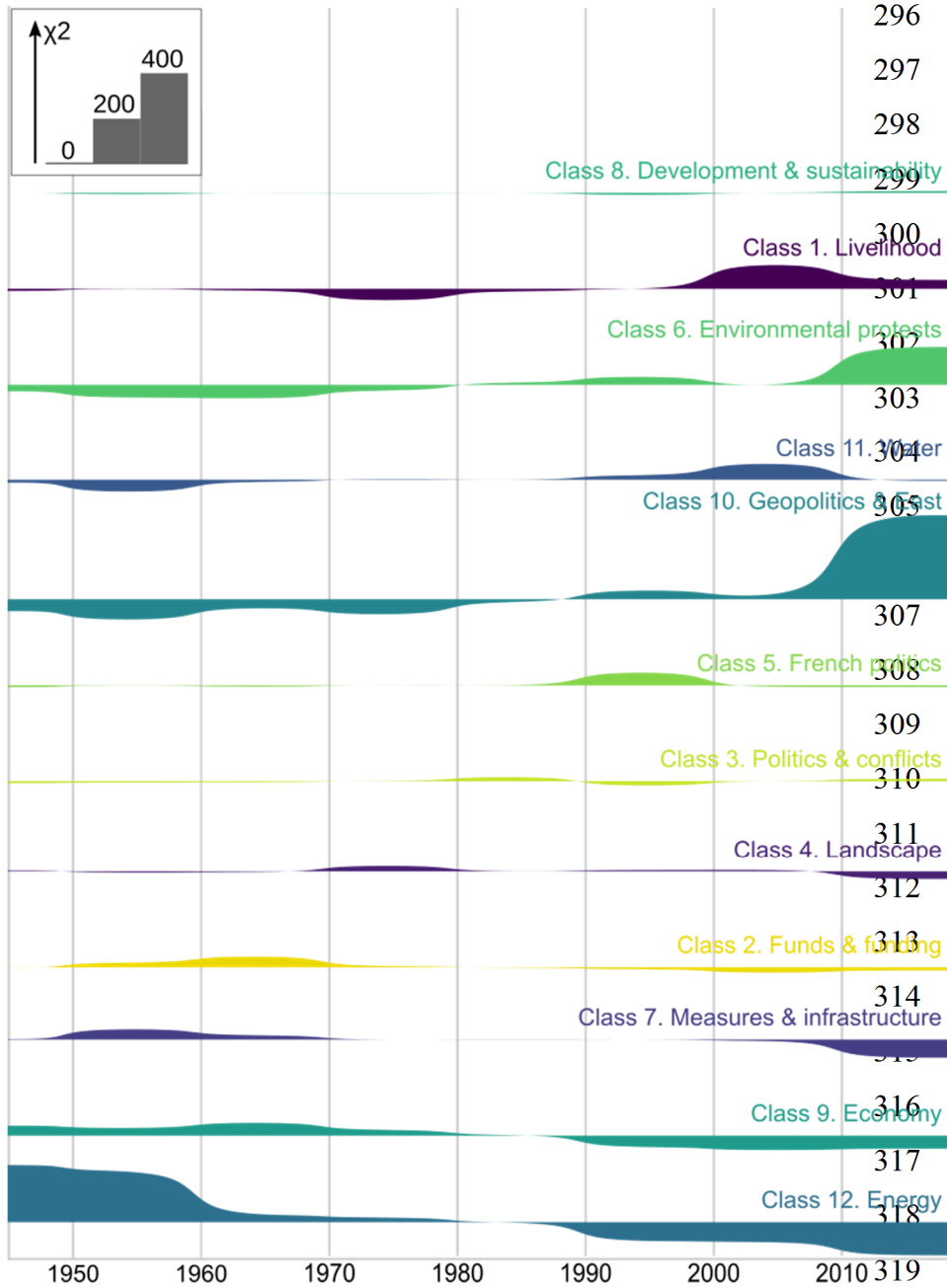
276 **Fig. 3.** The 12 lexical classes of *Le Monde's* articles on dams (1945-2019). The figure is the result
 277 of the hierarchical classification of the textual segments performed with Iramuteq. The authors
 278 added the keywords, established through a qualitative analysis, underneath the class numbers to
 279 facilitate reading the figure.

280
 281 **3.2. A discourse focused on the materiality of dams and on their economic and energy**
 282 **performances (1945-1960s)**

283 From 1945 to the beginning of the 1970s, three lexical fields were over-represented in *Le Monde's*
 284 articles on dams (Fig. 4). The journalists described in great detail technical aspects of dams,
 285 attaching particular importance to the size of the infrastructures.

286
 287 Energy consumption and production were also a major theme of the articles in the 1940s and 1950s.
 288 This issue, coupled with economic questions along with industry, capital, finances, and
 289 development, were also frequently evoked. The focus on energy and economics is explainable by
 290 the fact that, during this period, whereas France was experiencing economic growth (the 'Trente
 291 Glorieuses' period, in connection with the Marshall Plan), the newspaper mainly described dams

292 planned or under construction in France. The newspaper also focused on countries historically
 293 linked to France (colonies or ex-colonies, such as Morocco or the Ivory Coast), and dams
 294 financially supported by France or with involvement from French engineers (such as Aswan in
 295 Egypt, Fig. 2c, or Cahora Bassa in Mozambique).



320

321 **Fig. 4. Evolution of the 12 lexical classes between 1945 and 2019.** The figure, made with RAW
 322 Graphs, shows the degree of association (χ^2) between the different classes and the decade of
 323 publication of the newspaper articles. The degree of association can be positive or negative (above
 324 or below the horizontal lines). The scale representing the degree of association is shown in the top-
 325 left corner of the figure.

326

327 A qualitative analysis of the newspaper articles showed that, between 1945 and the end of the
328 1960s, dams were described as solutions to different types of crises such as drought, flood, water
329 supply or energy shortage. The articles presented dams as tools for development and modernisation,
330 most often on a national scale. Although most newspaper articles remained neutral (i.e., they did
331 not explicitly support the dam projects), some articles demonstrated pride towards the
332 infrastructures and engineering technicity. Regarding the Roselend scheme in the French Alps, a
333 journalist asserted France's superiority over the United States or the Soviet Union: "None of the
334 foreigners [who were visiting the dam and its power plant, La Bâthie] claimed to have something
335 better at home. Not even a Soviet. Not even an American" (*Le Monde*, 10th August 1961). Dams
336 were tightly linked with a discourse on national interests and on political and economic
337 independence in the post-World War II and Cold War contexts. Some articles highlighted the beauty
338 of the dams by comparing them to temples or cathedrals. In the newspaper articles, water was
339 represented as raw material that does not have a cost, as a resource that could be entirely exploited
340 for human activities by implementing "rational" projects. The Dordogne River (in the southwest of
341 France) was described as having been "rationally equipped" and as one of the "best examples of the
342 complete usage of a river" (*Le Monde*, 1st July 1953). The newspaper articles rarely described the
343 source of water and the environment in which water flows. Rather, journalists mentioned head and
344 flow rate, "white coal" ("*houille blanche*") when they described water, or "liquid stairways" (*Le*
345 *Monde*, 25th May 1964).

346

347 Nevertheless, some articles mentioned debates, disputes and controversies before the 1970s. Local
348 negative consequences were evoked, notably those related to land loss (e.g., during the construction
349 of the Tignes Dam in the Central French Alps), and regional oppositions between downstream and
350 upstream interests (e.g., Serre-Ponçon Dam and the Durance valley in the French Southern Alps).
351 Although some articles focused on the benefits of the Aswan High Dam (in Egypt), others
352 underlined the geopolitical tensions linked to the project and the archaeological consequences of the
353 inundation of Nubia even after the reconstruction of the Abu Simbel temple. The international
354 campaign related to the dam, carefully followed and reported on by *Le Monde*, influenced French
355 journalists to adopt a more critical perspective regarding the benefits of dams. By the end of the
356 1960s, a shift had taken place: while economics, energy production and the technical characteristics
357 of dams played an increasingly smaller role in the discourses on dams, the articles began to question
358 the assets of dams.

359

360 **3.3. A discourse increasingly adding value to the socio-natural environment and landscape**
361 **(1970s-1980s)**

362 During the 1970s and the 1980s, as dam building reached its peak, dams were extremely topical
363 (Fig. 1b and 1d). Nevertheless, these two decades did not present major specificities from a
364 discursive point of view (Fig. 3). Although some themes grew during the 1970s—such as landscape
365 (Fig. 3, class 4)—and the 1980s—such as politics and conflicts (class 3) or environmental protests
366 (class 6)—they did not dominate the articles as much as energy or the technical aspects of dam
367 building that dominated the articles in the 1950s.

368
369 While the journalists continued to focus on France or on the dams planned in France, the articles
370 also turned towards North and South American dams (the most publicised having been Itaipu,
371 Fig. 2c, on the border between Brazil and Paraguay) and towards some Asian dams. From the
372 1970s, the negative consequences of dams appeared more and more although some articles
373 continued to assert the benefits of dams in terms of development. The Oil Crises (which were
374 evoked in three articles between 1977 and 1979) might have played a role in the latter case. The
375 debates and controversies were no longer simply local or regional but were national and even
376 international. The opposition to the Silent Valley Dam in India was described, for example, as part
377 of a broad campaign to defend tropical environments and in particular tropical forests throughout
378 the world. The inundation of farmland was increasingly cited (in particular in the Loire valley with
379 Villerest or Naussac, Fig. 2c, in the centre of France but also in Haïti). By raising this topic, the
380 journalists questioned both the type of nature desired by society and the economic model dominant
381 in France and throughout the world. While the foreign dams built with French assistance continued
382 to specifically attract the attention of journalists (for example, Itaipu, Fig. 2c), compared with
383 articles of the 1950s and 1960s, the articles of the 1970s and 1980s were much more critical of
384 French foreign aid. The building of dams on the Senegal River was described as leading to the
385 “disappearance of subsistence agriculture in favour of the development of export crops” (*Le Monde*,
386 15th October 1983). Ongoing and past debates on American dams— the O’Shaughnessy in the
387 Hetch Hetchy Valley or the Marble Canyon on the Colorado River—were evoked.

388
389 In some articles, dams became synonymous with environmental degradation and destruction. Since
390 its inauguration in 1971, the Aswan High Dam has remained newsworthy (Fig. 2c) because of its
391 negative impacts: the increase in soil salinity, river bank erosion, the disappearance of certain
392 species such as sardines (*Sardina pilchardus*), and the regression of the Nile’s delta. In recent
393 articles, Aswan has become a symbol of negative consequences of dams, in particular for arid

394 countries. More attention was also paid to rivers in terms of pollution, yield, temperature, and algae
395 development. Subjects such as hydro-peaking, flushing flows, and discontinuity became
396 newsworthy. For some journalists, once the dams were built, the nature of the river changed. The
397 Verdon River (in the Southern French Alps) “has ceased to exist for a third of its distance” (*Le*
398 *Monde*, 28th June 1982), for example, and the Tagus (in Central Spain) was “imprisoned by a series
399 of dams” (*Le Monde*, 12th March 1971). During this period, the expressions “wild river” and “living
400 river” appeared in journalistic vocabulary (Fig. 5a), which revealed the growing concern for pristine
401 and rare environments. Starting in the 1980s, some articles focused on or evoked plans for dams,
402 which were cancelled because of environmental considerations in France but also in Germany,
403 Australia, the United States and the Soviet Union.

404

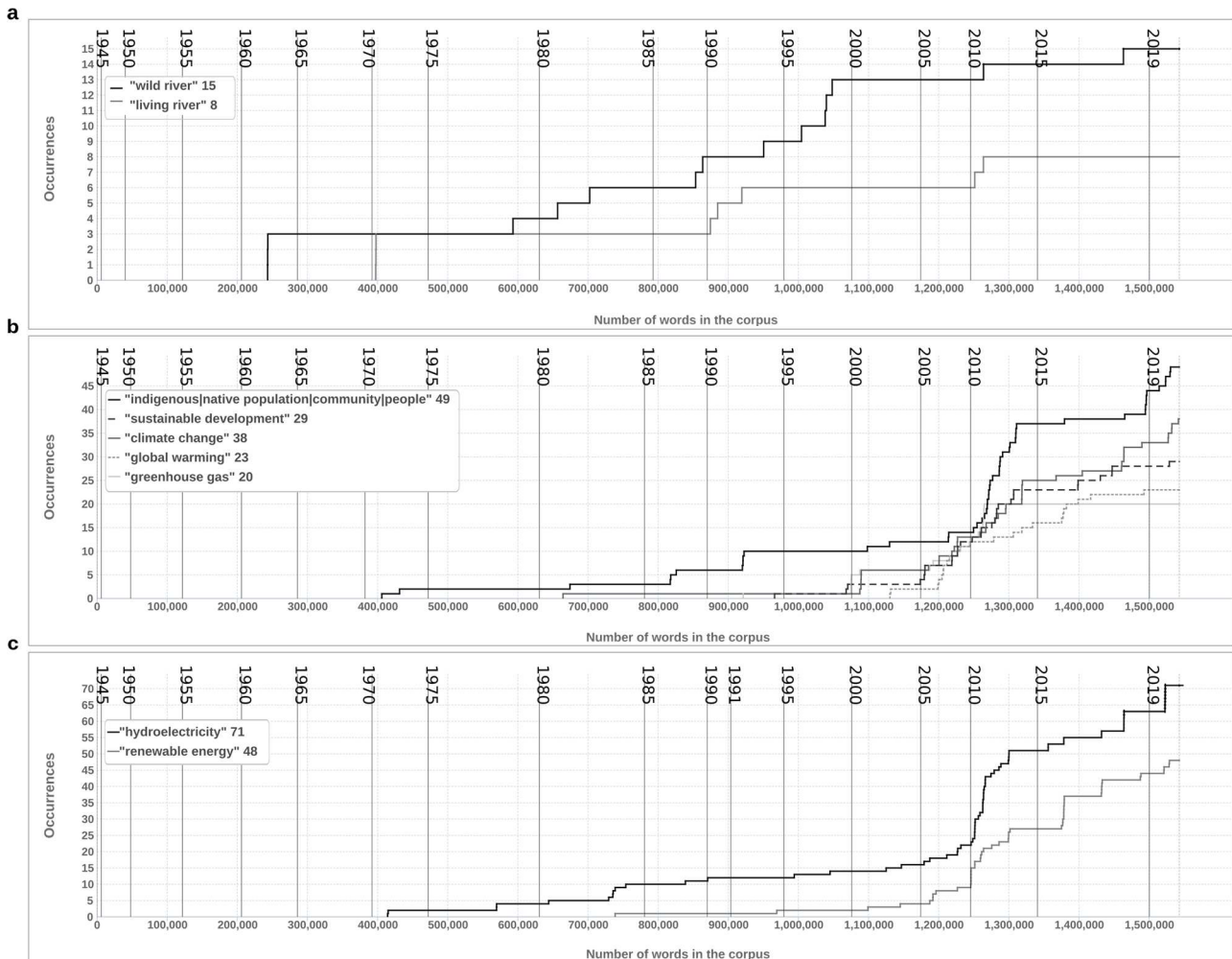
405 According to *Le Monde*, dams became particularly controversial hydraulic infrastructures during the
406 1970s and 1980s, although no lexical fields particularly stood out in the corpus. During these two
407 decades, while environmental concerns emerged, economic and social issues split apart as some
408 dams were described as economically interesting but socially questionable.

409

410

411

412



413 **Fig. 5.** Significant keywords and expressions and their evolution between 1945 and 2019. a,
 414 Cumulative frequencies of the expressions “wild river” and “living river”. b, Cumulative
 415 frequencies of the expressions “indigenous|native population|community|people”, “sustainable
 416 development”, “climate change”, “global warming”, “greenhouse gas”. c, Cumulative frequencies
 417 of the expressions “hydroelectricity” and “renewable energy”.

418

419 **3.4. From social and environmental impacts to controversies on sustainability (1990s-2010s)**

420

421 *3.4.1. A discourse on the impact of dams on water and physical environment and their interactions* 422 *with society (1990s-mid 2000s)*

423

424 During the 1990s and the beginning of the 2000s, the coverage of issues related to dams slightly
 425 decreased in *Le Monde* (Fig. 1d). Nonetheless, environmental protests became more topical during
 426 the 1990s in relation to specific debates (for example, the Three Gorges project in China, Fig. 2c).

427 The social and environmental impacts of dams continuously appeared—although the tone of the

428 journalists remained neutral in general. Impact on water (quality and quantity) also became more
429 central (Fig. 4).

430

431 The introduction of such topics in the newspaper's accounts were linked to various events. Firstly,
432 in 1992 the French government passed a water law and defined water as a national heritage.
433 Secondly, at the end of the 1990s, some members of the French government considered
434 implementing a sustainable water development scheme for the Loire River basin. At the end of the
435 1990s, such a program implied abandonment of dam projects, with an important example being the
436 Chambonchard Dam (*Le Monde*, 19th February 1999). It represented a major turn for water
437 development in France, as dam projects were cancelled due to environmental concerns and protests.
438 Thirdly, the newspaper also highlighted newly discovered environmental impacts of dams, in
439 particular the biological consequences of the release of methylmercury after the flooding of forests
440 or boglands in Canada (*Le Monde*, 27th December 1991) or the release of greenhouse gas. The
441 newspaper's columns debated the latter, when the main French operator *Électricité de France*
442 (EDF) was obliged to temporarily shut down its newly inaugurated dam and power plant of Petit
443 Saut in French Guyana. The flooded tropical forest released so much methane that many fish
444 suddenly died. Scientific studies demonstrating that the reservoir released important quantities of
445 greenhouse gas that were quoted by the newspaper led journalists to conclude that "hydroelectric
446 dams are not insignificant in terms of greenhouse effect" (*Le Monde*, 28th August 1995). The subject
447 of greenhouse gas was introduced in some articles on dams since the early 1990s (Fig. 5b) but only
448 became topical at the end of the 1990s and even more so after 2004.

449

450 3.4.2. When sustainability enters the discourse on dams (from the mid-2000s)

451

452 Although international conferences and reports introduced the concept of sustainable development
453 at the turn of the 1990s (with the 1987 report *Our Common Future* and the 1992 Rio Earth Summit),
454 based on *Le Monde's* reporting, the sustainability of dams only became central in the discourses on
455 dams after the mid-2000s. The expression "sustainable development" appeared regularly since 2005
456 (Fig. 5b). Similarly, the use of the expressions "climate change", "global warming" and
457 "sustainability" increased substantially after 2004 (Fig. 5b), possibly in relation to the 2001 Third
458 Assessment Report of the Intergovernmental Panel on Climate Change. Economic development was
459 tightly linked to environmental and social sustainability, as shown in the class 8 (Fig. 3), which
460 gained momentum in the last decade (Fig. 4). Sustainability was shown as a paradigm for
461 development and for water management that can be invoked to either defend or criticise dams.

462 Livelihoods, living standards, social equity and justice and human rights were more and more
463 reported on after 2000 (Fig. 4). *Le Monde* participated in giving indigenous communities an
464 international audience (Fig. 5b), in particular in the cases of Southeastern Asian dams (such as
465 Murum in Malaysia) or of South and North American dams (such as Belo Monte in Brazil, Fig. 2b
466 or Agua Zarca in Honduras, or various Canadian projects), which may endanger these communities'
467 livelihoods, according to the newspaper.

468

469 The newspaper also explained, however, how different projects may contribute to sustainability. *Le*
470 *Monde* reported that the Nam Theun 2 project, planned in Laos, was defended by the World Bank—
471 although the World Bank had previously refused to finance some other dam projects—and
472 presented by the international institution as an example of sustainable development (*Le Monde*, 14th
473 September 2004). The construction of the multipurpose Kandadji Dam on the Niger River in the
474 South of Niger was also said to have raised no opposition “because the dam was conceived
475 according to the standards of sustainability” (*Le Monde*, 10th May 2012). Instead, the story of an
476 irrigation dam planned on the Acheloos River in Greece, was reported in the newspaper after the
477 decision taken by the Greek Council of State (i.e., the Supreme Administrative Court) to prohibit
478 the dam’s construction as the project contradicted the principles of sustainability recognised by the
479 Greek constitution (*Le Monde*, 6th March 2014). In many recent articles focusing on China (which is
480 the second most newsworthy country, Fig. 2a and Fig. 2b), the journalists argued that sustainability
481 has entered the discourse of Chinese officials. This discourse focused on justifying the building of
482 new dams when, in fact, the multiplication of dams and the accompanying growth and climate
483 change “put pressure on hydrology” (*Le Monde*, 12th November 2008). The Three Gorges Dam,
484 proposed by the Chinese government who “assured that such construction work is essential for the
485 modernisation of a country where energy shortages are slowing development” (*Le Monde*, 16th
486 December 1994), in fact “amplifies the consequences of global warming which has already
487 contributed to diminishing the Yangzi River’s yield” (*Le Monde*, 30th December 2009). While
488 irrigation represented a controversial topic, as demonstrated by the debates on the Sivens Dam
489 project in Southwest France (Fig. 2c), “sustainable”, “development” and “renewable” are amongst
490 words that co-occurred most with the word “hydroelectricity” in the newspaper corpus. Although
491 hydropower remained much less articulated as a theme connected to dam building than it was in the
492 1940s and 1950s, hydroelectricity became more topical in the newspaper also at the turn of the
493 second millennium (Fig. 5c). The newspaper revealed the complexity of the debate. While
494 indicating the possibility of greenhouse gas release related to certain dam-reservoirs, it also
495 explained that after “the Fukushima accident, the questioning on nuclear power and the struggle

496 against greenhouse gas emissions should speed up the scramble to large infrastructures” (*Le Monde*,
497 19th April 2011). The journalists covered explicitly the return to large infrastructures, especially in
498 developing countries. While reporting on a meeting between the African Union and ICOLD,
499 journalists explained that hydropower is presented as a clean “alternative to fossil energy resources”
500 and the organisations’ “intentions are clear: large dams must become once again instruments for the
501 development of nations” (*Le Monde*, 27th November 2008). The journalists also highlighted,
502 however, that this return to large infrastructures can be a source of major political tensions, for
503 example in the case of the Great Ethiopian Renaissance Dam, which the newspaper has very often
504 reported on in recent years (Fig. 2c). By 2019, with the rise of an environmental discourse on
505 economic, social and environmental sustainability, and the emergence of themes such as climate
506 change, global warming and greenhouse gas emissions, the reporting on dams has therefore become
507 more ambiguous and associated with uncertainty.

508

509 **4. Discussion**

510

511 Despite the fact that *Le Monde* does not specialise in environmental issues, the results of the
512 analysis showed that the newspaper documented changes in discourses on hydraulic infrastructures
513 such as dams. It provided insights on a continuing dilemma over the period and into the future: to
514 dam or not to dam? Although dams have been controversial infrastructures as early as the 1940s, it
515 was mostly after the 1970s that they were portrayed as disrupting social and environmental
516 configurations, the daily living environments of the local inhabitants. From this point of view, the
517 results showed a time gap between the scientific controversy on the impact of dams, which emerged
518 during the 1960s at conferences such as the Royal Geographical Society symposium on “Man-made
519 lakes” (in 1965), and the media and political debate. The necessity to take into account the local
520 population and conduct impact assessments, which was proposed by the scientific community at the
521 beginning of the 1970s (Scope, 1972), was not advanced in newspaper articles of *Le Monde* until
522 later years of the same decade. The characterisation of dams and hydropower as ‘clean’ and ‘green’,
523 which has been debated within the scientific community since the 1990s (Rosenberg et al., 1995),
524 only appeared in the media in the mid-2000s. Moreover, while Allan (2003, p. 2) underlined that
525 “the water sector in the North adopted the principles of sustainable development during a protracted
526 discursive struggle from the late 1950s to the mid-1970s”, the issue of sustainability only
527 progressively emerged in newspaper articles in the 1970s and only became a prominent topic,
528 conceptualised as such, in the past decade.

529

530 These results are similar to those of other studies on media coverage of environmental issues. In a
531 study of the coverage of climate change in the mass-media of the United States, Boykoff and
532 Boykoff (2007) explained that “Even though scientists had warned for years that emissions of
533 carbon dioxide and other greenhouse gases would lead to changes in the Earth’s climate, this did
534 not capture large-scale media attention in the US until 1988” (p. 1195). The time gap is also
535 explainable by events not directly connected with dams, but which triggered a sudden interest in
536 such infrastructure and its sustainability. In France, in the mid-2000s, the government organised a
537 multi-party debate on ecology and sustainable development (*‘Grenelle Environnement’*), whose aim
538 was to elaborate a list of measures to implement. In 2002, the name of the Ministry for Environment
539 (*‘Ministère de l’Environnement’*), which had kept the same name since 1971, was changed to
540 ‘Ministry for Ecology and Sustainable Development’ (*‘Ministère de l’Écologie et du*
541 *Développement Durable’*). These political events could potentially explain the growing interest in
542 the sustainability of dams in the mid-2000s. As Boykoff and Boykoff (2007) underlined, increases
543 in the media coverage of environmental topics are often attributable to “a combination of
544 circumstances that [are] far from purely scientific in nature” (p. 1196).

545

546 From both a genealogical and critical perspective, results of this study showed that, until the 1970s,
547 *Le Monde* produced and conveyed a discourse highlighting human domination over nature. This
548 discourse mostly promoted development and paid much attention to the infrastructures themselves.
549 From the end of the Second World War to the 1970s, the media’s discourse can essentially be
550 described as ‘Promethean’ or ‘Modernist’ (Kaika, 2006), i.e., a discourse about taming and
551 controlling a ‘savage’ nature (Boelens et al., 2019). With a strong focus on industrial development,
552 the newspaper also highlighted the dependency of capitalist States and companies on the building of
553 new dams and hydraulic infrastructure. In this perspective, dams appeared as ‘hydraulic fixes’—in
554 other words, hydraulic projects branded by their supporters as tools for growth, social and economic
555 development, but which in fact contribute essentially to the longevity of hydraulic companies and
556 capitalist States (Swyngedouw, 2015). Evidenced in articles published after the 1970s, the
557 newspaper had apparently distanced itself from the Promethean discourse and adopted a more
558 critical tone. The media began to pay more attention to human livelihoods but also to other
559 nonhuman living beings. The evolution of the newspaper’s discourses illustrates how dams have
560 become the ‘symbol of an exogenous development model that is imposed on vulnerable local
561 societies’ (Barraud, 2008: 3)².

² Translated from French by the authors.

562

563 The genealogical approach utilised in this study also revealed how sustainability has entered the
564 discourse on dams and shows a coexistence of different conceptions of sustainability. Although
565 different stakeholders seemingly agree today that sustainability involves three constituent
566 elements—ecology, economy and society—the newspaper articles showed changing prioritisations
567 of these three elements (equitability, viability, bearability). The articles of the 1970s and the 1980s,
568 for example, highlighted the opposition between stakeholders who favoured economy and who
569 expressed few concerns regarding ecology—putting forward dams as equitable development
570 levers—and stakeholders concerned with social changes related to dams, and finally an emerging
571 group of stakeholders concerned with ecological issues. By the 2010s, sustainability was apparently
572 central to stakeholders on all sides—i.e., against or in favour of dams—and the environmental
573 impact of energy infrastructures in particular was brandished by both dam proponents and dam
574 opponents. For some stakeholders—in particular for some governments or hydraulic institutions—
575 the articles showed that sustainability was more connected with social and economic aspects than
576 with environmental ones. More generally, the tension between the different pillars of sustainability
577 and the consequences of dams at different scales (e.g., local, national, and global) underlines the
578 importance of deliberation in order to move towards concerted decision-making. It also reveals the
579 extent to which the sustainability of dams, and notably the criteria we use to define viability (the
580 opposition between river ecology conservation and carbon emission control) and equitability, has
581 today become extremely controversial in the public domain.

582

583 **5. Conclusions**

584

585 In conclusion, analysis of media discourses held on dams since the mid-20th century revealed how
586 different generations of debates on dams, water planning and more generally on development
587 paradigms have emerged and evolved. Results of the genealogical study of the newspaper *Le*
588 *Monde* provided answers to the research questions posed in this paper as follows:

589

590 First, how have the discourses and debates on dams, and notably on the sustainability of dams,
591 developed within the public domain?

592 Our analysis shows that between 1945 and 2019, different discourses have been developed on dams.
593 Until the 1960s, the dominant discourse focused on the materiality of dams and their economic and
594 energy performances. Essentially Promethean, this discourse was occasionally opposed to a
595 discourse presenting dams as controversial and having negative social and cultural impacts. During

596 the 1970s and the 1980s, i.e., a decade after the beginning of the scientific controversy on dams, the
597 discourse on dams increasingly added value to the socio-natural environment and landscape
598 affected by dam projects; dams tended to be presented as economically interesting but socially and
599 even environmentally questionable. After the 1990s, the impacts of dams were more and more
600 highlighted, in relation to society and to the physical environment. Finally, our results showed the
601 extent to which the debate on the sustainability of dams has gained momentum during the past ten
602 years.

603 However, the notion of sustainability was addressed in newspaper articles on dams in an ambivalent
604 way. On one hand, negative social and environmental impacts of dams were listed to demonstrate
605 that dams are incompatible with sustainability. On the other hand, the newspaper articles explained
606 how in some cases hydropower projects could contribute to sustainable development.

607

608 Second, how can tracing a ‘genealogy’ of discourses on dams inform their sustainability into the
609 future?

610 Analysing past and present discourses on dams can help inform future discussions on dams and
611 their sustainability. Our results have shown that controversies about dams are not new in the public
612 domain, and that the notion of sustainable development has to some extent reactivated the
613 Promethean discourse in which dams are presented as solutions to a range of socio-environmental
614 problems. Commonalities between past and present discourses can be found, even though the
615 Promethean discourse is no longer dominant in the media we analysed.

616 The analysis of media discourses on dams also showed the complexity of the public debate
617 regarding the knowledge of the social and ecological impacts of dams, of both short-term and long-
618 term environmental alterations they may cause, and of the political choices to be made in the future.
619 To gain more complete insights and continue informing discussions on dams and sustainability,
620 future work can extend to other media sources, as archives are becoming more and more digitised.
621 Additional sources may reveal different trends in the evolution of discourses on dams and the
622 integration of sustainability within these discourses. Other avenues may include exploration of the
623 sustainability of dams as producing ‘green energy’, as well as the study of other sources, notably the
624 advertisements (e.g., leaflets, posters, etc.) produced by hydropower companies. Results from this
625 study further suggest a need for a stronger dialogue between the scientific and public domains.
626 Knowledge transfer and exchange would be beneficial on topics including the meaning of
627 ‘renewable energy’ and ‘green energy,’ and alternative modes of governance regarding dams.

628

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654 **Competing interests**

655 The authors declare no competing interests.

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