

1 **The emergence of private land conservation in scientific literature: a review**

2

3 Keywords: Biodiversity; conservation easements; conservation actions; policy instruments; private
4 land conservation; stakeholders.

5 Type of article: review article

6

7 **Abstract**

8 Private land conservation (PLC) is an important means for achieving global conservation targets.

9 We reviewed peer-reviewed literature focussing on PLC to summarize past scientific evidence and
10 to identify research trends and gaps to direct future research. We carried out an in-depth review of
11 284 scientific articles and analysed where, when and in what context PLC has been studied.

12 Specifically, we (i) assessed where and when PLC studies took place and which topics they
13 covered; (ii) identified the most addressed conservation actions and policy instruments, and (iii)
14 investigated whether stakeholders' engagement during research processes was reported or not. We
15 found that (i) there has been an increase in the number of scientific PLC publications over time; (ii)
16 78% of the articles in scientific journals focussed on four countries only (United States of America,
17 Australia, South Africa and Canada); (iii) literature content focussed mostly on easements,
18 programs and landowners and showed both geographical and temporal differences; (iv) land/water
19 protection, law and policy and livelihood, economic and other incentives were the most addressed
20 conservation actions; (v) property rights, particularly conservation easements, were the most
21 addressed policy instrument; and (vi) half of the articles did not report the engagement of any
22 stakeholder sector and cross-sector stakeholders' engagement was often missing. Overall, our
23 results highlight the need for future studies on PLC to cover currently underrepresented regions; to
24 assess the effectiveness of more conservation actions and policy instruments; and to test how

25 engaging different stakeholders can potentially promote legitimate and equitable PLC policies
26 across contexts.

27

28 **1. Introduction**

29 Aichi target 11 of the Convention of Biological Diversity promotes the expansion of the global
30 protected area network to cover at least 17% of all terrestrial land by 2020, while enhancing
31 ecological representativeness and connectivity (Convention on Biological Diversity [CBD], 2010).
32 With limited resources available for protected area expansion and effective management, meeting
33 Aichi target 11 requires countries to design and implement complementary area-based conservation
34 policies (CBD 2010).

35

36 With privately owned land covering large areas of the world, private land conservation (PLC) is an
37 increasingly recognized strategy to complement protected area networks, either as privately
38 protected areas (PPAs, i.e. areas that have a primary conservation objective) or as ‘other effective
39 area-based conservation measures’ (i.e. areas that deliver the effective in-situ conservation of
40 biodiversity, regardless of its primary objectives) (Bingham et al., 2017; Kamal et al., 2015b;
41 Mitchell et al., 2018; Stolton et al., 2014; WCPA, 2019). As the field is complex and continuously
42 growing, the semantics and governance systems of PLC include multiple definitions (e.g. Stolton et
43 al. 2014; Kamal et al. 2015b). In this article, we broadly refer to PLC as land under private
44 ownership (e.g. individuals, families or other non-public institutions) managed to help achieve
45 biodiversity conservation objectives. PLC policies have the potential to (i) increase total area under
46 protection, (ii) increase the diversity of stakeholders engaged in conservation policy-making, (iii)
47 enhance ecological and socio-economic connectivity and (iv) reduce social conflict (Doremus,
48 2003; Maciejewski et al., 2016; Paloniemi and Tikka, 2008; Stolton et al., 2014; Wallace et al.,
49 2008). However, designing effective national and sub-national (e.g. municipal) PLC policies is

50 challenging, as it requires interacting with complex, context dependent socio-ecological,
51 institutional, legal and economic processes (Cocklin et al., 2007; Doremus, 2003; Kamal et al.,
52 2015a; Selinske et al., 2017).

53
54 Implementing on the ground conservation actions on private land mostly depends on landowners'
55 willingness to collaborate with conservation organizations (e.g. in terms of enrolment, permanence
56 and security of conservation agreements) and their management capabilities (e.g. in terms of
57 resources and knowledge) (Farmer et al., 2017; Hardy et al., 2017; Knight et al., 2010; Selinske et
58 al., 2015). In addition, the success of PLC depends on conservation organizations capacities to
59 adequately plan, implement and monitor the effectiveness of conservation actions (Clement et al.,
60 2015; Drescher and Brenner, 2018; Epstein et al., 2015; Rissman et al., 2017). In this context, many
61 policies involving a wide range of instruments have been developed worldwide to increase
62 landowners' engagement in PLC, to support them with implementing conservation actions, and to
63 ensure their long-term commitment (Casey et al., 2006; Selinske et al., 2015). These range from
64 involuntary policies, which might include imposed land use regulations, to voluntary policies,
65 which can include financial and capacity building instruments (Casey et al., 2006; Disselhoff,
66 2015; Kamal et al., 2015b). Overall, the success of PLC policies depends on designing and
67 implementing a suite of different policy instruments according to geographical contexts and to the
68 needs, values, and capabilities of different stakeholders (Cocklin et al., 2007; Doremus, 2003;
69 Selinske et al., 2017).

70
71 Engaging stakeholders in conservation research and policy-making processes has been considered
72 critical to adequately address complex science-implementation spaces (e.g. Reed et al. 2009;
73 Sterling et al. 2017; Toomey et al. 2017). As a result, a growing number of international
74 conventions and science-policy platforms call for stakeholders' engagement as a way of facilitating

75 the co-production of relevant and usable knowledge (e.g. CBD, Intergovernmental Platform for
76 Biodiversity and Ecosystem Services [IPBES], Future Earth; van der Hel 2016; Tengö et al. 2017).
77 Engaging stakeholders in a comprehensive way (e.g. by conducting stakeholder analyses, Reed et
78 al., 2009) is seen particularly important in the context of PLC research that aims to inform policy-
79 making because a wide range of community, business and government stakeholders might be
80 interested or affected by the implementation of PLC policies (Cocklin et al., 2007; Cooke et al.,
81 2012; Kamal and Grodzinska-jurczak, 2014; Paloniemi et al., 2018).

82

83 As several governments are currently developing and implementing different PLC policies to
84 achieve national and global conservation targets (Disselhoff, 2015; Stolton et al., 2014; WCPA,
85 2019), there is a clear need to assess the published scientific literature, identify research gaps, and
86 direct future research. To our knowledge, no previous literature review has studied research trends
87 and gaps in PLC peer-reviewed literature at the global level (but see for example Casey et al. 2006;
88 Stolton et al. 2014; Disselhoff 2015; Kamal et al. 2015b, for PLC policy instruments descriptions
89 and classifications). Here, we filled this gap and (i) assessed when and where the identified studies
90 took place and which topics they covered; (ii) identified the most addressed conservation actions
91 and policy instruments, and (iii) investigated whether stakeholders' engagement during research
92 processes was reported or not. For the purpose of this review, we focused on the broader PLC
93 literature, including literature on PPAs as well as other PLC policies. Finally, we discuss possible
94 ways for future PLC research to fill the gaps in order to better inform PLC policy-making and to
95 increase on the ground outcomes.

96

97 **2. Methods**

98 We conducted a comprehensive keyword search in SCOPUS database, capturing articles published
99 between 1988 to February 2018. We used the following keyword search: (TITLE-ABS-KEY

100 ("Private land Conservation" OR "Private Reserves" OR "Private* Protected Areas" OR "Private
101 conservation areas" OR "Private Game Reserves" OR "Private Wildlife Reserves" OR "Private
102 Wildlife Refuges" OR "Private Nature Reserves" OR "voluntary conservation" OR "conservation
103 easements" OR "conservation covenants"). As PLC terminology can be context-dependent, we
104 included other widely used broad synonyms for PLC in different countries and regions (e.g. private
105 game reserve, conservation easements). While we are aware that there are many PLC policies and
106 topics addressed in the "grey literature" (e.g. local and national reports) and that scientific
107 documents on biodiversity conservation are also published in other languages than English (Amano
108 et al., 2016), in this study we only focussed on peer-reviewed articles in English. This choice was
109 due to the global nature of this study and the potential geographical and language bias in accessing
110 and interpreting national and local reports.

111

112 Our initial search resulted in 858 articles. We read all abstracts to ensure inclusion of relevant
113 articles only. We considered an article relevant for our review if it described PLC policies, policy
114 instruments, actions, and/or analysed their effectiveness and impacts on biodiversity conservation.
115 We discarded articles focussing on reporting ecological surveys inside PLC areas without relating
116 the results to PLC policies or those articles focussing on agriculture policies without addressing
117 their potential impact on biodiversity conservation.

118

119 After manual sorting, our final database resulted in 284 articles (264 research articles, 16 reviews,
120 two letters and two notes, according to Scopus document type classification) (see Appendix A for a
121 full list). After reading the whole text, for each study we recorded (i) year of publication, (ii)
122 countries where the studies were conducted, (iii) conservation actions and policy instruments
123 addressed, and (iv) stakeholder sectors reported to be engaged during the research process. Some

124 studies were from several countries and/or addressed more than one policy instrument and were
125 classified accordingly.

126

127 We then carried out a content analysis to identify most frequent words (hereafter topics, according
128 to our content interpretation) present only in articles' abstracts, using the tm package (Feinerer and
129 Hornik, 2017) in R version 3.4.4 (R Core Team 2018). We also counted the number of abstracts
130 that use these most frequent topics. In order to concentrate on the relevant policy related content,
131 we removed frequent English "stop words" (e.g. the, is, what, we) from the analysis. We removed
132 the term "private land conservation" because it was already the focus of our review and might have
133 obscured the relationship between other words. We then classified the articles according to the date
134 when they were published. We used year 2010, when the Strategic Plan for Biodiversity 2011-2020
135 and the Aichi Biodiversity Targets were approved (CBD 2010), as a policy landmark that could
136 have affected the temporal trends in PLC research content. In addition, we classified the abstracts'
137 content per continent where the studies were conducted to detect geographical content patterns. We
138 also searched for unique topics within the most frequently addressed topics (i.e. ten most frequent
139 topics) to detect other patterns at geographical and temporal levels. While it is important to note
140 that we have only analysed text from articles' abstracts, abstracts should nonetheless report the
141 most relevant concepts from the entire articles. Therefore, we argue that analysing the whole text
142 would not greatly affect our main results (Nunez-mir et al., 2015).

143

144 In order to assess which conservation actions were addressed or recommended in the articles to
145 increase the effectiveness of PLC policies, we followed the classification by Salafsky et al. (2008).
146 Conservation actions can be defined as interventions undertaken by different stakeholders, designed
147 to reach conservation goals (Salafsky et al., 2008). We then classified conservation actions as: (i)
148 land/water protection, i.e. those actions that identify, establish or expand legally protected areas,

149 and those that protect resource rights; (ii) land/water management, i.e. those actions that aim to
150 conserve or restore habitats and the environment in general; (iii) species management, i.e. those
151 actions focussed on managing or restoring species; (iv) education and awareness, i.e. those actions
152 directed at improving people's understanding and skills; (v) law and policy, i.e. those actions that
153 help develop and implement legislation, regulations, and voluntary standards; (vi) livelihood,
154 economic and other incentives, i.e. those actions developed and implemented to influence
155 behaviour; and (vii) external capacity building, i.e. those actions aiming to facilitate the conditions
156 to increase conservation impact.

157

158 In the context of this review, we followed Game et al. (2015) definition of conservation policies, to
159 be any set of institutionalized behaviours or practices that influence conservation activities. PLC
160 policies typically consist of a set of different policy instruments, which can be defined as any type
161 of instrument designed to support or promote a change in behaviour (induced or voluntary),
162 associated with biodiversity conservation on private land (Casey et al., 2006; Disselhoff, 2015;
163 Doremus, 2003; Selinske et al., 2017). We classified the policy instruments addressed in the articles
164 following the classification by Casey et al. (2006). We used this taxonomy because it is
165 comprehensive and broad enough to include a wide variety of policy instruments developed to
166 promote PLC (Casey et al., 2006). We classified policy instruments as: (i) *regulatory & economic*
167 *disincentives*: policies that discourage practices that might have negative impacts on biodiversity,
168 by defining management standards and penalties for non-compliance; (ii) *legal/statutory*
169 *innovations*: new rules that provide some permits for ecosystem transformations or regulatory relief
170 for those landowners who voluntarily commit to implement conservation actions on their properties;
171 (iii) *property rights instruments*: involve landowners voluntarily transferring total or partial
172 property rights to a conservation organization (e.g. land trust, government agency) in order to
173 restrict land use intensity; (iv) *market based instruments*: developed to create markets that value

174 biodiversity conservation, increasing economic opportunities for landowners through the design of
175 certification schemes or ecotourism; (v) *financial instruments*: involve payments to compensate
176 landowners for the opportunity and/or management costs associated with implementing
177 conservation actions on their land; (vi) *public tax instruments*: provide tax reductions (e.g. income,
178 property) to those landowners who maintain or restore land for biodiversity; (vii) *facilitative*
179 *instruments*: institutional strategies designed to build landowners' capacity to implement
180 conservation actions, by providing training, technical assistance and recognition of conservation
181 efforts among other benefits.

182
183 In order to assess which stakeholder sectors were reported to be engaged in PLC research we
184 followed the classification suggested by the United Nations Development Programme (UNDP
185 2012). The classification recognizes the following types of stakeholder sectors: *private* (e.g.
186 individuals, families, businesses), *public* (e.g. national and local governments, international bodies)
187 and *civil society* (e.g. media, universities, NGOs). Then, to determine whether a given stakeholder
188 sector was reported to be engaged, we used Rowe & Frewer (2000) stakeholders' engagement
189 classification, which is based on the direction of communication between parties. It recognizes three
190 broad categories: (i) communication (i.e. dissemination to passive recipients), (ii) consultation (i.e.
191 collecting information from participants) and (iii) participation (i.e. two-way communication and
192 learning process between participants and researchers) (Rowe and Frewer, 2000). Within the scope
193 of this review, we broadly considered that a stakeholder sector was engaged in the research process
194 if the paper documented (i) consultation or (ii) participation engagement (e.g. interviews, surveys,
195 workshops).

196

197 **3. Results**

198 Our results showed an increasing temporal trend in the number of published peer-reviewed articles
199 in English focussing on PLC (see Appendix B, Fig. B1). The number has, in fact, doubled after
200 2010 when the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets were
201 approved (CBD 2010). However, the number of articles appears to have stabilized in the last years
202 (Fig. B1). Furthermore, we found a strong geographic bias in the English peer-reviewed literature
203 (Fig. 1). Research in the analysed 284 articles was conducted in 26 countries (15 studies were either
204 theoretical or analysed different aspects of PLC policies without focussing on any particular
205 region). Most studies (78%) were conducted only in four countries, namely United States of
206 America (U.S.A) (56%, N=155); Australia (12%, N=33); South Africa (6%, N=16); and Canada
207 (4%, N=12). Asia was the least represented continent with only one study conducted in Indonesia.
208 In Europe, the most represented country was Finland (3%, N=7). In Latin America & the Caribbean
209 the most represented country was Brazil (3%, N=7). In Africa, the second most represented country
210 after South Africa was Kenya (2%, N=6).

211

212 The most frequent topics covered in the abstracts were “easement(s)”, which was mentioned 508
213 times in 125 abstracts, “landowner(s)” which got 329 mentions in 138 abstracts, and “program(s)”
214 that was mentioned 326 times in 125 abstracts (see Appendix C, Table C1). Other important topics
215 were “management” (f=202, 91 abstracts) and “protect” (f=175, 47 abstracts). Other topics such as
216 “institution(s), or (institutional)” (f=41), “sustainability (or sustainable)” (f=34), “governance”
217 (f=15) and “well-being” (f=3), were less present in the abstracts.

218

219 Regarding temporal patterns in abstracts content, the three most frequent topics in PLC literature
220 (easement, program and landowner, Fig. 2, see Table C1 for full details) were present both before
221 and after CBD Aichi targets. However, we also found differences in research focus before and after
222 CBD Aichi targets. Before CBD, topics such as “reserve” (f=75), “incentive” (f=68), “public”

223 (f=55) and “use (e.g. use of biodiversity)” (f=52) received more attention, whereas after CBD Aichi
224 targets literature mostly focussed on issues regarding “property” (f=115), “forest” (f=106), “policy”
225 (f=102) and “participation” (f=101) (Table C1).

226

227 We also found geographical differences in PLC abstracts content (Fig. 3, see Table C2 for full
228 details). In North America, the most common topics were “easement” (f=493), “landowner”
229 (f=246) and “program” (f=193). Latin America and the Caribbean literature mostly focussed on
230 topics such as “reserve” (f=87), “protect” (f=36) and “incentive” (f=22), whereas in Africa the most
231 frequent topics were “management” (f=41), “protect” (f=34) and “species” (f=26). The most
232 prominent topics in the abstracts from Europe were “landowner” (f=53), “program” (f=36) and
233 “voluntary” (f=34). In the case of Oceania, the most frequent topics were “program” (f=77),
234 “landholder” (f=63) and “management” (f=45). We did not include the results from Asia because
235 only one article was found. In addition, we found unique topics within the most frequently
236 addressed topics per continent (i.e. ten most frequent topics), for example “public” in North
237 America, “ecotourism” in Latin America and the Caribbean, “species” in Africa, “voluntary” in
238 Europe, and “benefit” in Oceania.

239

240 Regarding conservation actions, all articles in our database addressed or discussed land/water
241 protection actions (100%, N=284), followed by law and policy conservation actions (88%, N=251),
242 conservation actions related to livelihood, economic and other incentives (75%, N=213), land/water
243 management (45%, N=128), external capacity building (32%, N=91), species management (15%,
244 N=43), and education and awareness (14%, N=41). We also found that English peer-reviewed
245 literature in different continents generally reflected these global patterns, with the exception of
246 Africa, where incentives and land/water management were the most addressed actions, following

247 land conservation actions (see Fig. D1). Education and awareness conservation actions were the
248 least addressed actions across all continents (see Fig. D1).

249

250 Regarding the policy instruments addressed in the articles, property rights, particularly conservation
251 easements, were the most covered policy instrument accounting for 73% of the studies (N=207),
252 followed by financial instruments (e.g. cost-share incentives; 37%, N=105), and market-based
253 instruments (e.g. ecotourism and certification schemes; 30%, N=84) (Fig. 4). The least addressed
254 policy instruments were regulatory and economic disincentives (8%, N=22) and legal/statutory
255 innovations (5%, N=13). We found geographical differences in the number of English peer-
256 reviewed articles addressing different policy instruments in different continents (Fig. D2). In North
257 America and Oceania, property rights were the most addressed policy instruments. In Latin
258 America and the Caribbean and in Africa, market-based instruments received more attention,
259 whereas in Europe financial instruments were the most addressed instruments.

260

261 In relation to stakeholder sectors engagement, no stakeholders were reported to be engaged in 48%
262 of the PLC studies (N=138; Fig. 5a). Furthermore, we found that only one sector was reported to be
263 engaged in 38% of the studies (N=107). Within those articles that reported to engage only one
264 stakeholder sector, the private sector was the most engaged 80% (N=86), followed by the civil
265 society sector 17% (n=18) and the public sector with only 3% (N=3). Similarly, within those
266 articles that reported to engage at least one stakeholder sector (52%, N=149), we found that private
267 sector (e.g. landowners) was involved in 79% of the studies (N=118), followed by the civil society
268 sector (e.g. NGOs; 36%, N=54) and the public sector (e.g. governments; 26%, N=39) (Fig. 5b).

269 Overall, cross-sector engagement was unusual in our database, with only few articles reporting the
270 engagement of two (8%, N=22) or three (7%, N=20) stakeholder sectors (Fig 5a). The number of
271 English peer-reviewed articles reporting stakeholders' engagement in each continent broadly

272 reflected these global patterns, except for studies conducted in Europe where private and the public
273 sectors were the most reported stakeholders (Fig. D3).

274

275 **4. Discussion**

276 In this paper, we reviewed the PLC literature to identify important research trends and gaps. Our
277 results showed (i) an increase in the number of PLC publications over time, followed by a period of
278 stagnation after 2010; (ii) a strong geographical bias with most scientifically published research
279 conducted in four countries only, particularly the U.S.A.; (iii) that the literature content broadly
280 focussed on easements, programs, landowners and management, and that there were both
281 geographical and temporal content patterns; (iv) that literature mostly focussed on addressing
282 conservation actions related to land/water protection, to law and policy and to livelihood, economic
283 and other incentives; (v) that property rights were the most addressed PLC policy instruments; and
284 (vi) that almost half of the studies did not report any stakeholder sector engagement in research and
285 that engaging more than one stakeholder sector was infrequent. While we are aware that there is an
286 important amount of information about PLC policies and implementation in grey literature, our
287 results nonetheless reflect important PLC trends and gaps and the way key issues are currently
288 covered in peer-reviewed literature.

289

290 Although PLC has a long history in some countries, formal international recognition came only
291 recently and only for some PLC policies (e.g. PPAs, other effective area-based conservation
292 measures; Bingham et al., 2017; Mitchell et al., 2018; Stolton et al., 2014; WCPA, 2019). In this
293 sense, the increasing scientific publication trend is in accordance with the growing recognition of
294 the importance of PLC policies to achieve biodiversity and ecosystem services conservation targets
295 (Bingham et al., 2017; Stolton et al., 2014).

296

297 Regarding the geographical distribution of research, it is not surprising that the U.S.A., Australia,
298 South Africa and Canada were the most represented countries in the literature given that they have
299 long PLC tradition (Fitzsimons, 2015; Maciejewski et al., 2016; Merenlender et al., 2004; Schuster
300 et al., 2017). We acknowledge that, in spite of our efforts, our results might be biased to a certain
301 level because we only considered peer-reviewed articles written in English, while the topic might
302 well be covered in other languages (Amano et al., 2016) and PLC be an important topic of
303 discussion also in other countries. Nonetheless, the fact that only ~20% of the reviewed studies
304 were conducted in other countries around the world reveals the existence of an important
305 geographical bias in English peer-reviewed studies related to PLC. Therefore, considering that most
306 processes involved in PLC are typically context dependent, it is important to be cautious when
307 transferring evidence and recommendations from current English peer-reviewed literature to policy-
308 making in other countries (Cooke et al., 2012). In order to fill this gap and to understand how
309 variations in local contexts might influence policy outcomes, there is need to conduct more
310 internationally recognised scientific research in different underrepresented geographical regions
311 where land is mostly privately owned (Cetas and Yasué, 2016; Cooke et al., 2012; Selinske et al.,
312 2017; Sorice and Donlan, 2015).

313

314 In terms of research focus at the global level, there was a clear emphasis in literature content on
315 conservation easements as instruments to promote the conservation of both land and threatened
316 species. Understanding landowners' motivations and preferences to place an easement or to join
317 other PLC programs was another major research focus. Although these topics are relevant, it would
318 be important to conduct more research assessing the contribution of PLC to socio-ecological
319 systems sustainability and human well-being (e.g. Wallace et al. 2008; Villamagna et al. 2015;
320 Clements & Cumming 2017; Horton et al. 2017; Serenari et al. 2017).

321

322 Regarding temporal trends in content, even though the most frequent topics present in the abstracts
323 were similar before and after CBD Aichi targets (easements, programs and landowners), a closer
324 look into high frequency unique topics showed different emphasis in content. For example, while
325 before Aichi targets reserves and incentives were frequently mentioned in abstracts, after Aichi
326 targets topics such as property, policy and participation became more prevalent. In the context of
327 having to meet national and international targets for biodiversity conservation with limited
328 resources, literature focus has shifted from a focus on general biodiversity conservation programs
329 (e.g. species conservation, land use restrictions, Langholz, 1996; Merenlender et al., 2004; Swift et
330 al., 2004; Wright, 1994) to studying national and international policies, and the broad set of
331 instruments and requirements to comply with them (e.g. Adams and Moon, 2013; Barton et al.,
332 2013; Cooke and Moon, 2015; Drescher et al., 2017; Owley and Rissman, 2016).

333
334 Research from different continents focussed on different topics. This geographical heterogeneity in
335 PLC literature topics and focus might be influenced to a certain extent by researchers' interests, but
336 might well also reflect research adaptation to regional contexts (i.e. related to the types of existing
337 policies in each region). In Latin America & the Caribbean, PLC literature mostly focussed on
338 addressing issues related to nature reserves, different incentives to increase landowners' enrolment
339 and ecotourism. Focus on these topics was mainly driven by literature from Brazil, where private
340 reserves in perpetuity are legally recognized and can only be used for research, education and
341 ecotourism (Pegas and Castley, 2016, 2014). In the case of PLC literature from Africa, the content
342 was largely driven by studies conducted in South Africa, addressing issues related to endangered
343 and charismatic species management and protection (e.g. Maciejewski and Kerley, 2014). Social
344 aspects of PLC planning were also addressed in literature from Africa (e.g. Knight et al., 2010;
345 Pasquini et al., 2010). Literature from Europe mostly focussed on issues related to landowners'
346 attitudes and preferences and on voluntary programs (e.g. Kamal et al., 2015c; Mönkkönen et al.,

347 2009; Nielsen et al., 2018). Finally, literature from Oceania was mostly driven by Australia and
348 broadly focussed on addressing landowners' motivations, programs design and land management
349 (e.g. Adams et al., 2014; Greiner, 2015; Moon and Cocklin, 2011). This literature content
350 heterogeneity contributes to the identification of regional needs and opportunities to increase PLC
351 impact on the ground.

352

353 Regarding conservation actions, our results showed that the most addressed actions in PLC peer-
354 reviewed literature were land conservation, law and policy and actions related to livelihood,
355 economic and other incentives. These findings were to a certain extent expected, given the
356 importance of these actions in the context of PLC. Although these results were largely influenced
357 by research conducted in North America, it is interesting to note that English peer-reviewed
358 literature in different continents generally reflected these patterns, except in Africa, where
359 incentives and land management actions received comparatively more attention. Overall, most of
360 the literature focussed on landowners' motivations and barriers to participation while less than half
361 of the peer-reviewed articles addressed or discussed about management actions implementation and
362 effectiveness after enrolment (Farmer et al., 2017). This gap might be partially caused by
363 conservation easements generally focussing on restricting development and preventing land use
364 change rather than on fostering stewardship and adaptive management (Rissman et al., 2013;
365 Rissman, 2013). Although attention towards addressing management actions has increased recently
366 (e.g. Adams et al., 2012; Farmer et al., 2017; Hardy et al., 2017; Rissman, 2010; Stroman and
367 Kreuter, 2015), there is still need to conduct more studies in different geographical contexts.
368 Research on other key conservation actions such as external capacity building (e.g. Clement et al.,
369 2015), species management (e.g. Maciejewski and Kerley, 2014), and education and awareness (e.g.
370 Van Fleet et al., 2012) was consistently underrepresented both at the global and continental levels.
371 Efforts should be made to fill these gaps, both in order to build a more comprehensive PLC science

372 framework, and to understand how to better combine different conservation actions to increase PLC
373 effectiveness on the ground.

374

375 Regarding policy instruments, we found that property rights, particularly conservation easements
376 and covenants, were the most addressed instruments at the global level (e.g. Merenlender et al.
377 2004; Rissman et al. 2007; Fitzsimons & Carr 2014; see Nolte, 2018 for a recent in-depth review
378 on acquisition of private forest property rights for conservation). While the proportion of
379 investments on property rights acquisitions has grown exponentially in the last decades (Fishburn et
380 al., 2009), comprehensive evidence on their long-term effectiveness is still relatively limited (Braza,
381 2017; Byrd et al., 2009; Copeland et al., 2013; Hardy et al., 2017; Merenlender et al., 2004;
382 Pocewicz et al., 2011; Rissman et al., 2007). In addition, as easements are becoming increasingly
383 international, there is need to assess their implementation feasibility in different countries where
384 resources for conservation are limited, either to buy property rights or to bear the loss of revenue
385 from taxes (Kamal et al., 2015b). Furthermore, there is an urgent need to assess their implications
386 for different socio-political contexts, particularly regarding effectiveness of public expenditure,
387 transparency and equity (Cooke and Corbo-Perkins, 2018; Rissman et al., 2017). Future research
388 should aim at addressing a broader set of policy instruments, which might be relevant in
389 geographical areas not yet covered in English peer-reviewed literature and at identifying general
390 aspects of PLC policy design that could enhance effectiveness across contexts (Cocklin et al., 2007;
391 de Vente et al., 2016; Moon and Cocklin, 2011).

392

393 Despite the recent emphasis on stakeholders' engagement in conservation research (Reed et al.
394 2009; Sterling et al. 2017; Toomey et al. 2017), almost half of the PLC studies did not report any
395 stakeholder sector engagement in their research processes. The private sector was the most engaged
396 stakeholder group (mostly through consultation, e.g. surveys, interviews), not only at the global

397 level but also at the continental level. This finding was expected according to the key role private
398 sector plays in PLC policies implementation (Farmer et al., 2017; Knight et al., 2010; Moon and
399 Cocklin, 2011). However, research would also benefit from increasingly engaging other
400 stakeholders, such as the public sector, who might be key for supporting, recognizing and reporting
401 private initiatives to comply with international conventions such as the CBD (Bingham et al.,
402 2017). We also found that reporting cross-sector stakeholders' engagement was infrequent.
403 Integrating different stakeholders' perspectives into research and decision-making depends on the
404 research question and can be challenging due to issues such as legitimacy, power relations and
405 conflicting interests (Reed et al., 2009). However, actively and comprehensively engaging different
406 stakeholders following co-production approaches could potentially lead to (i) more innovative
407 research, (ii) increasingly shared understanding of complex socio-ecological systems, and (iii) the
408 formulation of more legitimate and actionable policy proposals (Beier et al., 2017; Bracken et al.,
409 2015; de Vente et al., 2016; Jolibert and Wesselink, 2012; Paloniemi et al., 2018; Salomaa et al.,
410 2016). While we acknowledge that stakeholders' engagement in research might not always be fully
411 documented in peer-reviewed articles (Jolibert and Wesselink, 2012), we call for better
412 documentation to increase future learning opportunities.

413

414 To conclude, our results highlight the need for future studies on PLC to aim at (i) improving our
415 understanding of diverse socio-ecological contexts and how they influence PLC policy outcomes,
416 (ii) assessing the implementation feasibility and effectiveness of different conservation actions,
417 particularly land management, (iii) covering a broader set of policy instruments, (iv) engaging
418 different stakeholders in research to co-produce actionable knowledge, and (v) identifying general
419 principles that might inform the design, governance and implementation of effective, legitimate and
420 equitable PLC policies across contexts.

421

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678 **Figure legends**

679

680 Figure 1: Global distribution of private land conservation peer-reviewed articles in English,
681 classified according to the countries where the studies were conducted. Colour classification shows
682 the number of articles per country and was prepared using the geometrical interval method in
683 ArcMap. The geometrical intervals classification is an appropriate method to classify heavily
684 skewed, not normally distributed, data and was used only for visualization purposes.

685

686 Figure 2: Barplots showing the ten most frequent topics (i.e. words) occurring in abstracts of peer-
687 reviewed articles about private land conservation. Abstracts were divided by the time when the
688 studies were published: (a) before the approval of the Convention on Biological Diversity (CBD)
689 Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets in 2010; (b) after the
690 approval of the CBD Strategic Plan for Biodiversity. Note the differences in the y-axes.

691

692 Figure 3: Five most frequent topics (i.e. words) occurring in abstracts of English peer-reviewed
693 articles about private land conservation, classified according to the continents where the studies
694 were conducted. Continents classification followed the United Nations “Standard Country or Area
695 Codes for Statistical Use” (<https://unstats.un.org/unsd/methodology/m49/>). Note that data from Asia
696 was not displayed due to the small sample size (only one article).

697

698 Figure 4: Barplot showing the number of scientific peer-reviewed articles in English addressing
699 different private land conservation policy instruments. Note that a given article can address more
700 than one policy instrument.

701

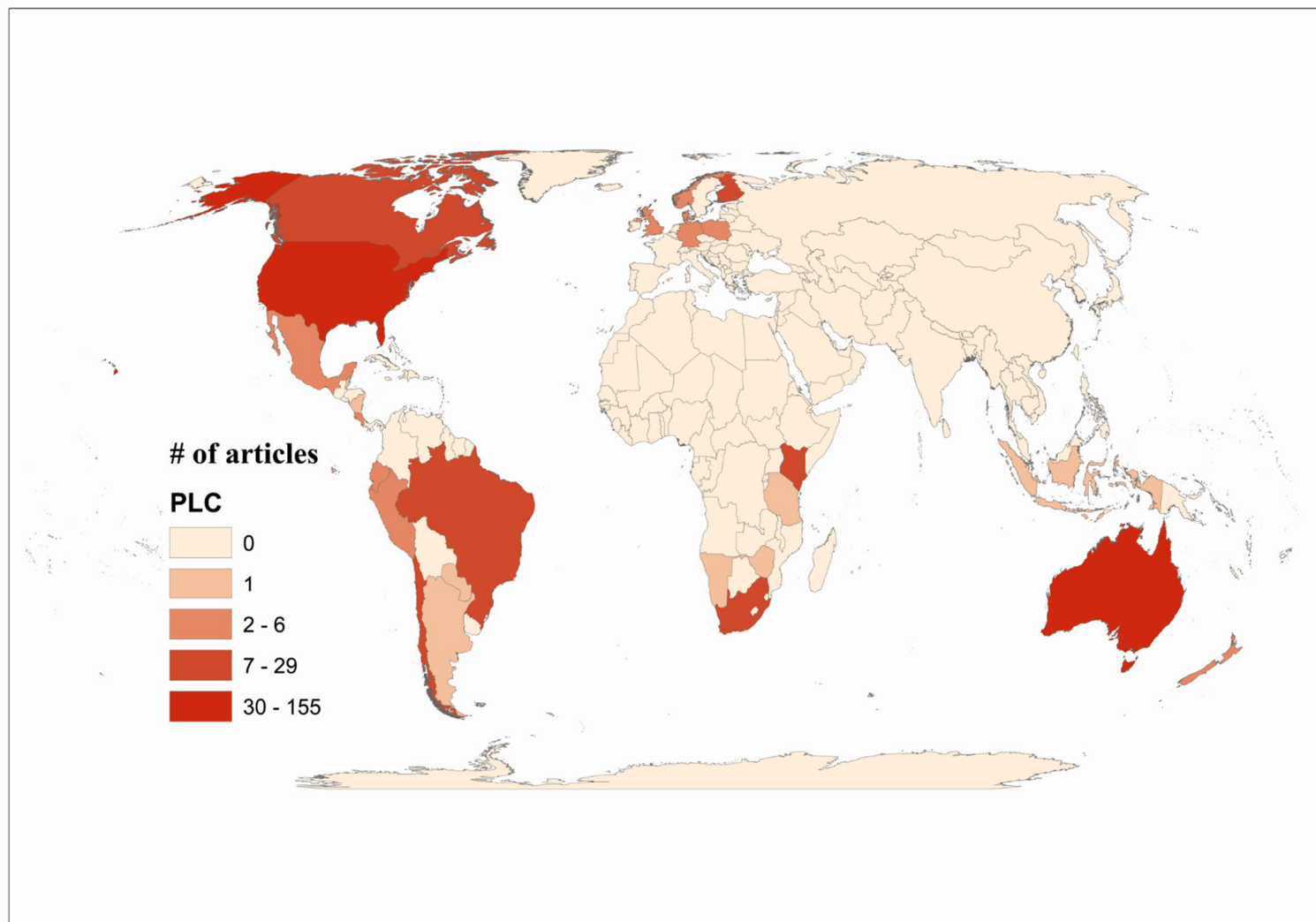
702 Figure 5: Reported stakeholders' engagement in private land conservation scientific peer-reviewed
703 articles in English, shown as two barplots: (a) the number of articles reporting the engagement of
704 none, one, two and three stakeholder sectors (i.e. private, public and civil society) in the research
705 process; (b) the number of articles reporting the engagement of different stakeholders sectors in the
706 research process. Note that a given article can report the engagement of more than one stakeholder
707 sector..

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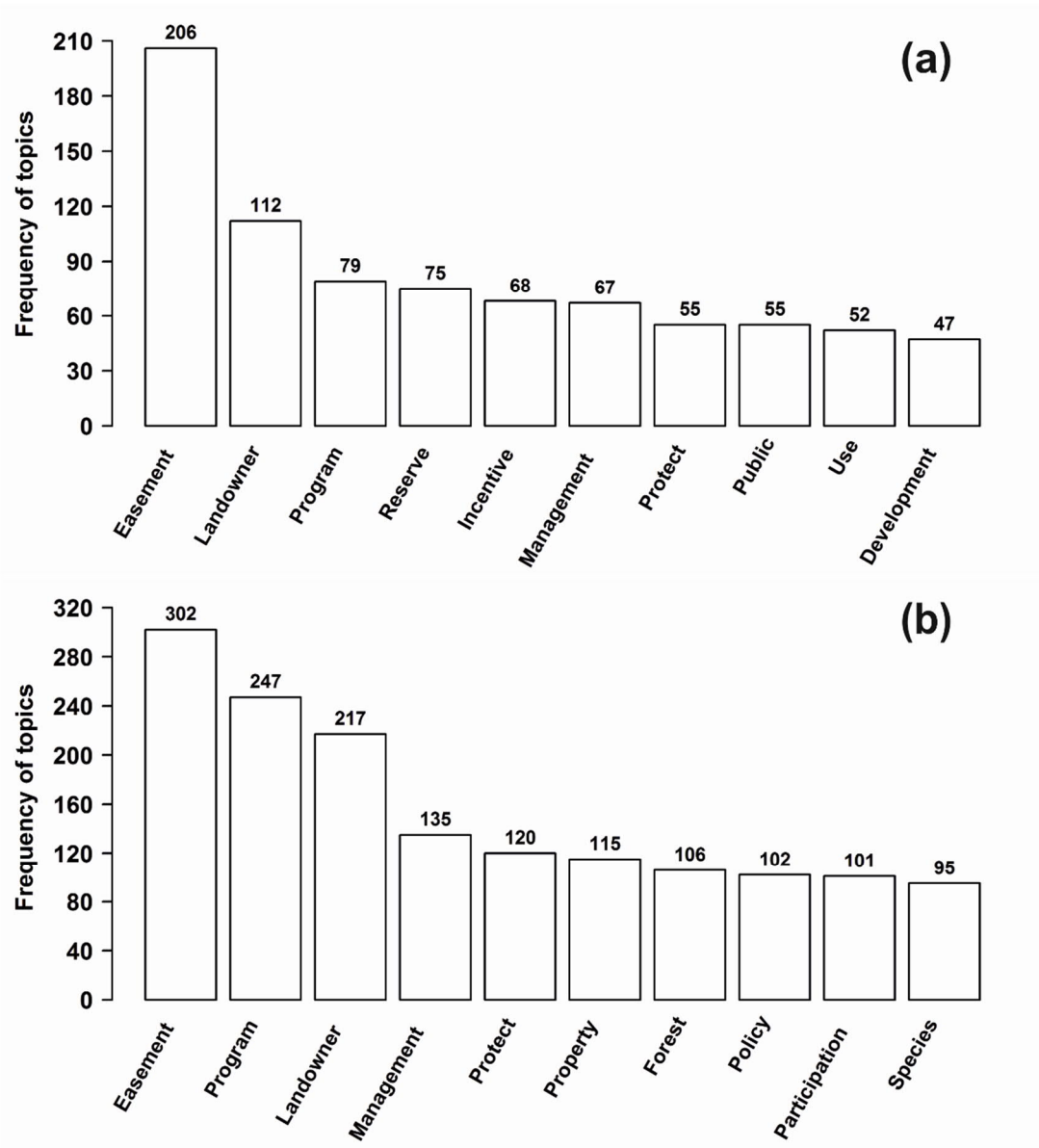
711 **Figure 1**

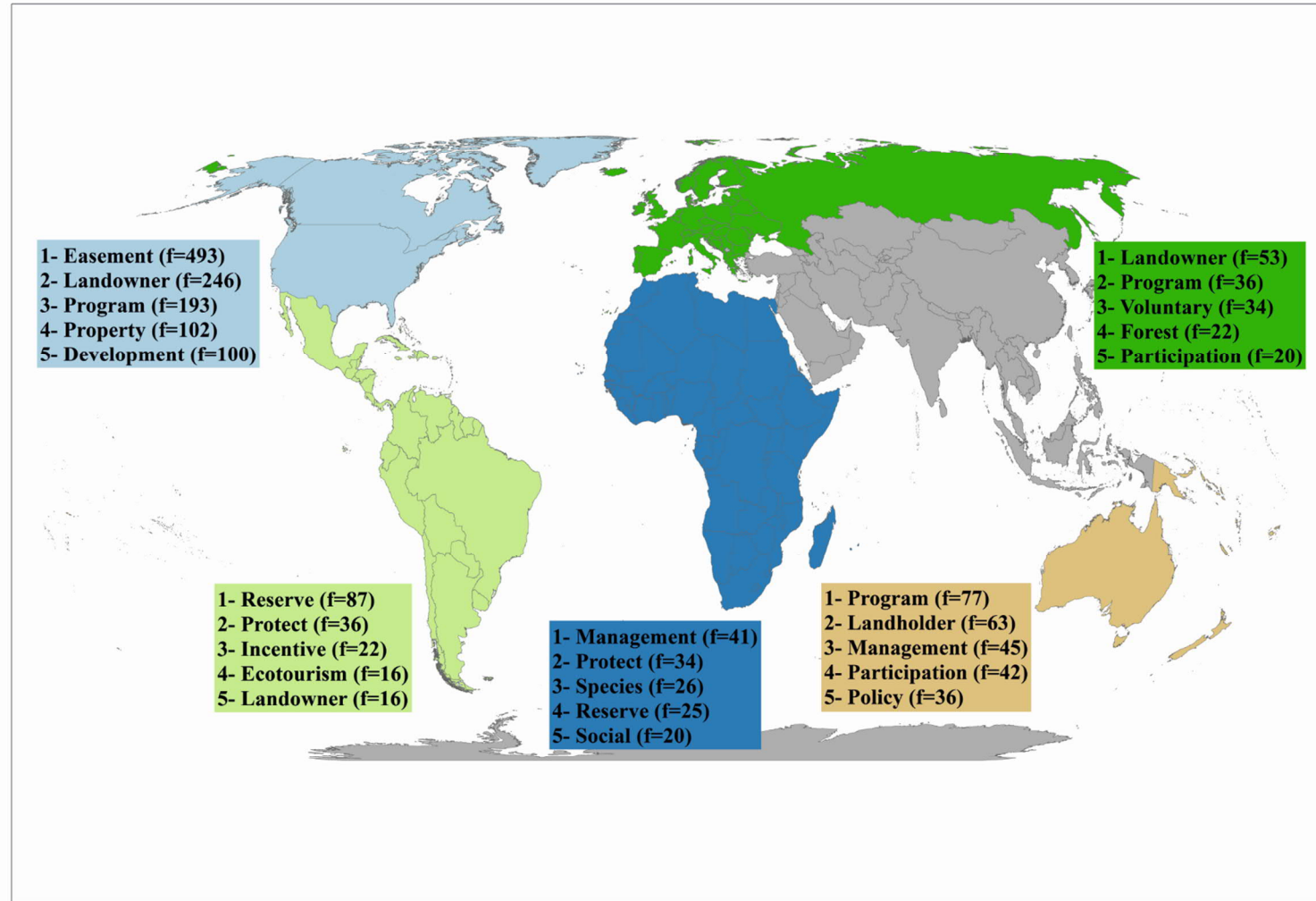


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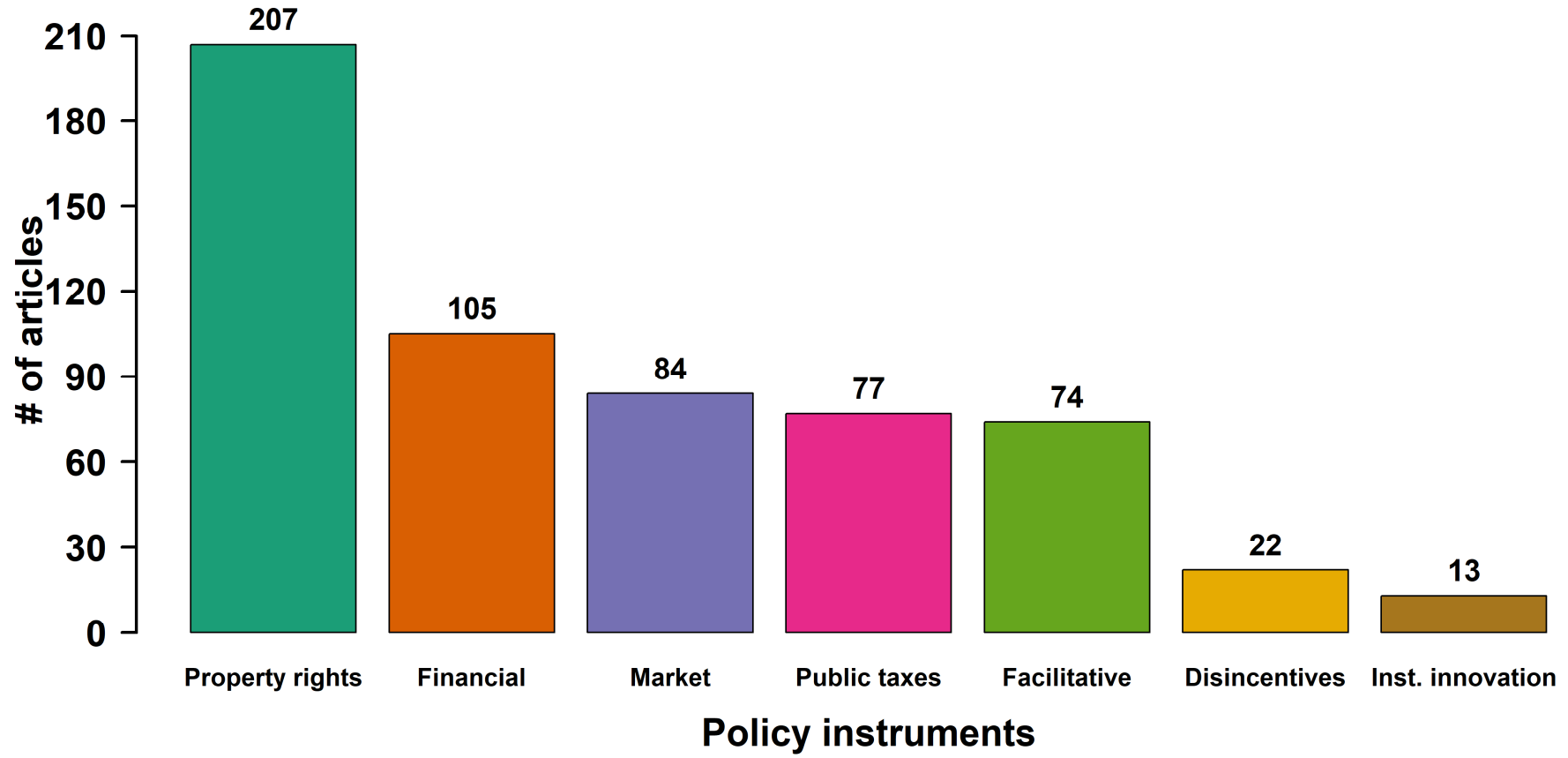
713

714 **Figure 2**





719 **Figure 4**



720

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722

