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Two systematic literature reviews of scientific research on the environmental impacts of forest certifications and community forest management at a global scale

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ABSTRACT

Forest certifications (FCs) and community forest management (CFM) are two major forest governance interventions whose aim is to reverse forest degradation and deforestation, while providing socio-economic benefits to the people involved. Despite being applied for more than a quarter of a century, there is a dearth of scientific evidence on the environmental impacts in the long- and short-term that these governance interventions have on the ground. Evidence is also needed to elucidate the governance mechanisms and contextual factors that facilitate the achievement of positive impacts. To fill these knowledge gaps, we conducted two systematic literature reviews (SLRs) comprising sixty-five publications in total, which collectively cover a total forest area of around 19 million hectares. Of these publications, only thirteen can be considered 'sufficiently rigorous' according to CEE and 3ie standards. The evidence of the reported environmental impacts of both FCs and CFM nonetheless shows clear trends towards (strong) positive impacts on the ground, with only six studies reporting no impact and only two studies, concerning FCs, reporting negative impacts. However, given the small sample size of the (rigorous) publications, we cannot make strong generalizing statements about the impacts that these interventions actually have on the ground. Moreover, both SLRs highlighted serious evidence gaps concerning the impacts that both forest governance interventions have on fauna and ecosystem services. Governance mechanisms most associated with positive impacts in the SLR on FCs were 'institutions', whereas for CFM the combination of 'institutions', 'incentives' and 'information' appears to be necessary to see positive impacts. As far as additional contextual factors are concerned, the political environment in which FCs are being implemented emerged as one important enabling factor for achieving positive impacts, together with the biophysical characteristics of the forests. For CFM, a combination of contextual factors already identified by the work of IFRI (2015) enables positive impacts, namely resource system characteristics, user group characteristics, and the biophysical characteristics of the forests.

1. Introduction

Forest certifications (FCs) and community forest management (CFM) are two major forest governance interventions whose aim is to reverse forest degradation and deforestation, while providing socio-economic benefits to the people involved. FCs are a form of non-state, market-driven governance developed at the beginning of the 1990s (Bernstein & Cashore, 2004). The two main certification schemes are the Forest Stewardship Council (FSC) established in 1993, and the Programme for the Endorsement of Forest Certification (PEFC) created in 1999. Currently, 554 million hectares are certified by either FSC or PEFC, accounting for 14% of the global forest area, but 95 million hectares are double certified by both (www.pefc.org; www.fsc.org). Around 90% of the global certified area is located in the boreal and temperate biomes, and only 10% is in the tropical biome (Kraxner et al., 2017).

CFM is a form of decentralized governance that can be defined as 'the

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use, the management and conservation of forests by communities' (Arts and de Koning, 2017, p. 315). Today, CFM is a prominent approach in forest management, particularly in the tropics (Arts et al., 2017). On a global level, around 732 million hectares are currently being managed under this regime (Gilmour, 2016), which is approximately 18% of the global forest area.

Despite the fact that both FCs and CFM have been applied for more than a quarter of a century, there is a dearth of scientific evidence on the environmental impacts, in the long- and short-term, that these governance interventions have on the ground (Burivalova et al., 2017; Romero et al., 2013; Kraxner et al., 2017; Bowler et al., 2012; Lund et al., 2014; van der Ven and Cashore, 2018; Baylis et al., 2016).

Overall, the scientific literature on both forest governance interventions lacks rigorous studies that allow for establishing whether the observed changes can be ascribed to the intervention itself, or are simply correlated to it (Burivalova et al., 2017; Lund et al., 2014; Bowler et al., 2012). So far, the existing evidence is derived mainly from case studies that describe the changes that have occurred once FCs and CFM have been implemented; few studies use a control group, or take confounding factors into account, and even fewer studies measure the outcomes over the long term.

Confounding factors are particularly important since the impacts that forest governance interventions have on the ground could be enhanced, mitigated, or even obstructed by the type of political, economic, social, and cultural context where FCs and CFM are being implemented. For instance, for FCs, the political context is relevant in countries with high corruption and weak governance, where the strict adherence to the rules demanded by FCs can generate conflicts between the local communities and the certified logging company, undermining any potential positive impacts of FCs (Cerutti et al., 2017). In countries where the national law already prescribes sustainable practices for forest management, FCs may be easily adopted because forest companies do not have to undergo costly changes to be certified. However, in these cases, positive impacts of FCs may be more moderate ('low-hanging fruit') (Arts et al., 2017). Finally, the biophysical factors of the certified forests are an essential aspect to consider since forests respond differently depending on the plant and animal species that they comprise and on the type of logging management, thus determining different impacts (van Kuijk et al., 2009).

For CFM, user group characteristics play a significant role in influencing the impacts. Medium sized, relatively wealthy communities are more likely to successfully monitor and enforce rules (Poteete and Ostrom, 2004; IFRI, 2015). Demographic and market pressures are other essential elements that may influence the outcomes of CFM (IFRI, 2015). The stability of demographic conditions is particularly important with respect to the homogeneity of the user group. Indeed, the homogeneity of the group is important as it fosters the predictability of the interactions and increases trust, which in turn promotes collective action (Poteete and Ostrom, 2004).

While the importance of contextual factors has been largely debated (White, 2009; Romero et al., 2017; Waylen et al., 2010; Young et al., 2015; Miller et al., 2015), a systematic review of their role in the environmental impacts of FCs and CFM is still missing. The main difficulty of doing an impact evaluation is due to a lack of trustworthy and standardized data. Moreover, comparisons on a global level are hindered by the lack of standardized indicators and different units of measurements (Cashore and van de Ven, 2018). Indeed, FC standards change over time, as well as CFM research approaches, making the long-term impact evaluations a daunting task. Last, but not least, these types of evaluations are expensive and time-consuming, and few scientists are trained in both conservation science and environmental impact evaluations (Romero et al., 2013).

It goes without saying that donor agencies, governments, and international organizations, as well as scholarly institutions, need transparent, rigorous and reliable evidence (Ferraro and Pattanayak, 2006) on the impacts of both FCs and CFM. Such evidence can help to halt deforestation and forest degradation, as well as promote the conservation of biodiversity, by steering funding, influencing policy decision-making, and supporting a more effective and efficient governance intervention. Stakeholders need to know what governance mechanisms and contextual factors contribute to the positive impacts of both FCs and CFM. This type of evidence is urgently needed to improve these policy interventions and maximize their success (Ferraro and Hanauer, 2015). Finally, insight is also needed into how the environmental impacts of FCs compare with the environmental impacts of CFM, and vice versa (Romero et al., 2013; Baylis et al., 2016).

This paper aims to fill this knowledge gap by providing a detailed synthesis of the peer reviewed literature on the environmental impacts of FCs and CFM. The research questions to be addressed by this systematic review are:

1) What are the environmental impacts of FCs and CFM at a global scale, as reported in the academic literature?

2) What are the governance mechanisms and contextual factors identified in the academic literature that facilitate the achievement of positive impacts?

3) How do these environmental impacts compare between the two forest governance interventions analysed?

In order to address these questions, we systematically reviewed sixty-five publications published between 2003 and 2018, selected from two samples of nearly 3000 publications which truly investigated the environmental impacts of FCs and/or CFM around the globe (such implies that more recent relevant papers are not included in the review, an example being Hajjar et al., 2021). Collectively, these publications analysed a total forest area of just over 19 million hectares (1.7% of certified and CFM areas taken together). The scientific and social relevance of the results that we are going to present is threefold. First, this systematic literature review (SLR) will provide policy-makers, international donors, and academics with evidence-based evaluations on the environmental impacts that both interventions have on the ground. This type of information can improve forest governance by providing lessons from both failure and success cases, and it can help to increase sustainable forest management across the globe. Second, by examining what the governance mechanisms and contextual factors are that promote the achievements of positive impacts, this SLR will respond to urgent calls for impact evaluations in the forest conservation field (Ferraro and Pattanayak, 2006; Miteva et al., 2012; Pullin et al., 2004; Pullin et al., 2003; Sutherland et al., 2004), where it is critical to understand how, why, and under what circumstances conservation policies work or do not work. Third, the comparison between the environmental impacts of FCs and CFM is critical to highlight potential trade-offs and synergies between these two interventions (Romero et al., 2017; Romero et al., 2013; Baylis et al., 2016), which share the same goals of halting forest degradation and deforestation, promoting the conservation of biodiversity and ecosystem services, and enhancing the livelihoods of people.

The remainder of the paper is structured as follows. In the next section, we explain the theoretical framework used to analyse which mechanisms foster positive impacts from FCs and CFM. This is followed by our account of the applied methodology in conducting the SLRs, in terms of database selection, formulation of inclusion and exclusion criteria, and formulation of the Data Extraction Form. Then, the major findings of the SLR are presented. The paper finishes with the conclusions and limitations of our study and with a short outlook for further research.

2. Theoretical framework: Forest governance interventions, mechanisms and impacts

Many forest governance interventions are designed by policy-makers with a specific combination of three mechanisms in mind, 'information', 'incentives' and 'institutions'; but the exact combination depends on what precise impacts the intervention aims to achieve (Agrawal et al., 2018; Bemelmans-Videc et al., 2011; Krott, 2005). Here, based on Hulme's (2000) conventional model of an impact chain (Fig. 1), we define an impact as the difference between the *modified* outcome as a result of an intervention, as compared to the baseline outcome *without* this intervention.

Despite being two very different types of forest governance interventions, both FCs and CFM generally comprise 'institutions', 'information', and 'incentives' to change business-as-usual outcomes in order to improve forest conditions, protect biodiversity and ecosystem services, and provide socioeconomic benefits (Agrawal et al., 2018) (Fig. 2).

Simply explained, the program intervention –either FCs or CFM – is being implemented in a forest area, including the communities living in and around it. 'Information', 'incentives', and 'institutions' are the mediating processes, which co-produce the impact in terms of improving forest conditions, protecting biodiversity and ecosystem services, and providing socio-economic benefits for the people involved. The difference in environmental and socio-economic outcomes compared to the situation or area without these program interventions is ultimately the impact to be considered and assessed.

In FCs, 'institutions' such as FSC and PEFC, create and revise certification standards. In both FC schemes, principles, criteria, and indicators are developed by all the stakeholder members in a process that is defined as 'democratic, open, transparent, and participatory' (Cashore et al., 2007; FSC Theory of Change). These standards are periodically revised based on best practices indicated by meta-governance organizations. The legitimacy of both FSC and PEFC is ensured by accredited third-party auditors responsible for verifying the compliance with the standards on the ground (Cashore, 2002). 'Incentives' are mainly conceived as market incentives, such as price premium, increased market access, exposure to new clients, and improved reputation. These are an important factor for the uptake of FCs. However, without citizens being informed about the importance of buying goods that are sustainably produced, market incentives are not a sufficient factor for the success of FC schemes. Therefore, the 'incentive' mechanism is heavily dependent on the 'information' mechanism of FCs. 'Information' is used in the form of marketing and advocacy campaigns to sensitize citizens to the importance of buying products that are responsibly made and to convince forest managers and wood processers to be certified. It is also used in the form of standards and guidance documents in order to improve the forest management practices of logging companies and forest owners.

In CFM, 'institutions' are responsible for creating enabling conditions for the communities to manage forest resources successfully. These conditions comprise the total or partial devolution of tenure rights, the development of rules that are easy to understand and enforce, the inclusion of local communities in the rule-making process, the creation of conflict-resolution mechanisms, and the implementation of efficient benefit-sharing mechanisms (IFRI, 2015). The enforcement of rules and effective sanctioning mechanisms are, in particular, identified as being critically important to preserve forest resources (Gibson et al., 2005; Chhatre and Agrawal, 2008; Agrawal, 2001). 'Incentives' are used both for the central state and the local communities. For the central state, CFM can be a means to decrease the financial burden of managing forest resources, especially with substantial economic support from donors (Gilmour, 2016). For the local communities, it is a way to be included in the rule-making process, to apply their local knowledge to manage forest resources, and to improve their forest-dependent livelihoods. The possibility for local communities to develop the most appropriate institutions and to be included in the rule-making process is considered paramount to improve forest conditions and to increase the legitimacy of those institutions (Chhatre and Agrawal, 2008; Poteete and Ostrom, 2004; Agrawal and Gibson, 1999). The prospect for the local community to increase, improve, and exchange knowledge with capacity development activities implemented by external actors (Arts and de Koning, 2017) is another important mechanism to engage local communities in the intervention and foster the achievements of positive results. 'Information' is principally conceived as knowledge that communities have about their forests and that they obtain and exchange with capacity building activities organized by NGOs, donor organizations, and universities. The opportunity for local communities to apply their knowledge to cost-effectively manage their forest resources, as well as to develop the most appropriate local institutional arrangements, emerge as being an important element in CFM from the literature (Agrawal and Gibson, 1999; Agrawal, 2007; Arts & De Koning, 2017). The role of knowledge, thus, serves both as an 'incentive' and as the 'information' mechanism of the intervention. Below, we will apply this theoretical framework to the publications under systemic review in order to assess whether these refer to the three governance mechanisms, while explaining the (lack of) environmental impact of both program interventions (certification and CFM). In addition, we will report contextual factors that those publications put forward as explanatory factors, in addition to these three governance mechanisms.

3. Methodology

We followed the guidelines for SLRs recommended by the Collaboration for Environmental Evidence (CEE) and the International Initiative for Impact Evaluation (3ie) (source websites referred to in the reference list). For both SLRs carried out for this paper, the search protocol was

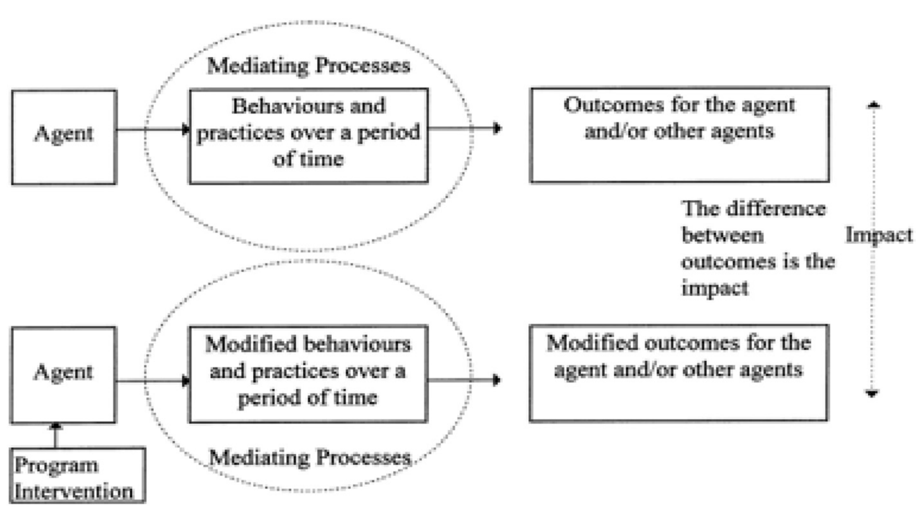

Fig. 1. The conventional model for impact chain, p.81, Hulme, 2000.

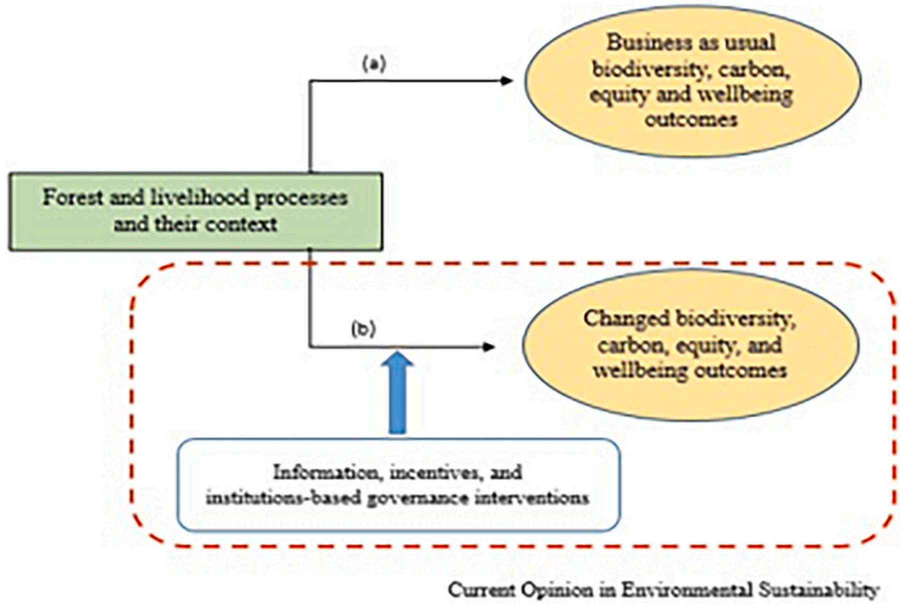

Fig. 2. Basic representation of how forest governance interventions may affect socioecological outcomes. Source: Agrawal et al., (2018), p. A3.

characterized by two different temporal phases. The first phase should be considered as an exploratory stage of this SLR, whose aims were to start collecting preliminary publications, identify key publications in the field to snowball their list of references, and to look for grey literature in order to avoid publication bias. The second phase is the phase in which the actual research in online databases was carried out.

The inclusion criteria were quite general and common for both SLRs. Considering that the focus of this paper is to evaluate the environmental impacts of FCs and CFM around the globe, the four main – and common to both parts – inclusion criteria were:

1. Geography of the studies: global scale.
2. Environmental Impacts: must include at least one indicator that relates to the categories of flora, fauna, and ecosystem services of forests.
3. Type of Impact: environmental impacts, whether positive, negative, or no impact.
4. Outcome: change or no change in biodiversity (flora and/or fauna); change or no change in forest cover; change or no change in forest condition; change or no change in ecosystem services provision.

Common exclusion criteria were:

1. The paper does not measure the environmental impacts of the intervention.
2. The paper does not provide details on the methodology used.
3. The paper is a meta-analysis that includes studies already in the list.

For both SLRs, only scientific literature written in English was considered for data extraction and synthesis. The literature search in online databases was carried out in April 2018, mainly in Scopus and Wageningen University and Research online library.

3.1. *Search protocol for SLR on the impacts of FCs*

The systemic literature review on the environmental impacts of FCs started with twelve records provided by the Forest and Nature Conservation Policy group (FNP) of Wageningen University and Research during the month of March 2018. After reading the full text of this sample, nine publications were excluded for two main reasons: not measuring the environmental impacts of the intervention ($n = 6$) and not providing details on the methodology used ($n = 3$). Therefore, only three publications were included in the list (Simonsson et al., 2016; Elbakidze et al., 2011; De Iongh et al., 2014).

Before collecting papers from online databases, we started to develop the list of publications by snowballing the list of references from the main reports and papers on the environmental impacts of FCs (e.g., Van Kuijk et al., 2009; Karmann et al., 2009; and Romero et al., 2017). In particular, from Romero et al. (2017), we identified four potentially relevant papers; however, after reading the full text, only two were chosen for this SLR (Panlasisgui et al., 2015; Miteva et al., 2015). The remaining two publications were excluded for not measuring the environmental impacts of the intervention.

Informal meetings with experts on FCs informed us about the relatively new Forest Certification for Ecosystem Services (ForCes) created by FSC. ForCES is a project implemented by FSC in collaboration with several international partners, and financially supported by the Global Environmental Facility (GEF). The main goal of this new scheme is to certify the provision of essential ecosystem services (e.g., biodiversity conservation, watershed protection, and carbon sequestration) by forests already certified by FSC, after verifying the actual impacts on the ground with a third-party auditor (Forces.fsc.org). After testing this new scheme in several pilot projects, nine Ecosystem Services Certification Documents (ESCDs) were published on the official ForCES.FSC.org website, and we decided to include these documents as part of the grey literature. We did this for three main reasons. First is the novelty of this initiative. Considering that it is a new project, it could provide some interesting data on the impacts of FSC on ecosystem services. Second, these documents contain technical information and a clear description of the methodology used to measure the effects on the ground. And third, each ESCD is assessed by a third-party auditor that decides, against a given set of indicators, whether to approve the claim or not. This is particularly important, since the impartiality of the auditor decreases the risk of bias for or against the claim reported in the ESCD. We contacted the policy managers of ForCES via e-mail to establish whether all the documents were approved. Out of nine, only five passed the examination. However, we had to exclude two documents written in Spanish due to linguistic limitations. In the end, we included three ESCDs. The Boolean search on Scopus were the following:

«"FSC biodiversity impacts" OR "PEFC biodiversity impacts" OR "FCs impacts on biodiversity" OR "FCs" OR "FSC and PEFC" OR "FC environmental impacts"».

The research returned 883 papers. We screened the title and the abstract of each of these papers, and a selection was made based upon three criteria. First of all, the paper had to investigate the environmental 'impacts' or 'effects' or 'performance' or 'effectiveness' or 'outcomes' of the intervention. This means that, for instance, all the papers that analysed only the social or economic impacts of FSC and/or PEFC were excluded from our list, as well as all opinion and theoretical papers. Second, the publication had to measure the direct environmental impacts of the intervention. This means that all the scientific articles that evaluated the impacts indirectly, based on management practices often associated with FCs (e.g., Reduced-Impact Logging, retention trees, and the creation of riparian buffer zones) were excluded from the research. Third, the paper had to analyse the impacts mainly of FSC and/or PEFC, which are the forests certifications of our interest.

After this step, thirty-seven papers were considered for the full text screening. Out of these, eleven papers were excluded for not actually measuring the environmental impacts of the intervention. Two papers did not examine the environmental outcomes of our interest. Two papers based their own analysis solely on Corrective Action Requests (CARs), without assessing whether these impacts were produced on the ground. And finally, one paper was excluded for not providing details on the methodology used. We eventually collected twenty-one papers from the research performed on online databases. The complete list of the excluded and included papers can be found in Appendix B. Including the publications gathered during the first three stages of our research, twenty-nine publications in total were used for data extraction and synthesis. Out of these, fifteen publications measured the outcomes only on flora; six evaluated the impacts on fauna; four examined the impacts on ecosystem services; and four investigated the impacts on flora and ecosystem services. (Fig. B1, in appendix B).

3.1.1. Search protocol for SLR on the impacts of CFM

The literature search started with thirteen records provided by FNP in July 2018. Eleven publications had to be excluded for three main criteria: not measuring the environmental impacts of the intervention ($n = 4$), not providing any details of the methodology used ($n = 5$), and being focused only on community-conservation ($n = 2$). Therefore, only two papers were included for the systematic review.

As recommended by the systematic review tool kit of Waddington et al. (2012), before starting the research in online databases, we began building up the body of evidence by snowballing the list of references of relevant publications in this field. Through the websites of Mongabay and the International Initiative for Impact Evaluation (3ie), we selected two publications that examined the impacts of forest conservation interventions. The first one is the systematic review of Burivalova et al. (2017), and the second one is the impact evaluation of Puri et al. (2016). In the first case, from the systematic review, we extracted thirteen papers. After screening the full text, eight papers had to be excluded for five criteria: focusing only on institutions ($n = 2$), focusing only on community-conservation ($n = 3$), not providing any details of the methodology used ($n = 1$), not measuring the environmental impacts of the intervention ($n = 1$), and doing the analysis based only on future scenarios (criterion 'other') ($n = 1$). Hence, only five papers were included for the systematic review. In the second case, from the impact evaluation, we selected three papers. After reading the full text, one paper was removed for focusing only on institutions, and the remaining two papers were included for the review. The Boolean search terms were:

«"CFM" OR "community forestry" OR "community-based conservation" OR "participatory forest management" OR "impacts of CFM" OR "decentralized forest management" OR "environmental impacts of community-based forest management" ».

The research yielded a total of 2082 results, including possible duplicates. Abstracts and titles were screened, and the selection of papers was based on three criteria: the paper investigates the 'impacts', 'effects', 'performance', 'effectiveness' or 'outcomes' of the programme; the abstract includes outcomes specifically on deforestation, forest degradation, biodiversity, and ecosystem services; the abstract specifies the type of tenure rights regime. After this step, forty-six papers were considered for the full-text screening. Out of these, nineteen were excluded for four main criteria: not measuring the environmental impacts of the intervention ($n = 6$); not providing any details on the methodology used ($n = 4$); focusing only on community-conservation ($n = 8$); and for being a meta-analysis that included studies already in the list ($n = 1$). Despite being an inclusion criterion at first, papers on community-based conservation were excluded at a later stage, as they did not involve any type of management of natural resources by the local communities. The complete list of the excluded and included papers can be found in Appendix C.

Including those selected in the first phase of the research, thirty-six publications were selected for the data extraction and synthesis. Twenty-four measured the outcomes on flora; two measured the impacts on flora, fauna, and ecosystem services; seven measured the impacts on both flora and ecosystem services; and three measured the outcomes only on ecosystem services (Fig. C1, in appendix C).

3.2. The data extraction form

After the completion of the search protocol, and before synthesizing the evidence, we had to extract data from each paper. To do so, we created two different data extraction forms (DEFs), one for each SLR, that comprised seven different parts:

Part 1: General study details (e.g., research questions, study aim, unit of intervention, level of analysis).

Part 2: Study methodology (e.g., time scale of the analysis, study design, data collection method, baseline/ reference point, comparison group, sample size, indication of bias).

Part 3: Data source (e.g., environmental category examined, indicator(s), type of FC, type of community).

Part 4: Study context (e.g., country, biome, area size, type of forest).

Part 5: Governance mechanisms (i.e., institutions, information, incentives).

Part 6: Contextual factors (e.g., biophysical factors).

Part 7: Impacts (positive, negative, no impact).

Parts 5 and 6 were specifically developed to test the theories of change, and therefore these two parts differ from each other in the two DEF models. In fact, as discussed in the previous section, to design the theory of change of FCs, we mostly relied on the scientific research on the non-state, market-driven governance of Cashore (2002, 2007, 2018), the global theory of change of FSC, and the information provided on the website of both PEFC and FSC. However, to define the single queries presented within the sections of parts 5 and 6, we needed more specific information. Therefore, we expanded our research looking for scientific papers that investigated not only the environmental impacts, but also the socio-economic impacts of FCs. To define the twenty-six queries under governance mechanisms, namely institutions, incentives, and information, we took inspiration from Cerutti et al. (2017); Elbakidze et al. (2011); Ebeling and Yasué, (2009); Kalonga et al. (2015, 2016) and Carlson and Palmer (2016). To establish the eighteen queries under contextual factors, specifically, political factors; economic context; sustainability practices; and biophysical factors, we took inspiration from Arts et al. (2017); van Kuijk et al. (2009); Sollman et al. (2017); Polisar et al. (2017); Tobler et al. (2018), and Elbakidze et al. (2016). To shape parts 5 and 6 for the DEFs concerning CFM, we simply used the elements that we inserted in the assumption sections of the theory of change, which are based on Arts et al. (2017); IFRI, (2015); and Gilmour, (2016). From each publication, we extracted information only for the areas under the interventions. Moreover, we reported only what was explicitly written in a given publication, thus ensuring that the type of impact, whether positive, negative or no impact, is not the product of our own interpretation. The data extraction forms used for SLR on FCs and CFM can be found in Appendix A.

3.3. Quality and rigour assessment

The quality of the reporting of each paper was evaluated based on the quality assessment form inspired by Nyambe et al. (2016) and Da Silva et al. (2018), (Table A1, in appendix A). This form comprises seven quality indicators: clarity of research questions/ hypothesis/ study aim; clarity of data collection method; clarity of sampling plan; clarity of sampling size; clarity of analysis method; clarity of conclusions; and clarity of limitations. All these indicators allow for a score ranging from zero to two, with the exception of clarity of conclusions that only allows for a range from zero to one. If a publication would score high on each quality indicator, it would get a maximum of thirteen points. All scores from zero to seven were considered as low, all scores from eight to ten were considered as medium, and all scores from eleven to thirteen were considered as high (Table A1).

While the quality assessment will tell us how clearly the authors structured and reported their research, it is not sufficient to appraise the methodological rigour of the included studies. Indeed, to be able to make any causality inference and to provide reliable evidence, researchers need to adhere to strict standards when designing an impact evaluation study. For this reason, we created another data extraction form, mostly inspired by the "Guidelines for 'gold standard' CFM assessment" of Bowler et al. (2012). While these guidelines were created specifically to evaluate CFM projects, the principles are general enough to be suitable also for the evaluation of the impacts of FCs. From these principles, we developed nine rigour indicators (Table A2, in appendix A). Each rigour indicator allows for a score ranging from zero to five, depending on the indicator. If a paper would score consistently high on every rigour indicator, it would get a maximum score of twenty-three points. All scores from zero to ten were considered as low, all scores from eleven to twelve were considered as medium (the average of twenty-three), and all scores from thirteen to twenty-three were considered as high. Besides the explanation provided by Bowler et al. (2012), the criteria for each score were justified with extracts from the scientific literature and grey literature that concerns impact evaluations (i.e., Burivalova, (2017); Waddington et al. (2012); World Bank.org, 2016; ISAEL (2017); and UNICEF-irc.org, n.d.). A primary reviewer conducted both SLRs, however 15% of the publications were examined by a second reviewer for an intersubjective reliability check. While there were some differences in details, the quality and the rigour assessment scores coincided in the overall conclusions.

3.4. Evidence synthesis

We decided to focus specifically on the publications that scored high on both rigour and quality. These steps were taken in order to provide the most objective and high-quality evidence to inform policy-makers, academics, and international donors, which is the goal of every SLR (Waddington et al., 2012).

4. Findings from the SLR

4.1. Sample composition

The systematic review on FCs comprised twenty-nine publications, which covered the three main biomes (i.e., boreal, temperate, and tropical), for a total area of 13,241,894.90 ha. The systematic review on CFM, on the other hand, included thirty-six publications which principally covered the tropical and temperate biomes, for a total area investigated of 5,809,822.84 ha.

In terms of study design, the publications included in both SLRs had, in the majority of the cases, a quasi-experimental design, followed by a comparative case study, pre-experimental design, and single case studies. While the main method of data collection used in the publications included in the SLR of FC was quantitative, for the CFM it was mostly mixed.

Both SLRs mostly lacked publications that used baseline data before the implementation of the intervention, and in fact, in both reviews, the majority of the papers relied on a reference point after the adoption of FCs, or after the beginning of CFM. The majority of the publications, in both reviews, did not provide any indication of bias, although when it was reported, papers mostly indicated the same types of bias: confounding bias (i.e., failure to include potential confounding factors in the analysis), selection bias (i.e., non-random selection), and measurement bias (i.e., when a measurement technique or instrument can overestimate or underestimate the true value of the measurement. See Lund et al., 2014; Elbakidze et al., 2011).

For half of the publications on FCs, it was not possible to determine the time scale of the analysis, whereas half of the publications on CFM consisted of studies that evaluated the impacts of the intervention in the long run. Moreover, not all the publications on FCs reported data on governance mechanisms and contextual factors that may influence the final impacts, while all CFM publications included in the SLR actually did.

Both SLRs comprise publications that scored high on the quality assessment. The SLR on FCs included publications of somewhat better quality compared to the publications included in the SLR on CFM. In fact, none of these publications had a low score. For both parts, the main quality indicator for which most of the papers scored low was 'clarity of the limitations'. Only four papers out of twenty-nine properly addressed their limitations in the part of FCs, and only nine papers out of thirty-six did the same in the part of CFM.

Seventeen publications out of the twenty-nine included in the SLR on FCs scored low on the rigour assessment. The main rigour indicators where these publications fell short were 'appropriate time scale of the analysis', and 'use of statistical techniques to establish the causal impact of the intervention'. In the SLR on CFM, just fourteen publications out of thirty-six scored low on the rigour assessment. Also here, the main rigour indicator in which the majority of the publications scored low was 'use of statistical techniques to establish the causal impact of the intervention'. However, generally, in both SLRs, the studies used a reference group to compare the impacts, and they included baseline data and/or a reference point to analyse the changes, if any, in the areas under the intervention. A summary of the methodological design of the publications included in both SLRs is provided in Table 1 on the next page.

Overall, the publications included in both SLRs mainly differ in three methodological features: data collection method, the quantity of information provided on governance mechanisms and contextual factors, and the time scale of the analysis. The publications included in the SLR on CFM relied mostly on the use of mixed methods, whereas FCs publications mainly relied on quantitative methods. The fact that CFM publications included the use of qualitative methods allowed for a substantial collection of data concerning governance mechanisms and contextual factors. Moreover, the majority of CFM publications consisted of studies carried out after more than ten years since the implementation of the programme. This last point is critically important for an impact evaluation, since ecological processes triggered by the intervention (e.g., reaction of forest species to management practices) may take years to manifest themselves (Franklin, 1989), and therefore studies conducted after just two or three years since the beginning of the programme could fail to discern these changes.

4.2. Reported environmental impacts of FCs and CFM

4.2.1. Reported environmental impacts of FCs

Out of the twenty-nine publications included, only five scored high on both rigour and quality (Blackman et al., 2018; Foster et al., 2008; Kalonga et al., 2016; Miteva et al., 2015; Rana et al., 2018). (Table 2, page 15).

Results are inconclusive with respect to the impacts that FSC has on

Table 1
Summary of the methodological design. Results are presented from the most reoccurring to the least.

Methodological design	Forest certifications	Community forest management
Study design	Quasi-experimental design (*n* = 17) Comparative case study design (*n* = 8) Pre-experimental design (*n* = 3) Single case study (*n* = 1)	Quasi-experimental design (*n* = 20) Comparative case study design (n = 8) Pre-experimental design (*n* = 4) Single case study (n = 3) Multiple case studies (n = 1)
Data collection method	Quantitative (*n* = 22) Mixed (*n* = 7)	Mixed (*n* = 18) Quantitative (*n* = 15) Qualitative (n = 3)
Baseline	Reference point (n = 11) None (*n* = 10) Baseline before FCs (*n* = 6) Mix baseline before FCs and Reference point (n = 2)	Reference point (*n* = 14) Generic baseline before CFM without a specific year (n = 6) None (*n* = 6) Mix baseline before CFM and Reference point (*n* = 5) Baseline data before CFM, with a specified year (*n* = 5)
Indication of bias	Not reported (n = 22) Confounding (*n* = 2) Measurement bias (n = 2) Selection bias (n = 2) Potential spillover bias (n = 1)	Not reported (*n* = 27) Authors checked for possible bias, but it has not been concluded upon (n = 3) Other (n = 3) Confounding bias (n = 2) Selection bias (n = 1)
Time scale of the analysis	Not reported (n = 14) Short term (n = 7) Long term (n = 6) Medium term (n = 2)	Long term (n = 18) Medium term (n = 5) Short term (n = 5) Not reported (n = 8)
Governance mechanisms and contextual factors	Information provided (n = 20) Not provided (*n* = 9)	Information provided (*n* = 36)
Quality assessment	High quality (n = 20) Medium quality (n = 6) Not applicable (n = 3)	High quality (n = 18) Medium quality (*n* = 13) Low quality (n = 5)
Rigour assessment	Low rigour (n = 17) High rigour (n = 7) Medium rigour (n = 5)	Low rigour (n = 14) High rigour (n = 11) Medium rigour (*n* = 11)

deforestation.

With a quasi-experimental design, Blackman et al. (2018) analysed 859 forest management units in Mexico, certified and non-certified, for a total area of 167,327.222 ha over an eleven-year period, from 2001 to 2012. By using data on forest loss from Landsat images to control for unobserved confounding factors, combined with matched difference-in-differences models, the study could not find any statistically significant impact of FSC on deforestation.

Miteva et al. (2015) evaluated the performance of FSC certified logging concessions in Indonesia, compared to non-certified ones, over an eight-year period, from 2000 to 2008. With a quasi-experimental design, the study used secondary data such as MODIS Vegetation Continuous Fields datasets and NASA FIRMS datasets, combined with triple difference matching estimators to establish the causal impact of the intervention. The study found that FSC reduced deforestation by 5% over the examined period, however it also increased perforated areas by 4 km^2 on average.

Rana et al. (2018) analysed the tree cover change in FSC certified forest management units compared to non-certified ones over a twelve-year period, from 2000 to 2012, in Brazil (545,335 ha), Gabon (688,262 ha), and Indonesia (171,240 ha). This study had a quasi-experimental design, and it used secondary data, such as Hansen data on tree cover change, along with the application of the synthetic control method to control for confounding factors. The study found that FSC had different effects in the examined countries, ranging from no impacts in Gabon, to small positive impacts in Indonesia, and to larger positive impacts in Brazil, although these positive impacts fluctuated over time.

Just one publication investigated the impacts that FSC has had on forest degradation. Foster et al. (2008) analysed three FSC certified sugar maple stands in comparison with three non-certified stands, both with partial harvest treatment, and six unharvested reference stands, in central Vermont, USA. With a quasi-experimental design, this study found that FSC did not have any impact on live tree characteristics. In fact, certified stands were identical to the non-certified ones, in terms of tree diameter and relative density of sugar maple.

The indicator of 'tree species richness, diversity, and density' was only used by one publication of Kalonga et al. (2016) which scored high on both rigour and quality. This paper compared two FSC certified community forests in Tanzania, Kikole (454 ha) and Kisangi (1966 ha), with open access forests and state forest reserves. This study had a quasi-experimental design and used mixed methods of data collection along with statistical analysis to control for confounding factors. The results showed that adult tree species richness, diversity and density were significantly higher in certified forests, compared to open access and state forest reserves, suggesting that FSC certification may be a valid option to effectively conserve floral biodiversity.

The reported evidence for the environmental category of ecosystem services shows mixed impacts.

Miteva et al. (2015) evaluated the performance of FSC certified logging concessions in Indonesia, compared to non-certified ones, over an eight-year period, from 2000 to 2008. With a quasi-experimental design, the study used secondary data such as MODIS Vegetation

Table 2
Reported environmental impacts of FCs and CFM.

		Forest certifications			Community forest management		
Categories	Indicators	Negative	No impact	Positive	Negative	No impact	Positive
Flora	Basal Area						7 8
	Canopy					1	
	Deforestation		2	9 10		11	12
	Forest Condition						6 13
	Forest Disturbance	9					6
	Forest Growth						6
	Live Tree Characteristics		4				
	Tree species richness, diversity, and density			5			
Ecosystem services	Air Pollution			9			
	Biomass	4				1	7 8
	Carbon Stock						7 8
	Carbon Sequestration					3	
	Coarse Woody Debris Volumes			4			
	Fire Incidents		9				

1. Baland et al., 2010. 2. Blackman et al., 2018. 3. Bluffstone et al., 2018. 4. Foster et al., 2008. 5. Kalonga et al., 2016. 6. Lund et al., 2014. 7. Lupala et al., 2015. 8. Mbwambo et al., 2012. 9. Miteva et al., 2015. 10. Rana et al., 2018. 11. Rasolofoson et al., 2015. 12. Santika et al., 2017. 13. Treue et al., 2014

Continuous Fields datasets and NASA FIRMS datasets, combined with triple difference matching estimators to establish the causal impact of the intervention. The study showed that FSC had no effect on fire events. However, FSC certified logging concessions had 31% less air pollution compared to the non-certified ones.

The indicators of 'coarse woody debris volumes' and 'biomass' have been used by one publication, Foster et al. (2008), which scored high on both rigour and quality. Three FSC certified sugar maple stands were analysed in comparison with three non-certified stands, both with partial harvest treatment, and six unharvested reference stands. The study found that certified stands had significantly higher volumes of coarse woody debris, compared to the non-certified stands, although these volumes were smaller than those in natural mature forests. Moreover, both certified and uncertified reference stands decreased biomass by one-third compared to the six unharvested reference stands, lowering the potential economic value of carbon storage by 25–30%.

No studies on fauna scored high on both rigour and quality.

4.2.2. Reported environmental impacts of CFM

Out of the thirty-six publications included, only eight papers scored high in both rigour and quality assessment (Baland et al., 2010; Bluffstone et al., 2018; Lund et al., 2014; Lupala et al., 2015; Mbwambo et al., 2012; Rasolofoson et al., 2015; Santika et al., 2017; Treue et al., 2014) (Table 2).

Treue et al. (2014) and Lund et al. (2014) investigated the impacts that CFM has on forest condition. In the first case, with a quasi-experimental design, this study aimed at evaluating whether participatory forest management in Tanzania has succeeded in managing forest resources sustainably. After seventeen years since the implementation of community-based forest management and joint forest management, the paper reports that forests were managed sustainably enough to support forest regeneration. Still, these positive results are achieved at the expense of neighbouring forests (non-PFM), where villagers extract the woody products that they need. Despite the fact that these activities are somewhat sustainable, the paper concludes that in order to be sustainable in the long run and to meet the needs of the villagers, PFM forests should be larger and include fast-growing species (Treue et al., 2014). In the second case, Lund et al. (2014) evaluated the impacts of CFM on forest condition, forest disturbance, and forest growth, in two neighbouring villages in Tanzania, Kiwele and Mfyome. By using both primary and secondary data, the study found that the two forests were in decent condition compared to before the implementation of the programme; however, the level of forest disturbance was higher in Kiwele, and lower in Mfyome. This difference was probably due to different priorities in conservation policies and forest extraction practices inside the two villages. In both cases, the programme fostered higher controls inside the forests and higher taxation on forest resource extraction.

Lupala et al. (2015) analysed the potential of climate change mitigation of community-based forest management in the Miombo woodland in Tanzania, compared to open access forests. By using on the ground measurements combined with satellite images the paper found that, after thirteen years since the implementation of the programme, CFM forests have higher stem density and increased basal area, biomass and carbon stock compared to non-CFM sites and pre-intervention conditions. Finally, the programme has fostered the sustainable management of natural resources and the enforcement of local bylaws, even in non-CFM areas.

Mbwambo et al. (2012) analysed the impact on forest resources of joint forest management and community-based forest management in comparison with state forest management. In over fourteen years since the implementation of the two programmes, the paper reports that the basal area, the number of stems, the biomass and carbon stock of forest resources are somewhat similar across the two interventions (JFM and CBFM), and these are slightly better than state forests. However, the paper warns to not generalize the results as, because of several confounding factors, it is not possible to fully attribute the positive results to both types of interventions.

Rasolofoson et al. (2015) and Santika et al. (2017), are quasi-experimental studies that used Landsat images and statistical techniques such as matching, to analyse the effectiveness of CFM at decreasing deforestation. The results are mixed.

Rasolofoson et al. (2015) examined all CFM areas established in Madagascar between 2000 and 2005, compared to non-CFM areas. Within the CFM areas, the researchers differentiated between CFM areas that allow commercial use of forest resources with CFM areas that do not allow it. Overall, the study does not find any statistically significant impacts between CFM areas and non-CFM areas. However, results show that CFM areas with commercial use had 1.83% more deforestation than non-CFM forests between 2000 and 2010. On the other hand, non-commercial CFM areas decreased deforestation by 2.01% compared to non-CFM areas. Compared to commercial CFM, there was a deforestation reduction of 5.59%. Santika et al. (2017) examined the performance of community forestry in Sumatra and Kalimantan in avoiding deforestation in undisturbed natural forests between 2012 and 2016. The study found a positive, but moderate, impact in avoiding deforestation across time and space. Whenever a *hutan desa* (village forest) had a poor performance, it was due to climatic factors (e.g., El Niño), and anthropogenic factors (e.g., agricultural pressure and palm oil plantations).

Baland et al. (2010) used a quasi-experimental design to evaluate the status of forests managed by *Van Panchayats* (local forest councils), compared to open access and protected forests, in the Indian state of Uttaranchal. The study examined 399 forest areas representing the whole mid-Himalayan region, and controlled for possible spillover effects in adjacent forests. Forests under *Van Panchayats* were 22% less looped compared to other forests without the programme, but in terms of canopy cover, biomass and regeneration, no statistically significant differences have been found between forest areas under the programme and non-CFM forests. Moreover, the study did not find any negative spillovers in adjacent forests without the programme. However, the study warns that due to a failure to include relevant characteristics of forests and forest communities in its analysis, these results might be affected by endogeneity bias, which could result in a substantial underestimation of the possible benefits of CFM on forest quality.

The reported evidence for the environmental category of ecosystem services shows positive impacts for the indicator of 'carbon stock' and mixed impacts for the indicator of 'biomass'. Two studies report positive impacts (Lupala et al., 2015; and Mbwambo et al., 2012), and one study points out no impacts at all (Baland et al., 2010). Just one study measured the impacts of CFM on 'carbon sequestration', and it could not find any statistically significant impacts (Bluffstone et al., 2018).

Studies that scored high on both rigour and quality that used the indicators of 'biomass' and 'carbon stock' are Baland et al. (2010), Lupala et al. (2015), and Mbwambo et al. (2012), whose evidence has already been reported in the previous sections. We will therefore focus on the indicator 'carbon sequestration' used by Bluffstone et al. (2018).

Bluffstone et al. (2018) analysed the effect of CFM on carbon sequestration after twenty years since the implementation of the programme. The study used a quasi-experimental design and investigated 620 plots (325 randomly selected plots in CMF areas, and 295 in non-CFM areas) in 130 natural forests across the middle hill and Terai areas of Nepal. The study could not find any statistically significant impacts on carbon sequestration in CFM areas compared to non-CFM areas. However, the study reports that communities in non-CFM areas that have well-defined groups and that identify their group formation year, store approximately seventy-three tons of carbon per hectare, compared to non-CFM areas with unclear user groups. These findings suggest that it is not the programme, per se, that fosters carbon sequestration, but it is the group behaviour (i.e., collective actions) that produces positive effects on the ground.

No studies on fauna scored high on both rigour and quality.

4.3. Governance mechanisms and contextual factors

Out of the five publications that scored high on both rigour and quality assessment in the SLR on FCs, we report the data on governance mechanisms and contextual factors of three specific publications (Table 3). Concerning the other two, one publication did not find any statistically significant impacts (Blackman et al., 2018), and the second one, Foster et al. (2008), despite demonstrating positive impacts (among others), could not be included because it did not report any data on governance mechanisms or contextual factors.

For the governance mechanism 'institutions', publications highlight that FCs provide effective monitoring mechanisms, and that the enforcement of standards and principles verified by a third-party auditor is related to positive impacts on the ground. Moreover, certified forest management units succeed in providing better living conditions for workers and their family, compared to non-certified units. While no data could be retrieved for 'information', one publication (Rana et al., 2018) reported price premiums as being the main 'incentive' for being certified.

Within the contextual factors, the included scientific literature indicates the following enabling factors for positive impacts: a government that enforces forestry laws, financial support by NGOs to assist forest companies in becoming certified, and biophysical characteristics of the forest, such as being rich in biodiversity.

Out of eight studies that scored high on both rigour and quality assessment in the SLR on CFM, we report the data on governance mechanisms and contextual factors of five specific publications (Table 4, page 21). The remaining three publications did not find any statistically significant impacts (Baland et al., 2010; Rasolofoson et al., 2015; Bluffstone et al., 2018).

In CFM, all three governance mechanisms appear related to successful impacts on the ground. The formal recognition of tenure rights by central institutions and the inclusion of local communities in the rule-making process are the most reoccurring mechanisms in 'institutions'. Lund et al. (2014) adds the effectiveness of monitoring and sanctioning mechanisms, an effective enforcement of rules, as well as institutions that foster accountability and design locally devised rules. With respect to the 'information' mechanism of CFM, specific elements that emerged are the use of the community's knowledge to develop local institutions and to manage forest resources. Knowledge appears as being particularly relevant as an 'incentive' mechanism as well, in terms of acquisition of knowledge with technical assistance and capacity development activities implemented by NGOs (Lund et al., 2014). Other relevant incentives that emerged from the literature are the possibility for the local communities to profit from managing forest resources sustainably, the use of forest products for their household needs, the inclusion of the community in the rule-making process, and the financial support by external donors.

As far as contextual factors are concerned, frequent elements that emerged as related to positive impacts are clear forest physical boundaries that are easily monitored, small communities that manage forest resources, a moderate dependence of communities on forest resources, and the provision of an additional source of income. With respect to the forest size, the scientific literature included in this SLR reports different dimensions including small, medium, and large size (Santika et al., 2017). Frequent biophysical characteristics of the forest are low forest elevation and a low volume of rainfall (Table 4, next page).

4.4. Comparison of the reported environmental impacts

Among the three environmental categories examined, no studies investigating the impacts of FCs or CFM on fauna scored high in both rigour and quality assessment. Therefore, we can only compare the impacts that these two forest governance interventions have on flora and ecosystem services. Within these environmental categories, the two indicators that were most used by the publications included in both SLRs are 'deforestation' for the category of flora, and 'biomass' for the category of ecosystem services (Table 2).

As far as 'deforestation' is concerned, both intervention results are definitely inconclusive.

Studies on FCs report impacts that range from strong positive in Indonesia (Miteva et al., 2015), to average positive in Brazil, Gabon, and Indonesia (Rana et al., 2018), to no impact in Mexico (Blackman et al., 2018). Studies on CFM report average positive impacts in Sumatra and Kalimantan (Santika et al., 2017) and no impacts in Madagascar (Rasolofoson et al., 2015).

As far as 'biomass' is concerned, Foster et al. (2008) presented negative impacts of FSC on certified sugar maple stands in Central Vermont. In fact, both certified and uncertified reference stands with partial harvest treatment reduced biomass by one-third compared to unharvested reference stands, decreasing the potential economic value of carbon storage by 25–30%.

Studies on CFM, on the other hand, presented average positive impacts in Tanzania (Lupala et al., 2015; Mbwambo et al., 2012) and no impacts in India (Baland et al., 2010).

Lupala et al. (2015) and Mbwambo et al. (2012) analysed the impacts of CFM in comparison with non-CFM forests after more than ten years since the beginning of the programme. Both studies concluded that there were higher volumes of biomass in forests under CFM than in their comparison groups.

In India, after analysing 399 forest areas in the mid-Himalayan region, Baland et al. (2010) could not find any statistically significant impacts of CFM on biomass compared to open access and protected forests.

Overall, CFM seems to produce more positive impacts compared to FCs. Indeed, out of eight CFM publications scoring high on rigour and quality only three publications could not find any impacts, whilst for FCs the results are definitely mixed. Out of five publications scoring high on rigour and quality, only two reported evidence of positive impacts (Rana et al., 2018; Kalonga et al., 2016) and one could not find any statistically significant impacts (Blackman et al., 2018). The remaining two publications reported evidence of mixed impacts, including negative ones (Miteva et al., 2015; Foster et al., 2008).

Table 3
Governance mechanisms and contextual factors associated with (strong) positive impacts.

Forest certifications	Author(s)	Institutions	Information	Incentives	Contextual factors
	Kalonga et al. (2016)	The certified FMUs are effectively monitored Enforcement is verified by a third-party auditor	n/a	n/a	The government enforces forestry laws NGOs support and assist forest companies and forest owners in becoming certified
	Rana et al. (2018)	n/a	n/a	Forest managers experienced price premiums	n/a
	Miteva et al. (2015)	Certified FMUs have better living conditions for workers and their family than non-certified FMUs	n/a	n/a	The certified forest is a hotspot for biodiversity

Table 4
Governance mechanisms and contextual factors associated with (strong) positive impacts.

Community forest management	Author(s)	Institutions	Information	Incentives	Contextual factors
	Lund et al. (2014)	Rules are locally devised Institutions include local communities in the rule-making process Institutions foster accountability Sanctioning mechanisms are effective Monitoring mechanisms are effective Enforcement of rules is effective	The knowledge of the community is used to develop the most appropriate institutions The knowledge of the community is used to manage forest resources	External donors provide financial support to implement the intervention The community is allowed to use its knowledge to manage forest resources The community is empowered by technical assistance and capacity development activities implemented by NGOs The community can profit from managing forest resources sustainably The community is included in the rule-making process The community can use forest products for its household needs	Forest size is small Forests' physical boundaries are clear Boundaries are easily monitored The user group is small The community is moderately dependent on forest resources Additional sources of income are provided The community has access to the market Technology influences forest resource management Forest is at low elevation Low rainfall
	Lupala et al. (2015)	Central institutions formally recognize tenure rights Institutions include local communities in the rule-making process	The knowledge of the community is used to develop the most appropriate institutions The knowledge of the community is used to manage forest resources	External donors provide financial support to implement the intervention The community is allowed to use its knowledge to manage forest resources The community is included in the rule-making process The community can use forest products for its household needs	Forest size is small The user group is small The community is heavily dependent on forest resources Forest is at low elevation Low rainfall
	Mbwambo et al. (2012)	Central institutions formally recognize tenure rights Institutions include local communities in the rule-making process	n/a	The community is included in the rule-making process	Forest's sizes are small and medium The user groups are medium and large size Forests are at medium elevation Medium rainfall
	Santika et al. (2017)	n/a	n/a	n/a	Forest size is large
	Treue et al. (2014)	Central institutions formally recognize tenure rights Institutions include local communities in the rule-making process	The knowledge of the community is used to develop the most appropriate institutions The knowledge of the community is used to manage forest resources	External donors provide financial support to implement the intervention The community is allowed to use its knowledge to manage forest resources The community is included in the rule-making process The community can use forest products for its household needs	Forest's sizes are small and medium

5. Discussion

5.1. Reported environmental impacts of FCs and CFM

The first question this SLR addressed was what are the environmental impacts of FCs and CFM at a global scale as reported in the academic literature? The evidence of the reported environmental impacts of both FCs and CFM shows clear trends towards (strong) positive impacts on the ground, with only six studies reporting no impact, and only two studies, concerning FCs, reporting negative impacts. However, given the small sample of publications and the different countries where these studies were carried out, we cannot provide a generalizable answer on the impacts that these forest governance interventions actually have on the ground. As far as the impacts that FCs have on deforestation, our findings are consistent with the evidence provided in the review of Burivalova et al. (2017) that indicate variable impacts of FCs, ranging from no impact to positive impacts. The SLR of ISEAL (International Social and Environmental Accreditation and Labelling) reported 'effectively zero' (Komives et al., 2018, p. 21) impacts of FCs on deforestation, which is a disturbing conclusion given that one of the main goals of this intervention is to halt deforestation, especially in the tropics. Possible reasons for why we do not have definitive answers yet are multiple and mainly due to methodological challenges. First, deforestation rates are generally measured with remote sensing data since they are easy to access and relatively inexpensive. However their use alone is not sufficient to give a reliable answer. Persistent cloud cover and inappropriate resolution can undermine the possibility to exactly identify forest increase or forest clearing within the investigated areas, leading to inaccurate conclusions (Couturier et al., 2012). Second, studies using remote sensing data combined with quasi-experimental statistical methods, can still provide uncertain results if they do not use a theory of change (Romero et al., 2017). The theory of change, in these cases, can help provide information about the contextual factors where the certified forests are located (e.g., historical, political, and economic situation of the country), and it can help to elucidate the 'certification continuum' of certified forests analysed (e.g., whether the certified area lost its certification status at a certain point and then re-gained the certified status, or whether it was continuously certified) (Romero et al., 2017). This type of data is essential to provide a more reliable and complete interpretation of the detected changes on the ground. So far, just one study (Blackman et al., 2018) which has been included in our SLR, and in both Burivalova et al. (2017) and the ISEAL report (Komives et al., 2018), used a theory of change in its analysis. However, that publication did not discuss which assumptions in its theory of change were violated or confirmed, as it was out of the scope of its analysis (Blackman et al., 2018). Third, and finally, the lack of appropriate counterfactuals, that are essential to make any causal inference, is, and will continue to be in the near future, one of the main challenges in impact evaluations because it is difficult to identify and costly (Romero et al., 2017; Steering Committee, 2012).

As for the impacts that CFM has on deforestation and forest degradation, the evidence provided in Burivalova et al. (2017) and Samii et al. (2015) points out that the impacts of CFM range from positive impacts to no impacts. This is consistent with our findings. Min-Venditti et al. (2017) highlights negative impacts reported in one study by Bonilla Moheno et al. (2013) which showed patterns of deforestation activities from 2001 to 2010 in all municipalities managed under *ejidos* (local communities) in Mexico, in comparison to *communidades agrarias* (private managed land) which experienced an increase in forest cover. As with FCs, there are several reasons for why we still do not have a generalizable answer, but it is partly due to the variability of CFM and methodological challenges. Specifically for CFM, community forests vary in terms of characteristics of the user groups, different governance mechanisms in place, and different social, economic, and environmental context where they reside. Different combinations of these elements can produce different impacts. This means that a generalizable answer will be difficult to obtain.

Both SLRs highlighted a lack of rigorous studies concerning the impacts of FCs and CFM on fauna.

For FCs, while a multitude of scientific studies do actually exist, and they all report positive impacts (Polisar et al., 2017; Mohamed et al., 2013; Nordén et al., 2018; Tobler et al., 2018; Dias et al., 2013; Sollmann et al., 2017), rigorous studies to be included in this SLR could not be found. This gap is confirmed in the SLRs of ISEAL (Komives et al., 2018) and Burivalova et al. (2017). This latter review only reported studies on the impacts that reduced impact logging (RIL) in logging concessions (not certified) has on species richness. Considering that RIL is largely implemented in CFs, this type of study can be a valuable source for the indication of potential impacts of FCs on fauna (see van Kuijk et al., 2009), but the studies cannot be used as evidence.

Similarly for CFM, while there are many scientific publications on the effectiveness of community conservation that demonstrate (strong) positive impacts (see Shahabuddin & Rao, 2010; Shanee and Shanee 2015; Alcàntara-Salinas et al., 2015; Muench et al., 2016; Corrigan et al., 2018), no rigorous studies on the impacts that CFM has on wildlife could be identified. This gap has been underlined even in Burivalova et al. (2017), which denounced the 'striking omission' of an investigation of the impacts that CFs can have on fauna. This is particularly important in order to explore the feasibility and compatibility of implementing CFM for protecting wildlife biodiversity, especially when communities have customary rights related to hunting.

Another evidence gap that emerged from both SLRs relates to the impacts that FCs and CFM have on Ecosystem Services. Since FCs and CFM are considered an 'effective way to safeguard nature and its contributions to people' (IPBES, 2019), there is an urgent need for increased impact evaluations in order to establish the potential conservation impacts of FCs and CFM on wildlife biodiversity and ecosystem services.

5.2. Governance mechanisms and contextual factors

The second research question addressed in this SLR was what are the governance mechanisms and contextual factors identified in the academic literature that facilitate the achievement of positive impacts.

From the analysis of governance mechanisms that can foster the effectiveness of FCs, the most reoccurring mechanism was 'institutions' (Kalonga et al., 2016; Miteva et al., 2015). This finding is particularly interesting since FCs are believed to work principally with economic incentives and information (Agrawal et al., 2018; Cashore et al., 2002; Cashore et al., 2007). Specific mechanisms that emerged are monitoring mechanisms and compliance verification by third-party auditors. The results comport with the wider scientific literature. Kalonga et al. (2017) reported that monitoring activities carried out by guards inside FSC villages in Tanzania, together with controlling activities of external auditors, helped to reduce the illegal harvest of forest resources. The verification of compliance by a third-party auditor is indeed one of the main pillars of non-state market driven governance (Cashore, 2002; Cashore et al., 2007), as it provides legitimacy to the intervention, fosters the recognition of certified products in the market place by consumers, and supports better market access and price premiums to the producers (Ibidem). However, it is important to stress that the auditing process itself is not free from weaknesses. Bartley (2012) pointed out that companies can still falsify documents, train workers to give the right answers to auditors, and even corrupt auditors to keep the status of being certified. Moreover, corrective actions requests (CARs) issued to companies do not necessarily imply substantial changes on the ground since CARs concern the management process rather than the actual impacts (Ibidem). Hence, when studies report efficient compliance controls in certified areas without measuring whether there are environmental changes on the ground, the reader should be cautious in assuming necessarily positive impacts. The only way to actually establish that an auditing process favoured a change on the ground is with appropriate methodologies for impact assessment.

As far as 'incentives' are concerned, the expectation of having a price premium appeared as the main mechanism for the adoption of FC. This finding is in contrast with other studies that identified increased market access as the main reason for being certified (see Faggi et al., 2014; Galati et al., 2017; Araujo et al., 2009; Carlson et al., 2016). Considering that the overall sample of the publications reporting on the governance mechanisms of FCs is small, more research is needed to have the full picture on how the synergies between these mechanisms affect the effectiveness of FCs. Not only would this allow a deeper understanding on how FCs actually work, but it would also shed light on potential implementation issues and contribute to the improvement of FC schemes (Komives et al., 2018).

The political context emerged as an important enabling contextual factor for the adoption of FCs. In agreement with Cashore and Auld, (2012) and Ebeling and Jasué (2009), this SLR highlighted that when the government supports the uptake of FCs by providing economic incentives and tax exemptions for logging companies, these latter are more likely to adopt an FC scheme. In developing countries, external financial support by NGOs to logging companies also emerged as being essential. Moreover, if the law already prescribes sustainable management practices that are compatible with FCs, there is a higher chance that forest companies will opt for a certification, since they do not have to undergo costly changes in order to be certified. This is partially the reason why FCs are mostly adopted in boreal and temperate countries, where they are actually less likely to make a significant difference in terms of improvements on the ground (see Villalobos et al., 2018). Tropical countries, on the other hand, are still lagging behind (Arts et al., 2017; Cashore & Auld, 2012). Ebeling & Jasuè (2009) compared enabling and disabling contextual factors for the uptake of FCs in Ecuador and Bolivia. The study reported that in Ecuador, a combination of wide spread corruption, weak enforcement of forestry law, lack of external support (i.e., by NGOs), the presence of mainly small sized firms, and insecure tenure rights hampered the wider adoption of FSC certification. However, the size of the companies and the importance of secure tenure rights did not come up in our research. This is likely due to the scarcity of qualitative data contained in the ecological publications that were included in this SLR. Nevertheless, we acknowledge that these are indeed factors to consider when evaluating the feasibility of the adoption of FCs in developing countries. The bigger the company, the easier it is to develop economies of scale and the vertical integration of the supply chain, which would lower the costs associated with being certified. Additionally, the security of tenure rights is important for making long term management plans in a given forest area.

Finally, it is important to be aware that though these political factors enable the implementation of FCs, they are not essential for having positive impacts on the ground. The scientific literature presents several cases in which FCs have been successfully adopted in countries with weak forest governance (see Cerutti et al., 2011; Cerutti et al., 2017). In some of these cases, FCs even helped to improve the forest governance of that country. For instance, Kalonga et al. (2015) and Kalonga et al. (2016), two studies included in this SLR, reported that communities living in FSC-certified forest villages in Tanzania, positively influenced communities living in non-certified villages, so much so that these latter were more open to implementing sustainable forest management in their forests. Savilaakso et al. (2017) pointed out that in Indonesia, Cameroon, and Peru, FSC certification influenced national forest governance to increase transparency, legality verification, and trust among different stakeholders in the forestry sector. Therefore, the interplay between FCs and different political factors is not straightforward.

In the SLR on CFM, from the analysis of governance mechanisms that are most associated with (strong) positive impacts, 'incentives' stand out as being critically important, particularly in the form of knowledge. This includes knowledge transferred with capacity development activities provided by NGOs, knowledge applied by the local communities in the form of traditional knowledge to manage their forest resources, and knowledge used to create contextually appropriate rules. Other types of 'incentives' that emerged from this SLR are the financial support of external donors and the opportunity to use and profit from forest resources. In the second place, this SLR highlights the essential role of 'institutions', consistent with studies of IFRI, (2015), and Gilmour, (2016). Elements of the 'information' mechanism that were highlighted are the importance of using the knowledge of the community to manage forest resources, and the importance of using the knowledge of the community to develop local institutions. Considering that the role of 'institutions' has already been largely debated in the literature (e.g., Agrawal, 2001; Chhatre and Agrawal, 2008; Saunders 2014; Behera, 2009; Gibson et al., 2005; Poteete and Ostrom, 2004), we are going to focus only on the 'incentives' and 'information' mechanisms, before discussing the contextual factors.

The first knowledge-related incentive concerns the technical assistance and capacity building activities provided by external actors, such as NGOs, to local communities. These results are consistent with Barnes and Laerhoven (2015) who acknowledge that NGOs in India provided the necessary skills to negotiate with government authorities, to teach official languages, and to educate the communities with respect to policies that might affect the communities themselves. This study also reported that to do so, building mutual trust was a prerequisite. Akamani and Hall (2019) pointed out that two community forests in the Ashanti region of Ghana improved their forest management practices with the transfer of knowledge and technical skills provided by external actors. However, the study warned that this type of assistance can pose a risk for the long-term survival of traditional knowledge.

The second knowledge-related incentive that is associated with successful impacts, is the possibility for local communities to use their knowledge to manage forest resources. This opportunity is particularly important in CFM, as it not only serves as an 'incentive' to engage local communities in the intervention, but it is also a critical 'information' mechanism of this intervention. These results are consistent with Kim et al. (2017) that analysed the impacts of using traditional ecological knowledge, in particular fengshui, in managing forest resources in China, Japan, and South Korea. Fengshui fostered large afforestation practices in areas surrounding human settlements in all three countries, favouring the provision of important ecosystem services, including water availability and flood protection. However, the study pointed out that using traditional knowledge to manage forest resources cannot keep up production with the current wood demand for industrial purposes, and therefore it can only be a complement to modern ways of forest management, and not a substitution. Other studies reporting on traditional ecological knowledge are Camacho et al. (2016) that highlighted positive impacts on biodiversity conservation and ecosystem services by using *muyong* practices in the Ifugao province in the Philippines and Boafo et al. (2016) that investigated how the traditional ecological knowledge in form of taboos and totems fostered both floral and faunal biodiversity protection in Northern Ghana.

A third knowledge-related incentive that emerged from this SLR is the possibility for the local community to be included in the rule-making process, so as to create local, knowledge-informed rules. This third incentive goes hand in hand with the other 'information' mechanism, which pointed out the importance of using the knowledge of the community to develop local institutions. These results comport with Agrawal and Gibson (1999) that reported how such an inclusion would create more contextually appropriate institutions and rules to manage forest resources, mainly because the local communities possess local knowledge, or 'indigenous knowledge', which central government authorities lack. Moreover, such an inclusion would foster the perception that local institutions are legitimate and fair (Poteete and Ostrom, 2004).

Other incentives that foster successful impacts are the possibility for the local communities to use the forest resources for their household needs and the prospect of profiting from managing resources sustainably. These findings are in agreement with Gatiso (2019) that reported strong positive impacts in a participatory forest management programme in Ethiopia, where the dependence on forest resources for both personal needs and income generation was a critical factor for the success of the intervention. Other studies in line with these results are Pagdee et al. (2006), Heltberg (2001), Kacani & Peri (2018), and Nhem et al. (2018). However, while the possibility to use and profit from forest resources is an important incentive to engage communities in CFM and potentially develop (strong) positive impacts on the ground, other studies underlined that a heavy dependence on forest resources is also associated with a higher level of forest degradation (Agrawal and Chhatre, 2008). Hence, it is important that either local communities are moderately wealthy, or that additional sources of income are provided (IFRI, 2015; Gilmour, 2016).

Finally, the financial support of external agents is an incentive mechanism that enables positive outcomes on the ground. External funds are indeed necessary, particularly in developing countries where the cost for the implementation of the programme is around thousands of dollars (Lescuyer et al., 2019). As far as contextual factors are concerned, the reported findings of the studies generally comport with the scientific work of IFRI (2015) and Gilmour (2016) with respect to forest resource system, biophysical factors, and user group characteristics.

5.3. Comparison of the reported environmental impacts

The third, and final, research question that this SLR addressed was how the environmental impacts compare between the two forest governance interventions analysed. The findings of both SLRs suggest more reported positive impacts in CFM than FCs; however, these results should be treated with caution for two main reasons. First, the very small sample size of these publications, the different indicators used, the different geographic locations and biomes investigated all hinder the possibility of providing an exhaustive and generalizable answer. At best, the evidence can only provide an indication of the impacts. Second, the publications included in both SLRs suffer from methodological challenges that hamper the possibility to make any strong causal inference. Four out of the thirteen publications that scored high on both rigour and quality had the following problems: they failed to control for confounding factors, the comparison group(s) was not always suitable for the analysis (i.e., lack of proper counterfactual), and not all the studies applied statistical techniques to help in attributing the impacts to the intervention.

5.4. Limitations

Overall, the findings of both SLRs are subject to some important caveats. Given the clear indication of (strong) positive impacts reported, it is plausible to affirm that both SLRs might suffer from several biases.

First of all, there is publication bias. Scientific journals are more prone to accept and publish scientific research that reports positive results rather than null or negative ones. This is particularly detrimental because negative results are actually essential to know where, how, and why a certain intervention needs to be improved (Simundic, 2013). Second, there is confirmation bias. This type of bias takes place when researchers tend to collect, analyse, and report data that only confirm their hypothesis or beliefs. This can have several consequences: it can lead to reporting of data that does not exist, eliminating data that does not support their hypothesis or beliefs, or using inappropriate statistical tests to validate findings (Ibidem). Third, there is methodological bias. The majority of the publications included in both SLRs had methodological flaws that might have affected the reliability of their findings. Beyond some form of bias already reported by some publications (e.g., cognitive bias, selection bias), some of the papers did not control for confounding factors, and this might have affected the validity of their reported impacts. Fourth, there is language bias. Both SLRs comprise only scientific literature written in English. We acknowledge that potentially relevant research written in other languages was excluded from these SLRs.

6. Conclusions

FCs and CFM are two major forest governance interventions whose aim is to reverse forest degradation and deforestation, while providing socio-economic benefits to the people involved. Today, around 732 million hectares and 554 million hectares are being governed under CFM (FAO, 2016) and FCs, respectively. Still, there is a paucity of scientific evidence on their environmental impacts on the ground and on the governance mechanisms and contextual factors that facilitate the achievement of positive impacts. To fill this knowledge gap, we conducted two SLRs comprising sixty-five publications in total, which collectively cover a total forest area of around 19 million hectares. The geographic distribution of the publications gathered for both interventions covers mainly the tropical biome. Out of sixty-five publications in total, only thirteen methodologically rigorous publications could be identified.

The lack of methodologically rigorous studies makes it difficult to provide a generalizable answer to the first research question, 'What are the environmental impacts that FCs and CFM have at a global scale, as reported in the academic literature?'. The evidence reported in both SLRs generally indicates positive impacts on the ground; however, if we examine the impacts on flora, the reported evidence is largely inconclusive, with studies reporting either positive impacts or no impacts at all. We found a significant knowledge gap on the impacts that FCs and CFM have on fauna, and evidence is largely lacking concerning the impacts that both interventions have on ecosystem services.

Due to the small sample size of publications scoring high on both rigour and quality assessment, more research is needed to exhaustively respond to the second research question, 'What are the governance mechanisms and contextual factors identified in the academic literature that facilitate the achievement of positive impacts?'

From the SLR on FCs, 'institutions' stood out as being critical for the effectiveness of this intervention, while for CFM, the combination of 'institutions', 'information', and 'incentives' is necessary to have positive impacts on the ground. Interestingly, the role of knowledge as an 'incentives' and 'information' mechanism stood out as being one important factor for the success of this intervention. The political context in which FCs are being adopted is one important enabling factor, together with financial support by NGOs and the biophysical characteristics of the forests. For CFM, a combination of contextual factors, already identified by the work of IFRI (2015), seems to enable positive impacts, namely forest resource system, forest biophysical factors, and user group characteristics.

The aim of the third research question, 'How do these environmental impacts compare between the two forest governance interventions analysed?', was to highlight potential synergies between the environmental goals of these interventions. However, a meaningful comparison was hindered by the very small sample size of methodologically rigorous studies and a lack of common indicators and common geographic areas covered. Still, such a comparison is needed in order to explore the synergies and trade-offs among the impacts that these interventions have on the ground. That understanding would allow policy-makers to improve the implementation of FCs and CFM and be aware of how, if, and where, these two interventions can be combined to foster a 'transformative change', which is essential to slow down the 'alarming' loss of biodiversity and ecosystem services (IPBES, 2019).

Based on the above, here are the recommendations for future research: Research is needed to fill the evidence gap on the impacts that FCs and CFM have on fauna and ecosystem services. To facilitate future comparisons, ideally, such investigations would use standardized methodologies for impact evaluations and standardized indicators. To understand in which ways, under what conditions, and at what costs (strong) positive impacts can be achieved, future research should explore what the governance mechanisms and contextual factors are that foster these positive impacts on the ground.

FCs and CFM aim not only at improving forest conditions, but also at providing socio-economic benefits for the people involved. This SLR only sheds light on one of the impacts that these interventions can have, and future researches would greatly benefit from the analysis of socio-economic impacts in addition to the environmental ones. This is because the impacts of an intervention can have synergies and trade-offs among each other, and to explore just one type of impact provides only a tiny part of a much bigger picture. To have a comprehensive overview on the impacts that both forest governance interventions have on the ground, it is recommended to expand the research as to include publications written in languages other than English.

Methodologies for impact evaluations need to be improved and more investments are needed to identify the proper counterfactual. However, when dealing with complex socio-ecological systems such as forests, to use only quantitative methods is restrictive. To have a holistic understanding of the impacts that a certain intervention has in a given context, the involvement of all stakeholders, including local and indigenous communities, is essential. This will increase the understanding of who really benefits from the intervention and at what costs, and it will foster collaboration, equity, and respect to the people that are most affected by the intervention itself.

Declaration of Competing Interest

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

Data availability

Data will be made available on request.

Appendix A, B, and C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.forpol.2022.102864.

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