Trends in governance research and the gender perspective for reducing deforestation: A bibliometric analysis

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Abstract. Governance with a gender perspective is very crucial in reducing deforestation. The existing policy is insufficient for addressing increasingly complex issues in forestry. To promote studies on Deforestation in relation to Gender and Governance (DGG), it is important to have comprehensive review that has the ability to provide an overview of the current research and identify future research. This article is a bibliometric analysis using VOS viewer application to identify and explore DGG research with data sources from Scopus. A total of 467 publications from 1995 to 2021 were obtained for analysis. The findings showed that there had been an increase in DGG research, and about 84 countries were involved in this study. There shifts in themes and diversity themes in research in each country, indicating that DGG research has changed with the scale of research that is developing gradually. Deforestation, gender and governance issues have captured the attention of world leaders especially since the SDGs were established in 2015, so it can be concluded that DGG research has high potential to be developed in the future. We suggest DGG research by conducting an in-depth literature review, for example by using a gender analysis tool.

1. Introduction

More than 1.5 billion people in the world depend directly on forests for food, shelter, medicines, and income [1]. Forests provide clean air, fresh water, and homes for a variety of plant and animal species. Many efforts have been made to promote sustainable forest management by countries in the world [2-4], but forests are still under threats. The biggest threat to forests is the loss of forest areas through land conversion or other land uses or commonly known as “deforestation” [5]. The research findings [6] showed that the major drivers of deforestation were illegal logging, commercial timber production, land clearing for agriculture, new settlements and land migration, natural disasters and human-caused forest fires and weak law enforcement.

Data from FAO [5] reveals that the rate of deforestation was estimated 420 million ha since 1990, but the rate has declined to 10 million ha per year in 2015-2020 while in 2010-2015 the rate of deforestation was estimated 12 million ha per year. The decline of deforestation rate cannot be separated from the role of a country in its governance [7, 8]. Agarwal studies [9, 10] reported that the women’s involvement in the executive committees of forest management was positively correlated with improving forest governance and resource sustainability and can reduce violations by communities, and several studies concluded that the presence of women in forest governance can improve the performance of the forestry sector, including reducing deforestation [11-13]. Besides threatening the lives of animals live in the forest, deforestation can also cause global warming by...
increasing the earth's surface temperature (climate change). Climate change will threaten global health through changing patterns of disease, water and food insecurity, vulnerable shelter and human settlements, extreme climate events, and population growth and migration [14].

There is several scientific research on deforestation conducted since 1890s, and in the 1990s the researchers began to connect deforestation, governance and gender perspectives (DGG). The DGG research namely [6] analyzing the driving factors on deforestation and forest degradation, [11] discussing the relationship between women's parliaments and land cover, [14] discussing the subordination of indigenous women in REDD+ projects and climate change, [15] mapping development of gender research in forestry research, with a focus on tropical and dry forests in developing countries in the period 2000-2011, [16] presenting a structured examination of the benefit sharing mechanism (BSM) in REDD+ program, [17] analyzing the experiences of three local communities in Nepal who participated in the REDD+ pilot program, with a focus on how indigenous peoples and women participate in REDD+ projects. The research mapping publications related to DGG using bibliometric analysis is unprecedented. This will fill the research gap.

This paper reviews the DGG literature from 1995 to 2021. Year 1995 was chosen because it is the year of Beijing Declaration and Platform for Action, namely the global agreement to realize gender equality which was integrated with the 2030 agenda for sustainable development goals (SDGs). The study aims to provide a better and more comprehensive understanding of trends in DGG research, by perform keyword mapping, development of research themes, most productive countries, and differences in research themes among countries. This is carried out to identify future research opportunities and to promote DGG research. With numerous topics in DGG research, it is expected to encourage state leaders in efforts to reduce deforestation [18] through policies that support forest sustainability.

2. Methods
Articles taken as research material are obtained from the Scopus database which has received recognition from international researchers. The research was conducted by searching online documents on July 13, 2021, using the keywords “Deforestation” AND “Gender OR Women” AND “Governance” using the criteria “title, keywords and abstract for the period 1995-2021. With the keyword "deforestation" it was found 30,150 publications, then by adding the keyword "gender OR women" it was found 1,395 publications, by adding the keyword "governance" 467 publications were found. In addition, the researcher also splits the period into three according to the commitments or agreements of countries in the world in realizing gender equality, namely the period of the Beijing Declaration and Platform for Action/BPfA (1995-1999), Millennium Development Goals/MDGs (2000-2014), and Sustainable Development Goals/SDGs (2015-2021).

The downloaded article from Scopus was then subjected to bibliometric analysis. Bibliometric analysis is an indispensable approach to highlight the main results of the literature in a structured method and able to reveal gaps in knowledge [19]. Bibliometrics helps researchers to explore, organize and analyze large number of information and discover hidden patterns that can be used in the decision-making process [20], demonstrating global performance and research trends [21, 22]. Articles downloaded from Scopus use the CSV file format by entering the downloaded file in the VOSviewer application. VOSviewer is a software for visualizing and analyzing research trends in the form of bibliometric maps [23, 24]. The frequency of keywords can be ordered by the most and least relevant keywords [25]. VOSviewer software can also be used to create journal keyword maps based on shared networks, mapping and grouping articles taken from database sources and investigating collaborations between countries [19, 20, 26].
3. Results and discussion

3.1. Publication overview and characteristics

The 467 search results publications, if we divide them into 3 periods of agreement by world leaders regarding gender equality, we get 336 articles in the SDGs/2015 – present period, 130 articles in the MDGs period (2000-2014), and only 1 article found in the BPfA period (1995-1999). As shown in diagram 1, the number of publications related to DGG, although experiencing ups and downs for example in 2010, 2013 and 2019 it had decreased compared to the previous year, but the trend has increased year over year, it can be seen in 1998 that one article became 79 articles in 2020.

![Diagram 1. Number of DGG publications 1995 to 2020](image)

A total of 467 articles were discussed, divided into 10 subject areas. The most discussed subjects were Environmental Science (30%), Social Science (27%), Agricultural and Biological Sciences (17%).

![Diagram 2. Subject Area, DGG Research](image)

3.2. The most productive countries published DGG articles 1995-2021

Research related to DGG from 1995 to 2021 was carried out by about 84 countries. Only the United States published more than 100 articles, as many as 142 articles (30.41%), then the second position is England with 78 articles (16.70%), the third position is Australia with 51 articles (10.92%), then in the fourth position is Indonesia with 47 articles (10.06%) and in the fifth position is Germany as many as 44 articles (0.09%), for more details can be seen in Figure 3.
3.3. Network analysis based on text data and keywords

Figure 3 below shows the most frequent network appeared more than 10 times with a total of 160 keywords. The circle size represents the frequency of the keyword, the larger the keyword, the more frequently it appears. “Deforestation” occupies a central position because it is the main keyword of this article. In the image there are four colors, namely red, blue, green, and yellow, each color indicating its own cluster of the keyword network. “Deforestation” is closely related to “forest management”, “climate change”, REDD+, “governance approach” and “sustainability”.

3.4. Keyword analysis

A total of 160 keywords appeared in 467 publications. To make the results more reasonable, similar keywords like REDD and REDD+ are combined. After going through a series of data processing, the 160 keywords declined to 156 keywords. Among these keywords, 37.18% appeared less than 10 times and 62.82% appeared more than 10 times. Important information in an article can be seen from keywords [21]. After ignoring the keyword “deforestation” (279 times), the top three were “REDD+” (108 times), “forest management” (95 times), and “climate change” (75 times).
Figure 5. Keyword co-occurrence

The table below is the most frequently used keywords in DGG research in the 3 periods of commitment of world leaders to achieve gender equality (BPfA, MDGs and SDGs). There is evolution of keywords in each period. In terms of frequency, the use of keywords omitting deforestation, namely "forest management" from 32 times in the MDGs period to 63 times in the SDGs period. Meanwhile, the keyword with the most significant increase is REDD+ from 9 times in the MDGs period to 69 times in the SDGs period. In addition to these two keywords, the keyword “climate change” also experienced a significant increase from 19 times in the MDGs period to 56 in the SDGs period.

Table 1. Keyword Evolution in Three Periods

| Keyword               | All 1995-2021 | SDGs (2015-2021) | MDGs (2000-2014) | BPfA (1995-1999) |
|-----------------------|---------------|------------------|------------------|------------------|
| 1 Deforestation       | 279           | 197              | 82               | 1                |
| 2 Forest Management   | 95            | 69               | 32               | 1                |
| 3 REDD+               | 78            | 63               | 19               | 1                |
| 4 Climate Change      | 75            | 56               | 15               | 1                |
| 5 Emission Control    | 64            | 49               | 15               | 1                |
| 6 Sustainable         | 50            | 35               | 15               | 1                |
| 7 Forestry            | 45            | 33               | 15               | 1                |
| 8 Governance Approach | 45            | 32               | 14               | 1                |
| 9 Environmental Policy| 41            | 32               | 13               | 1                |
| 10 Sustainability     | 40            | 32               | 13               | 1                |

3.5. Keyword in different country

Governance with a gender perspective is an alternative in reducing deforestation [6, 11, 12, 14]. However, due to geographical, social, cultural, and governmental systems, DGG's research varies between countries. The image below provides information on the 5 most popular keywords from the 10 most influential countries in DGG's research. Among these countries, one from Asia, three from America, five from Europe and one from Oceania. There are clear differences in the use of keywords in these countries. In America the keyword besides “deforestation”, “forest management” is the most popular, USA 26 times, Brazil 11 times and Canada 11 times. In Europe, the popular keyword is "climate change". In Australia the most popular keyword other than “deforestation” is “REDD+”, while in Indonesia appeared a different keyword from other countries, namely “governance approach”.

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3.6. Future research opportunity

To find research novelty, we can use the keyword network, in which the line connecting indicates that there is a relationship between one research theme and another or previous research using some of these themes that are unprecedented. If there is no line connecting to other keywords, indicating that there has been no research linking these themes, for example, "gender roles in sustainability reducing deforestation", "the relationship between gender and adaptive management in reducing deforestation" and so on. Besides looking at the visualization of VOSviewer, the researcher tries to add the keyword “gender analysis” in the 467 articles discussed as [11] highlighting the relationship between women in parliament and the decline rate of deforestation [12], analyzing the role of women in forest management, [15] mapping gender analysis in forestry research. Of the 15 search results pages, there is merely one relevant article, indicating that there are still very few DGG studies using the “gender analysis” as their instrument so that it becomes an opportunity for future research. In addition, to look for research novelties, it can also take DGG themes from a different point of view from previous studies, for example related to the themes of sustainability [14], leadership [18], conservation [9] and others.
4. Conclusion
The involvement of women is expected to be able to improve the performance of the forestry sector, including reducing the deforestation rate, which is currently an increasingly alarming condition, but the number of studies on governance with the gendered in reducing deforestation is unequal to the increase in research on deforestation. The application of the bibliometric method for mapping DGG research is a valid approach. Besides being able to check research trends from year to year, the most active countries in research, it can also find research themes that becomes the focus of the study using the keywords. The search results on the Scopus page found 467 publications, 336 articles in the SDGs/2015 period – present, 130 articles in the MDGs period (2000-2014), and merely 1 article was found in the BPfA period (1995-1999).

Besides deforestation, REDD+, forest management and climate change were the most discussed topics in DGG's research for the 1995-2021 period. The evolution of keywords from the MDGs period (2000-2014) to the SDGs period (starting 2015 until now) in the most prominent research is on the theme of REDD+. Although the increase is not significant from year to year, even experiencing ups and downs, but the DGG research has an upward trend. Of the 84 countries involved in DGG's research, the United States was the most active country in publishing the articles, while the foremost scientific fields are environmental science and social science.

By analyzing the keywords generated by the VOSviewer application, it can be concluded that there are still many opportunities issued for future research, especially deforestation, gender, and governance, capturing the attention to world leaders. Efforts to reduce deforestation have appeared in the era of the 1980s, gender issues have emerged since the birth of BPfA in 1995, while the concept of governance appeared in the 1980s. With the ratification of the SDGs in 2015, it further strengthens efforts to reduce deforestation through governance from the gendered, so that DGG research has a lot of opportunities in the future. Besides conducting DGG research with a different perspective, for example linked to sustainability, conservation, or leadership, another DGG research that has a high potential is to study whether existing DGG studies use gender analysis tools. This is important to perform to promote the DGG sector as an effort to capture the attention of the world leaders to this field for reducing deforestation and realizing sustainable forests.

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