# Women, science and intersectionality: an evidence map

# of gendered discourse in climate research

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## Abstract (300)

Climate science is unanimous on the urgency of action in both mitigation and adaptation. The people who have least contributed to the anthropogenic climate change are already suffering from the slow onset impacts and acute disasters; and the currently implemented policies only exacerbate the existing inequalities. It is thus crucial that a just approach is pursued, whereby the interests of the socially marginalised groups are made central and integral to all research and policy related to environmental governance. As climate adaptation focuses, in particular, on minimising exposure and building resilience to climate change impacts, an equitable approach is of utmost importance. Adaptation policy scholarship is ample and fragmented, making it hard for policymakers to stay well-informed. Machine-assisted systematic evidence reviews allow to identify the main patterns and gaps in the literature.

With mounting popularity of *intersectional feminism* and *climate justice* in both academia and activism, it begs further investigation into whether increasing women participation rates in science can have broader positive effects. Contrary to a prejudiced belief that women are inherently more caring and should thus focus their academic efforts on related topics, the hypotheses are supported by the assumption that women are socialised as a minority, and hence more attuned to the needs of other underrepresented groups. Consequently, it is believed that women scholars are more likely to integrate justice concerns in the scholarship relevant to policy making in climate change adaptation. This paper presents a systematic review of the climate change adaptation policy scholarship, which is rooted in machine-assisted methodology for gender estimation and thematic space analysis. By applying a mixed method for gender prediction from the first name and Structural Topic Modelling (STM) approach for identifying topical trends in the text corpus, I investigate the relationship between the gender variables and topic prevalence values for topics related to the conceptual framework of *climate justice*. The results support the argument for higher representation rates and more welcoming conditions for women researchers, especially in climate science, as they reveal a positive effect of author gender being estimated as female and the topic proportion of topics such as *Pathways to Equity, Local Communities, Gender, Food Security,* and *Displacement and Mobility*. This work further highlights the gaps in climate change adaptation policy research associated with underrepresentation of the voices and interests of various minority groups. Finally, the findings presented here confirm previously outlined patterns in gender disparities in academia.

The novelty of this work lies in implementing empirical evidence synthesis methods for testing intersectionality arguments from theoretical feminist literature.

## Introduction (750)

## Methods (1750)

## Results (5000-3200)

The analysis described in this paper consisted essentially of three distinct parts: gender

prediction, topic modelling and analysis of the relationship between an author’s gender and the

topical output of a research paper. Hence, this section presents the results of the analysis

arranged in a similar manner, where I first describe the gender composition of the chosen

scientific subfield, then its thematic landscape, and finally, the causal links present between the

two.

**5.1 Description of the results: gender composition**

In line with previous findings from different academic subfields (González-Márquez et al.,

2023; Larivière et al., 2013; Nielsen et al., 2017; West et al., 2013), I find climate change

adaptation policy scholarship to be male-dominated, as depicted in Figure 4. In reality, the

numbers could be slightly worse due to the upward bias of the tool used for gender estimation

towards prediction of ‘female’ authorship instances as described in the subsection 4.2 of this

paper; or slightly better, if names disregarded due to ambiguous gender estimations do indeed

more often belong to women researchers, similarly to the records of initials instead of full first

names; or rather comparable to the ones captured here if the described effects cancel each other

out.

Particularly, I find the last author position to be largely held by men researchers - 70.27%,

compared to 29.73% of women. As the last authorship in natural and social sciences usually

corresponds to the project supervisor or the head of the working group, this finding illustrates

once again the ‘leaky pipeline’ problem, where gender parity is lower in higher career stages.

One potential caveat of this judgement is that in some scientific fields such as economics, it is

common practice to list the authors in the alphabetical order. However, if the query did in fact

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match documents from such disciplines, the number 29,73% for women in leading academic

positions is even lower in reality. Among the first authorship instances, representing the authors

who often contribute most to the conceptualisation and assume most of the work for the project,

39.04% are predicted to be women, and 61.96% men. This is a higher women participation rate

than for the majority of the scientific disciplines described before, with the exception of, for

instance, the subfields in medical research related to ‘care’ and veterinary medicine or, in

sociology, - those related to sociology of the family and gender (González-Márquez et al.,

2023; West et al., 2013). It is also higher than the share of women contributing authors in the

IPCC AR6, which was equal to 33%. As the IPCC assessment reports synthesise knowledge

from 3 major areas (corresponding to the 3 working groups): science, impacts, and mitigation;

women are least represented in science (27%), most represented in impacts (40%), and quite

poorly represented in mitigation (31%) (Liverman et al., 2022). Considering that the field of

climate change adaptation policy falls under the umbrella of ‘impacts’, the subset of documents

I am working with, and the estimated authors’ genders seem to be in harmony with the levels

of women participation in the broader context of climate scholarship. Intuitively, the relative

number of papers where most authors are predicted to be female is even lower, at only 23.34%.

This is a worrying number as it indicates a possibility of *token participation* of women

researchers in a lot of projects. A situation where female researchers are part of the process but

are indeed discouraged from expressing their opinions or are facing additional pressure in the

form of increased competitiveness is not uncommon in a male-dominated environment as men

are reported to be more oblivious to the challenges that women are facing and oftentimes fail

to adjust the processes in an appropriate way (Liverman et al., 2022).

**Figure 4.** Relative representation of

female and male authors for the first and

last authorship instances, as well as for

the majority in a research group for the

climate change adaptation policy

scholarship. The numbers are provided

as percentages from the authorship

instances where an unambiguous gender

estimate could be assigned.

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These results appear in a more alarming light when one also considers the dominant

collaboration patterns. The previous evidence on women participation and collaboration

practice in science has been heterogeneous and field-specific (Boschini & Sjögren, 2007;

Ghiasi et al., 2015; Holman & Morandin, 2019; Jadidi et al., 2018; Kwiek & Roszka, 2021).

Hence, I asked myself the following exploratory and supplementary questions:

*(a) Are women in climate change adaptation policy research more likely to lead a paper*

*under a woman’s supervision?*

*(b) Do male research project supervisors tend to work in majority male groups?*

I attempt to answer them in reference to the descriptive statistics of the dataset. As these did

not focus on the predictive power of author gender for topic definition, they were studied in

much less detail, with no implementation of controls. However, a simple investigation of the

numbers has revealed that among the women first publishing authors, 41,75% published with

a female supervisor. Inversely, 54,09% of female supervisors worked with a female first author,

whereas only 32,70% of male supervisors published with a female first author. And among the

men first authors, only 22,85% published with a female supervisor. Furthermore, only 7,32%

of male supervisors publish with research teams where the majority of authors are women,

compared to 58,68% of female supervisors. Of course, these numbers do not necessarily speak

of the preference of men to work with men in academia, as they are skewed by the general

underrepresentation of women both in the first, and, especially, in the last author position.

However, they do underline discriminatory tendencies ever-present in the academic field.

Previous studies have shown that men do indeed tend to be less mindful of the gender gap and

of the implications of a male-dominated working environment on women’s ability to express

themselves; and that women academics particularly lack sufficient and healthy supervision

from senior colleagues (Gopinathan, 2007; Liverman et al., 2022). With the reality being that

men still occupy most of the senior positions in academia, they should be driving positive

change rather than reinforcing the implicit bias.

Overall, these results show a slightly more positive picture than those described before and

corresponding to different time periods and scientific fields. However, they also provide further

evidence of the persistent gender gaps and highlight the importance of further work towards

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tackling this issue. In other words, these findings are a confirmation of that we are not quite

there yet in achieving gender equity in science. The need for continued efforts towards tackling

gender-based discrimination is especially pronounced for developing countries, as women

there are more likely to experience intersecting discriminating pressures.

**5.2 Description of the results: STM outputs**

Topic modelling is often applied to explore general trends in textual data. Here, I ran topic

modelling on titles, abstracts and keywords, which is common for analyses on large corpora

(González-Márquez et al., 2023; Sietsma et al., 2021). This could potentially result in omitting

more nuanced topics but, at the same time, it allows us to consider specifically the topics

dominant in the research agenda of each project. I applied structural topic modelling to

investigate dominant themes in the climate change adaptation policy literature, identify topics

responsive to one or more of the concepts central to the climate justice approach, and the

publications closely associated with these.

In line with previous findings indicating a recent increase in social scientific research within

the climate adaptation literature and a lag in ‘solutions’ - oriented research (Sietsma et al.,

2021), I find the thematic landscape of the climate change adaptation policy scholarship is quite

heavily technical and ‘problem’- rather than ‘solution’- focused. However, several prominent

topics are formed that can be seen as corresponding to ‘enabling’ responses. These include

*Urban Planning, Water Management, Climate Strategy, Resource Management, Pathways to*

*Equity, Adaptation, Carbon Capture and Storage (CCS), Climate Finance* and *Green Energy*,

as can be seen in the Supplementary Table 5. Social sciences are mostly represented by the

following topics: *Socio-Economic Vulnerability, Pathways to Equity, Adaptation, Climate*

*Finance, Governance, Decision-Making, Policy, Public Perception, Displacement and*

*Mobility, Economic Analysis, Local Communities, Gender, Tourism* and *Culture.* Several

topics are harder to classify as they correspond to interdisciplinary areas, such as *Climate Risks,*

*Climate Strategy, Resource Management, Mitigation* and *Knowledge.* That being said, I do not

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analyse temporal or geographic trends in topic prevalence in this work as these are very well

summarised in a recent paper on global developments in adaptation research (Sietsma et al.,

2021).

The literature that deals with disproportionate climate vulnerability can potentially be both

about climate impacts and how they are currently being distributed or about strategic

approaches towards eliminating the systems of oppression or at least avoiding their

reinforcement in the climate governance arena. Hence, these aspects can also be brought up in

technical literature or literature from natural sciences, and publications describing the

‘problems’ rather than ‘solutions’. However, they largely correspond to the thematic course of

social sciences and literature on *enablers*. Overall, I was able to identify 7 and 8 topics

depending on the dataset, that were related to distributive, or procedural justice, or recognition,

in the light of climate adaptation governance. Topic labels corresponding to these are the

following, in the order of their prevalence in the text corpus: *Pathways to Equity, Socio-*

*Economic Vulnerability, Local Communities, Food Security, Gender, Displacement and*

*Mobility, Developing Countries,* and *Island Territories.* The most frequent terms for each of

these topics are captured in the Supplementary Tables 1,3 and 5. As described above,

*Displacement and Mobility* was not identified as a separate topic in the dataset with inferred

gender of the first author, and the keywords associated with the topic in two other cases were

observed as associated with such topics as *Island Territories, Developing Countries, Gender,*

and *Local Communities.*

Thus, I observed some of the expected topics in the corpus, but far from all. For instance, there

was no topic that would clearly focus on racial injustices in the context of climate change

adaptation, which quite possibly indicates a gap in this field of research. While indigenous

peoples and grassroots communities have been explicitly covered, alongside general socioeconomic

vulnerability topics, this was not the case for specific issues related to racial

injustices within developed/developing countries. Another topic that seems to be omitted

altogether, at least at this level of granularity, is *intergenerational justice*. Despite the centrality

of the concept to climate discourse, it does not appear to hold a steady position among the

scientific publications on climate change adaptation governance. Other socially marginalised

groups that have not found prominent representation in climate change policy adaptation

research were the LGBTQ+ community, differently abled persons and caregivers. It is quite

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possibly still unclear how climate adaptation policies could particularly disadvantage these

minority groups. Another reason for omission of these topics could be the pursued level of

granularity for this work. In other words, this could be an indication that these topics are

significantly less prominent, but not necessarily non-existent.

**5.3 Description of the results: effects of metadata**

The novelty of this work lies primarily in the quantitative analysis of the effects of an author’s

gender on the topical output of their research. In a recent work that followed rather similar

methods but investigated biomedical scholarship, Gonzàlez-Màrquez et al. have shown that

women researchers are more represented in research on nursing, education and psychology, but

are severely under-represented in disciplines related to engineering and, for example, surgery

(González-Márquez et al., 2023). However, to my current knowledge, a similar investigation

into climate literature does not exist up to the present date.

Of course, there are multiple factors at play in choosing one’s specialisation or a specific

research topic. This means the effects of an author’s gender on the research agenda they pursue

could easily be overestimated. Namely, there are varying levels of gender discrimination or the

“hostility” of certain academic fields towards women researchers, as well as there are certainly

inherent social pressures on women to be involved more in ‘care’ - related domains. However,

with the implementation of controls, I believe, I can estimate the specific effects of an author’s

gender on the topical content of their publications conceivably accurately. It is important to

mention, nevertheless, that this work does not aim to argue that men and women possess any

inherent qualities that make them more or less likely to choose any topic. Rather, that the

patriarchal structures have made it easier for men to ignore tackling persistent injustices

compared to women. Potential limitations to the validity of these findings are discussed in more

detail in the subsection 4.5 of this paper.

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Here, I applied the built-in functionality of the **R** package for STM to estimate the effects of

the author’s gender, the gender inequality index of the country of their affiliation, and the

impact factor of the journal where the study was published, on the topic proportions for each

of the topics considered relevant for *climate justice*. Hence, this subsection successively

presents the results corresponding to each of these variables, as well as to their interactions.

**Figure 5.** Mean effect of

the first author gender on

the topic proportion relative

to the mean topic

prevalence in the corpus

with 95% confidence

interval. The topics are

arranged by topic

prevalence in the corpus.

Intuitively, the effects of the author’s gender on topic prevalence in their publication vary in

size based on the topic we are investigating and the author’s position. Generally, the topic

proportions in the dataset are quite different for each of the topics, hence, the results are

presented as relative differences rather than absolute changes in topic proportions. For the first

author gender, Figure 5 presents the mean difference in topic proportion, while the

Supplementary Figure 2 shows the topical space reduced to 2 dimensions. For most of the

topics, I observe statistically significant differences in topic proportions based on the gender of

the first author at the level 95% confidence, with higher topic proportions associated with

women authorship instances. These include, namely, *Pathways to Equity, Local Communities,*

*Gender* and *Island Territories*. Furthermore, topics such as *Socio-Economic Vulnerability* and

*Food Security* also appear to be positively correlated with female authorship, but the confidence

interval reaches 0, meaning that the effect could be insignificant at the 95% level of confidence;

whereas the topic labelled *Developing Countries* does not seem to be affected by the gender of

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the first author. With the first author usually being the conceptual mind behind the project,

these results support the notion of that women initiate more research projects that include

*climate justice* topics. The null hypothesis is rejected for 4 of the 7 topics at the confidence

level of 95%; and *H1* that female researchers in the position of the first author include *justice*

topics in their research on climate change adaptation policy more often than male researchers

in the same position is accepted.

**Figure 6.** Mean effect of the

last author gender on the

topic proportion relative to

the mean topic prevalence in

the corpus with 95%

confidence interval. The

topics are arranged by topic

prevalence in the corpus.

If we now turn to the last author gender, Figure 6 and the Supplementary Figure 4 tell a slightly

different story. Here, I observe a significant positive effect of the last author’s gender being

estimated as female on the topic proportions of the topics labelled *Pathways to Equity, Socio-*

*Economic Vulnerability, Local Communities, Gender, Displacement and Mobility*, and *Island*

*Territories*. The effects on topics associated with *Food Security* and *Developing Countries* are

insignificant at the confidence level of 95%. Notably, the effect on *Pathways to Equity* topic

prevalence is even higher for the last author’s gender compared to the first author’s gender.

Hence, the null hypothesis is rejected for 6 out of 8 topics at the 95% confidence level; and *H2*

that female researchers in the position of the last author tend to include *justice* topics in their

research on climate change adaptation policy more often than male researchers in the same

position is accepted.

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**Figure 7.** Mean effect of

the last author gender on

the topic proportion

relative to the mean topic

prevalence in the corpus

with 95% confidence

interval. The topics are

arranged by topic

prevalence in the corpus.

With reference to the gender composition of the full author group, the mean effects on topic

proportions of the relevant topics are depicted in Figure 7, whereas the topical space reduced

in dimensionality to 2 dimensions is shown in the Supplementary Figure 6. Therein, the mean

positive difference in topic proportion for the topic *Pathways to Equity* is even larger compared

to the effects of the first or the last author’s genders. Rather similarly to what was described

above, I also observe positive significant effects of the majority author gender being predicted

as female on the topic prevalence of *Local Communities, Health and Gender, Food Security,*

and *Displacement and Mobility* at the 95% confidence interval. On the other hand, *Socio-*

*Economic Vulnerability, Developing Countries* and *Island Territories* do not appear to be

significantly positively correlated to the gender of the majority of the research group being

estimated as female. Thus, the null hypothesis is rejected at the 95% confidence interval for 5

out of 8 topics; and *H3* that research groups predominantly comprised of women researchers

pursue *climate justice* topics more often than those comprised predominantly of men is

accepted.

From the images of the topical spaces, one can infer that the *climate justice* topics are rather

tightly related. In this manner, document clusters associated with *Pathways to Equity, Gender,*

*Socio-Economic Vulnerability,* and *Island Territories* appear close to one another in all three

visualisations. In the Supplementary Figure 2, the evidently higher saturation of female62

authored articles in the part of the graph covering *climate justice* topics is a visual

representation of the quantitative results described above. In the Supplementary Figures 4 and

6, however, the trend is less obvious due to general underrepresentation of women in the last

author positions and as majority of the group. Still, where female authorships do occur is more

often in the same topical space. The representations of the topical spaces can also be found in

a higher resolution in the public repository as described above.

For each of the datasets, I also calculated the effects on topic proportions of the control

variables, such as GII and journal impact factor, before analysing their interactions with the

gender variables. Both the gender inequality index and the journal impact factor values were

split into quartiles and further treated as categorical variables, whereby in the regression

calculation each category got a dummy variable, and the effects of each category were

measured against the first category, or Q1. As described above, for the GII data, Q1 represented

the lowest GII values; and for the journal impact factor data, Q1 represented the highest journal

impact factors. The quartiles had been calculated specifically for the values present in the

dataset. Across the datasets, lower GII is unanimously associated with a significantly higher

topic proportion for *Pathways to Equity*, and lower topic proportions for *Socio-Economic*

*Vulnerability, Food Security, Developing Countries* and *Gender*. The effects on other relevant

topic proportions are statistically insignificant. By contrast, higher journal impact factor values

are associated with lower topic proportions for *Local Communities, Gender* and *Island*

*Territories*, which again highlights previous findings on bias against research on gender bias

(Cislak et al., 2018). The effects on other topic proportions are negligible. The effects of control

variables across the studied datasets are presented in the figures that can be found in the public

repository.

In order to isolate the effects of author gender from other interfering factors, such as in this

case the gender inequality in the country of the institutional affiliation, and the journal impact

factor of the publication, I further examined the interaction coefficients for the gender variables

with GII quartiles and journal impact factor quartiles. Here, the patterns I observe are only

somewhat similar across the three studied datasets. Generally, introducing interactions with

lower GII values (Q3 and Q4) significantly reduced the positive effects of gender variables on

representation proportions of topics associated with *climate justice*, and increased the

uncertainty intervals. However, for the first author gender, the interaction with the Q4 of the

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gender inequality index effectively eliminated any positive effects of female authorship,

whereas the effect persisted for topics on *Pathways to Equity* and *Gender* for the variables

representing the last and majority author genders. The interactions between the gender

variables and the highest GII values are depicted in the Supplementary Tables 7-9. Interactions

of the gender variables with the journal impact factor values introduce virtually no variability

to the results, apart from the increased uncertainty intervals.

Overall, the results, even if not entirely homogenous, indicate a positive statistically significant

effect between conceptual and supervising author being a woman, as well as the majority of

the research group being women, and the inclusion of climate justice topics into their agenda.

The variation in the results is attributed to the level of authority or effective power different

authorship positions are associated with.

## Discussion (750-500)

The omnipresence of implicit bias in social structures makes it particularly difficult to

disentangle specific causal effects of the author’s gender on topic preference. Hence, as its

author, I acknowledge that the results put forward in this paper may inherit the implicit biases

present in academia. In other words, one must interpret the results of this analysis with caution,

and keep in mind the limitations described above, as well as the precision metrics of the

implemented tools.

As has been demonstrated, the rate of women participation in research on climate change

adaptation policy at approximately 39% is higher than for other previously analysed scientific

areas. However, it drops significantly with a higher status - only roughly 30% of project

supervisors in the field are predicted to be female; and the observed collaboration patterns

further highlight the gender gap persistent in climate science. Furthermore, with some topicspecific

variability, justice considerations appear to dominate the agenda mostly for articles

authored by women, as hypotheses suggest. Hence, this analysis supports the centrality of

intersectional feminism to the adoption of climate justice framework in related research.

I am aware of the possibility that the findings presented here could be misinterpreted and

misused to support the argument that the level of scientific expertise somehow varies by gender

or that the gender of an author of a scientific article in any way affects its validity. On the other

hand, as set out in the beginning of the paper, I firmly believe that encouraging diversity in

research teams as well as in policymaking processes ensures higher cognitive ability,

inventiveness and fairness of the procedures and outputs. Furthermore, I completely disagree

with the idea of evaluating any scholarly work, or any work for that matter, based on the

person’s gender.

I would also like to highlight that a qualitative analysis is recommended to assess causal links

between author’s gender identity and the topical output of their research. An in-depth review

of the articles associated with climate justice topics would be necessary to be able to say to

which degree these are representative of the interests of the socially marginalised groups.

Another interesting aspect of this relationship, which is not covered in this analysis, is the

funding source and its causality on the topical contents and research group characteristics.

Regarding the methods described here, they can be replicated and applied to different datasets,

as well as enhanced through implementation of a different gender estimation tool or further

machine-assisted topical classification as described in previous literature.

Finally, unless an in-depth qualitative study is conducted, one cannot judge whether the effect

on topic proportion does indeed relate to the author’s gender and associated levels of awareness

towards the needs of the socially marginalised groups, or to the phenomenon of being

‘ghettoed’ to ‘more’ or ‘less’ scientific subfields based on the scholar’s gender by the dominant

practices.

Overall, this study presents a first insight into the topical space of the climate change adaptation

policy literature, where links between the author’s gender and prevalence of topics related to

the climate justice framework are outlined.