

Journal of Geoethics and Social Geosciences, 03, Special Issue, 2025; doi:10.13127/jgsg-80

Assessing gender distribution in Engineering Geology and Hydrogeology disciplines in Italy, with a focus on academic career progression and scientific productivity

Emma Petrella¹, Elena Del Gaudio², Rita Tufano^{*,3}, Monica Papini⁴, Daniela Ducci⁵

Article history: received May 6, 2025; accepted September 18, 2025; published September 26, 2025

Abstract

The European Union's strongly focuses on gender equality through policies like the Gender Equality Strategy 2020-2025 and the 2025 Roadmap for Women's Rights. Despite progress in gender equality policies across the EU, women still encounter major obstacle in Academia, especially in the STEM field. This study examines possible gaps in Engineering Geology and Hydrogeology disciplines in Italy, with a focus on academic career progression and scientific productivity.

Data collected from the MUR-CINECA database (2001-2024) and SCOPUS (2014-2024) show that women continue to be underrepresented in all Academia stages, covering only 19.3% of Full professors, 29.6% of Associate professors, and 30.6% of Researchers. Additionally, analysis of publication metrics shows that especially at the Full professor level, female academics exhibit scientific productivity that are comparable to – or even higher than – those of their male colleagues. However, women usually have lower

1

¹ Dipartimento di Scienze Chimiche, della Vita e della Sostenibilità Ambientale, Università di Parma, Italy

² Centro Interdipartimentale Ricerca Ambiente (C.I.R.AM.), Università degli Studi di Napoli Federico II, Italy

³ Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università degli Studi di Napoli Federico II, Italy

⁴ Dipartimento di Ingegneria Civile e Ambientale, Politecnico di Milano, Italy

⁵ Dipartimento di Ingegneria Civile, Edile e Ambientale, Università degli Studi di Napoli Federico II, Italy

H-index values and less last-author positions, suggesting possible barriers to research recognition and leadership opportunities.

Through an anonymous survey among female Engineering Geologists and Hydrogeologists, it emerges that about 60% of women have experienced of workplace discrimination, while 38% of mothers felt their careers were temporarily sidelined during maternity periods. Women reported difficulties with work-family balance, due to decreased involvement in research networks, and limited access to fieldwork opportunities.

The findings indicate that solving gender inequality requires actions that attend not just to representation numbers, but also to the nature of roles, recognition and research leadership opportunities combined with National/European laws that protect women during maternity periods.

Keywords: Gender inequality, Academic career, Bibliometric indicators, Engineering Geology, Hydrogeology.



1. Introduction

Gender equality between women and men is a core principle and a shared value established in European Union law. Throughout the years, the EU has made considerable progress in fostering gender equality, developing a progressively refined policy framework through successive strategies, roadmaps, and action plans. The Gender Equality Strategy 2020-2025 has been crucial in outlining gender equality policies and encouraging cooperation at all levels and across various policy areas. This policy framework has enabled the EU to make advancements on the commitments made 30 years ago in the Beijing Declaration and Platform for Action. On March 7, 2025, the European Commission adopted the Roadmap for Women's Rights (European Commission, 2025). This Roadmap presents a long-term vision for achieving gender equality, based on key principles and policy goals outlined in the Declaration of Principles for a Gender-Equal Society (Annex to the Roadmap on Women's Rights in European Commission, 2025). Its aim is to protect and advance women's rights, while addressing emerging challenges in gender equality, such as technology-driven bias, discrimination, and violence. The Roadmap sets a political framework for women's rights within the EU, guiding actions in the years to come.



The Commission invites the European Parliament, the Council and other European institutions to endorse the Declaration of Principles for a Gender Equal Society in the course of 2025 and to join this commitment. The Commission also invites other institutions, Member States, social partners, civil society organizations and other stakeholders to play an active role in implementing the principles and objectives of the Roadmap and to propose measures at the appropriate level.

Although significant progress has been made in recent years, gender discrimination and the employment gender gap continue to persist in numerous countries globally. Recent estimates from the ILO (International Labour Organization) indicate that women are still far from attaining full gender equality in the workforce¹. In many regions, they remain confined to lower-skilled and lower-paying roles compared to men. As an example, software engineering profession in Europe is limited to only 20% of female, and this percentage decreases to 5.17% worldwide (Jaccheri, 2024). In Italy, the gender earnings gap (calculated as the difference between the median earnings of men and of women relative to the median earnings of men) is decidedly below the OECD average (OECD, 2023).

Looking at figures for the academic world, appear clear a different distribution of men and women, especially in high level positions (Smith, 2025), with significant deviations in consideration of the research area (i.e., humanities, social sciences and natural sciences), as demonstrated in the Netherlands (van Norel, 2013). In Italy, women are significantly underrepresented in the university positions, accounting for one-third of the academic population, with a female representation in PhD graduates and full professors close to the EU average (Abramo et al., 2021; Falco et al., 2023). Gender disparity is more critical in STEM (Science, Technology, Engineering, and Mathematics) disciplines (Casad et al., 2021; Adambayev, 2024), with women underrepresented in higher academic and corporate positions (Rosa and Clavero, 2021), despite brilliant academic careers as student. Agnini et al. (2020) points out how gender balance varies by discipline: Paleontology shows female dominance, Mineralogy approaches parity for associate professors, while other geological fields maintain significant gaps. Moreover, the study reveals an alarming Glass Ceiling Index increases in Southern Italy, contrasting with improvements in Northern and Central regions.

Ross et al. (2022) demonstrate that women receive less credit than men: they are consistently less likely to be listed, as authors on academic articles and patents. The study is very solid and rigorous, based on a dataset that includes 17,929,271 possible article authorships and 3,203,831 potential patent inventorships. The analysis includes the date of the article or patent (by calendar year and month),

¹ https://www.ilo.org/resource/news/achieving-gender-equality-employment-rates-would-take-almost-two-centuries (accessed 17 September 2025).

whether the individual is a principal investigator (PI), the number of days worked on the team, job title, and fixed effects for each team.

In recent years, this topic has been addressed, with regard to Earth Sciences, by the women of the IUGS (International Union for Geological Sciences) and, in Italy, by the PANGEA group, a large network of Italian women geoscientists forming a Division within the Italian Geological Society². This group organizes a series of events on the topic at various locations across Italy.

In this context, the present study explored the situation of women in research in a specific STEM discipline in Italy: Engineering Geology and Hydrogeology. In the field of geology, women face problems mainly related to be considered less suitable for fieldwork and less available to participate in field trips and summer schools, often including overnight stays. These barriers related to geological careers are further reinforced by stereotypes associated with engineering disciplines which are considered even more as a male discipline, not suitable for women.

The article starts with historical data and proposes points of reflection for the future.

2. Material and methods

For the development of this research, an exhaustive systematic data acquisition was performed using the Italian Ministry of University and Research database (MUR-CINECA database). From this platform, we collected data regarding the number of individuals affiliated with the Engineering Geology and Hydrogeology scientific disciplinary field. The data were extracted and organized in chronological order to analyse trends in gender representation and related career progression over time from 2001 to 2024.

Moreover, to analyse scientific productivity, the SCOPUS database was utilized. The reference period for this analysis spans from 2014 to 2024. Productivity metrics obtained for each affiliate were first categorized by academic categories (e.g., Full professors, Associate professors, Researchers). Then within each group, the data were further subdivided considering authors' gender.

Statistical analyses were then performed on these categorized data. We specifically used the median value as our primary statistical measure, so that extreme values (outliers) would minimize their effects and the obtained values would more accurately represent the average gender productivity across various academic categories. This methodological choice enabled us to reach robust conclusions about gender-based productivity patterns, while minimizing the influence of exceptional cases.

² Email: divisionepangea@socgeol.it.



Additionally, to assess the actual state of discrimination, prejudice, and challenges faced by women, it was conducted an anonymous survey, using Microsoft Forms, among female belonging to geological engineering and hydrogeological sciences. The survey which consisted of 11 questions (including 2 open-ended ones) (see Annex 1), was distributed through Engineering Geology and Hydrogeology group networks, with significant support from AIGA (Italian Association of Engineering and Environmental Geology) and IAH Italy (International Association of Hydrogeologist, Italian section). A categorization note is necessary regarding the Researcher academic position, which varies significantly during the analysed 20-years. Thus, with this term we include both permanent researchers and non-permanent researcher position (called RTD-a and RTD-b according to Italian law n.240/2010) as well as the recent researcher category (called RTT) which essentially comparable with a tenure track associate professor position in other countries (according to the Italian law 72/2022).

3. Academic career progression of women in Engineering Geology and Hydrogeology

An analysis of academic career progression in Engineering Geology and Hydrogeology in Italy over the past two decades (2001-2024) reveals significant trends, not only in the overall numbers but also in gender distribution (Figure 1a). Despite some improvements in the total number of professors and researchers, gender disparity remains a persistent issue, especially at higher academic ranks and in research positions. The underrepresentation of women at senior academic levels is and continues to be a major concern.

Over the past two decades, the number of Full and Associate professors has fluctuated significantly (Figure 1b, c). Between 2001 and 2007, the number of Full professors increased, followed by a sharp decline between 2008 and 2013. This decrease was likely due to structural changes in Academia, hiring freezes, and economic constraints that impacted faculty recruitment. After 2013, recovery began, with a more pronounced increase after 2017. A similar pattern was observed among Associate professors, where stability characterized the early 2000s, followed by a significant drop between 2008 and 2013. Recovery started in 2014, accelerating after 2020, leading to a record high of 71 Associate professors in 2024.

For Researchers (Figure 1d), the overall number followed a similar trend. In 2012-2013, the peak was reached with 70 Researchers. After 2013, the number decreased to 50 by 2020, but began to rise again in subsequent years, reaching 69 Researchers by 2023, before slightly declining in 2024.

Despite overall growth in academic positions, gender disparities are evident at every level of the academic career pipeline. Until 2003, there were no female Full professors, and even in recent years, their numbers have remained extremely low, peaking at only seven in 2021. The situation is slightly better among Associate professors, where female representation has increased from single digits in the early 2001s to 22 in 2024. However, men still hold most of these positions.

In the Researcher category, while the number of women has gradually increased, they have never constituted more than one-third of the total Researcher workforce. In 2001, women made up only 20% of the Researcher pool (12 out of 60), but their numbers grew, reaching a peak of 23 in 2018. However, post-2020, the number of female Researchers declined again, highlighting the ongoing challenges women face in advancing their academic careers.

Figure 1 illustrates that, while progress has been made, women are still significantly underrepresented in senior academic roles, particularly among Full professors and Researchers. Gender disparities persist across all levels of the academic career

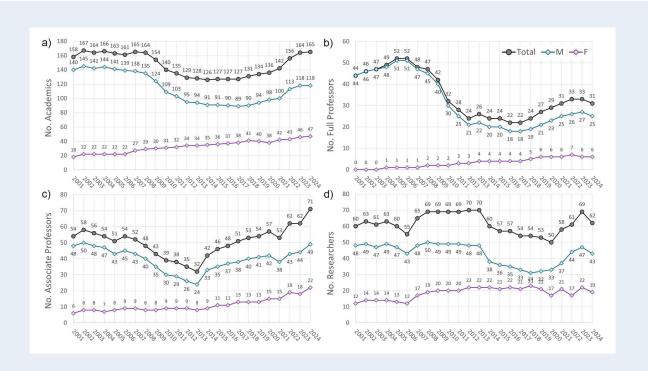


Figure 1. Temporal trends in the number of academic positions in Engineering Geology and Hydrogeology in Italy from 2001 to 2024, for total and divided by gender (M = male; F = female) and academic rank: a) total academics, b) Full professors, c) Associate professors, and d) Researchers.



ladder, with men continuing to dominate both senior academic positions and research roles. The slow growth of female representation underscores the need for targeted institutional policies and structural reforms to ensure women have equal opportunities to advance, from Researcher positions to full professorships. It is essential that policies be adopted to promote greater inclusivity and support women's career advancement at all academic levels, in order to foster a more equitable and diverse environment within Engineering Geology and Hydrogeology field.

The gender distribution in Engineering Geology and Hydrogeology disciplines in Italy, therefore, shows a persistent gender disparity over time and across all academic ranks. This could partially be due to the nature of the discipline, which is very technical with extensive fieldwork requirements that may not appeal to women. A partial support for this assertion can be found by examining both graduation data, where historically women have been underrepresented in STEM fields, and PhD students, where in 2024 women accounted only for 36.8% of basic sciences doctorates and 31.7% of engineering doctorates (Alma Laurea, 2025). Moreover, according to the CINECA website, regarding the 2025 Research Fellowship limited to the disciplines of Engineering Geology and Hydrogeology, men account for over 60%, while women make up less than 40% (41 men and 27 women).

4. Gender representativeness and scientific productivity in Engineering Geology and Hydrogeology

The analysis of gender representation in Engineering Geology and Hydrogeology reveals a complex and troubling scenario of academic dynamics (Table 1), outlining a clear gender discrepancy across all academic positions. Despite the growing awareness and sensitivity regarding gender balance in Academia, the data surprisingly show a concerning inequality already at the Researcher level (Table 1). This evidence could be interpreted as the result of an intrinsic feature of the discipline, perceived as strongly male-oriented and therefore typically less chosen by women, as previously

Gender		Number		Percentage (%)			
	Full Professor	Associate Professor	Researcher	Full Professor	Associate Professor	Researcher	
Man	25	50	43	80.7	70.4	69.4	
Woman	6	21	19	19.3	29.6	30.6	

 Table 1. Numbers and gender percentages by academic position.

observed. On the other hand, it could indicate that gender disparities are firmly rooted from the earliest stages of the academic career, despite contemporary efforts to address gender equality issues.

Associate Professors show a similar trend, with female representation standing at just 29.60%. The situation becomes even more critical in the category of Full Professors, where female representation drops to as low as 19.35%, highlighting a worsening gender disparity along the academic career ladder and an increasing underrepresentation of women at the highest levels.

This overall picture highlights not only the disparity across different academic levels, but also the persistence of gender inequalities across generations, with the risk that such dynamics may be perpetuated and further consolidated over time.

5. Scientific production by women in Engineering Geology and Hydrogeology

To better understand potential gender differences, this study considered not only numerical representation but also differences in scientific productivity between men and women. Scientific output was analysed in terms of the total number of publications, editorial preferences, and authorship roles. In addition, the H-index was used as a bibliometric indicator to more accurately assess the productivity and impact of scientific authors.

5.1. Publication performance

Except for Researcher category, Full and Associate professors show significant differences in terms of scientific productivity (Figure 2 and Table 2).

Concerning Full Professors (Figure 2a and Table 2), the median per capita values show that women demonstrate significantly higher publication rates than their male counterparts across most categories. The total number of publications (median per capita: 63 for women vs. 51 for men) represents approximately a 24% higher rate for women. This higher productivity is also evident in journal papers (45 for women vs. 40 for men) and conference papers (9 for women vs. 7 for men), while both groups produce the same output in the "Other" category, which includes book chapters, reviews, and editorials.

Results for male Associate Professors (Figure 2b and Table 2), based on median values, show a total of 39 publications per capita, consisting of 32 research articles, 3 conference papers, and 4 other types of publications (e.g., reviews, book chapters,



Academic Rank	Values .	Total pu	blication	Pa	per	Conferen	ice Paper	Ot	her	
		Number								
		М	W	М	W	М	W	М	W	
Full Professor	Min	23	19	13	13	0	4	1	1	
	Max	216	107	179	78	33	27	37	13	
	Median	51	63	40	45	7	9	5	5	
Associate Professor	Min	5	7	2	3	0	0	0	0	
	Max	139	74	109	56	33	30	29	14	
	Median	39	34	32	27	3	3	4	2	
Researcher	Min	0	11	0	9	0	0	0	0	
	Max	75	52	67	40	23	7	8	9	
	Median	22	22	19	18	1	1	2	1	

Table 2. Minimum, maximum and median values of different types of publications are separated for gender group (M = man; W = woman) and academic role.

editorials). In contrast, female Associate Professors, according to the median, have published 34 works, including 27 research articles, 3 conference papers, and 2 other types of publications.

Notable differences appear when considering the minimum and maximum number of publications. For men, the total number of publications ranges from 5 to 139, with research articles varying between 2 and 109, conference papers between 0 and 33, and other types of publications between 0 and 29. For women, the total number of publications ranges from 7 to 74, with research articles between 3 and 56, conference papers between 0 and 30, and other types of publications between 0 and 14.

Concerning Researchers, the results in Figure 2c and Table 2 indicate that both men and women produced a median of 22 publications per capita. Specifically, when analyzing the median values by type of publication, men published 19 research papers compared to 18 for women, 1 conference paper each, and 2 other types of publications (e.g., reviews, book chapters, editorials) for men versus 1 for women. In this case, no relevant differences appear between the two groups. However, more pronounced differences emerge when considering the minimum and maximum values of publications: men range from 0 to 75, while women range from 11 to 52. More specifically, men published between 0 and 67 research papers, 0 and 23 conference papers, and 0 and 8 other publications, whereas women published between 9 and 40 research papers, 0 and 7 conference papers, and 0 and 8 other publications. Looking at these data, an interesting trend emerges: female Full professors significantly outperform their male colleagues in publication output, while female

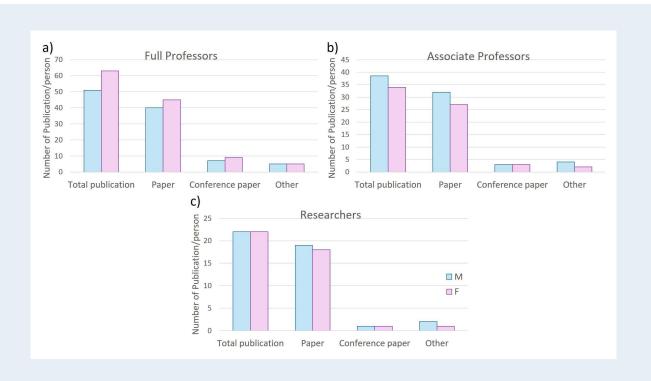


Figure 2. Gender vs. Number and Type of publications across academic categories.

Associate Professors publish slightly less than men, and Researchers show no gender differences.

This likely reflects a "survival of the fittest" effect: the senior women who attained Full Professor status had to be exceptionally productive in earlier generations to overcome historical barriers. By contrast, the younger cohort of researchers shows no productivity gap, suggesting more equitable conditions today, even though women remain fewer in number.

5.2. Authorship

Concerning Full Professors, women have a slightly higher percentage of first-author publications (17% of total output) than their male counterparts (14%; Figure 3a), despite being significantly underrepresented in this position (\sim 20% vs. \sim 80%). This suggests that women who achieve Full Professorship may continue to take a more hands-on role in research compared to men at the same level. This interpretation



is consistent with their higher production of conference papers, which also reflects more direct involvement in the dissemination of research results. Conversely, the gap in last authorship positions (37% for men vs. 33% for women; Figure 3a) indicates that male Full Professors may more frequently occupy research leadership roles or lead larger research groups, positioning them more often in senior authorship roles. Examining the role of Associate Professors as first authors, the median number of first-author publications is 9 for men and 7 for women, representing 17% and 20% of their total publications, respectively (Figure 3b). For men, the number of first-author publications ranges from 0 to 30, accounting for up to 60% of their total output. For women, the range is 1 to 16, corresponding to 2% and 46% of their total publications. These findings suggest an unequal distribution of first-author contributions, with men showing a broader range of productivity in this role.

Regarding last-author contributions, the median value is 9 for men and 5 for women, representing 20% and 14% of total publications, respectively. While the minimum is



Figure 3. Authorship of publications across academic categories.

0 for both groups, the maximum reaches 44 for men and 27 for women, accounting for 67% and 54% of their total publications. This indicates that, although both genders occupy the last-author role, often associated with leadership and seniority, men exhibit a wider range of productivity and achieve higher maximum values than women. Regarding the role of Researchers as first authors in academic contributions (Figure 3c), the median number of first-author publications is 8 for men and 6 for women, representing 33% and 29% of their total productivity, respectively. Both male and female Researchers have a minimum of zero first-author contributions, while the maximum reaches 30 for men and 15 for women.

When analysing last-author contributions, both genders have a median of 1 publication, accounting for 5% of total productivity. The minimum is zero for both groups, whereas the maximum reaches 24 for men and 12 for women.

These results indicate that differences between male and female Researchers are small when considering median values per capita, but the maximum values reveal notable discrepancies. The patterns suggest that even at equivalent academic positions, men and women may experience different role expectations or opportunities within academia.

5.3. Hirsch index

The boxplots in Figure 4 highlight differences in both central tendency and dispersion of H-index scores, indicating gender-based disparities in research impact. Looking to Full professors' category, Figure 4a shows several key insights. Both mean and median H-index values are slightly lower for women (mean and median both 23) than for men (mean 28, median 27). While men show a slightly lower minimum H-index value (11) compared to women (13), they exhibit a wider range and the presence of three notable outliers, indicating individuals with extremely high H-indices of approximately 52, 63, and 72. Notably, there are no outliers in women distribution. This finding related to the authorship underlines that female Full professors appear to maintain more balanced involvement between both initiating research (first author) and supervising research (last author), while male Full professors show a greater inclination towards supervisory roles and the creation of large research groups, which guarantee a greater number of publications and higher values of the H-index. Meanwhile, among Associate professors (Figure 4b), the H-index indicates a slightly higher mean and median for men (21 and 18.5, respectively) than for women (17 and 15, respectively). The men show a greater variability in citation metrics suggesting a more heterogeneous distribution of publication impact. The range for men spans considerably wider than for women, with the highest H-index of 38, while the women's



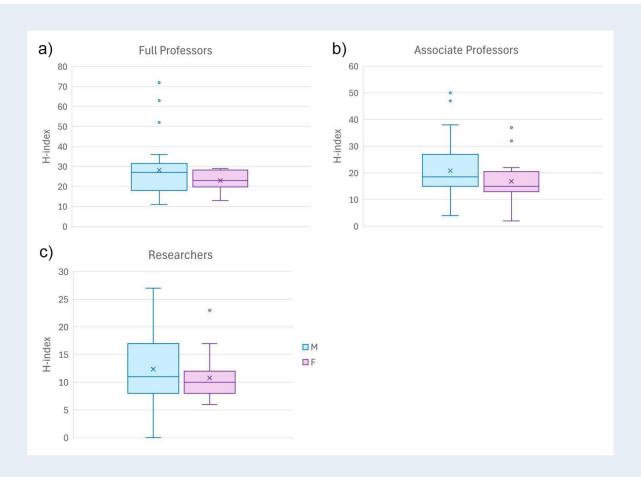


Figure 4. Boxplots showing the Hirsch-index (H-index) distribution for male and female by academic rank: a) Full Professors, b) Associate Professors, and c) Researchers. The median (line), mean (mark) and outliers are also indicated.

distribution reaches only about 22. Both gender groups show outliers, but the males reach significantly higher values (35 and 50), indicating the presence of some male Associate professors with remarkably high citation performance. The lower H-index value appears similar between male and female (around 5-6), suggesting comparable minimum performance thresholds.

About Researchers, the boxplots (Figure 4c) reveal a similarity in mean and median value of citation index between genders, with a value of 12 and 11 respectively for men, and 11 and 10 for women, indicating only a slight gap. Similarly to other categories, results indicate a wider distribution of H-index for men representing exceptionally high and low H-indexes (from 0 to 27). Distribution of H-index for women shows a relatively narrow interval compared to men, with a single outlier (23).

6. Discrimination, prejudice, problems

A total of 20 female colleagues responded to the questionnaire (§2), representing 43.5% of the total female academic population in 2025. Among them, 68% reported experiencing discrimination in their work (Figure 5a), while 58% stated that they did not face discrimination compared to men in accessing their job positions (Figure 5b). 37% indicated that, during their careers, they had received "attention" of various kinds from male colleagues, and in most cases, the male colleague held a higher rank, potentially influencing their future career. 56% of respondents experienced motherhood during their careers, and 17% felt that male colleagues "bypassed" them by taking advantage of their absence or reduced participation in research (Figure 5c). Additionally, 68% reported difficulties in reconciling work and family responsibilities (e.g., children, partners, elderly parents), and 100% agreed that family and household responsibilities typically fall on women.

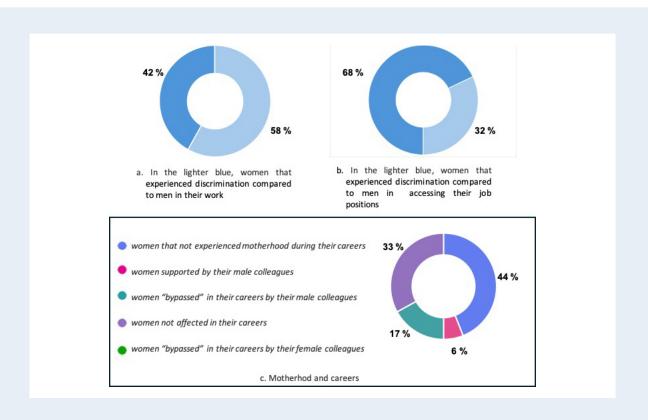


Figure 5. Results of the anonymous survey of women in Engineering Geology and Hydrogeological Sciences in Italian academia.



About half of the respondents believe that women face challenges in attaining prominent or institutional positions within departments or universities. 73% noted that the gender gap at the career level has decreased over the past 20 years, but primarily in entry-level positions. In contrast, significant gender disparities persist in higher positions, such as Full Professorships.

Integrating objective data on scientific productivity from the CINECA and SCOPUS databases with the subjective experiences of the interviewed women reveals several patterns. Men are more likely to participate in larger projects and have greater opportunities to collaborate with experts in their field, which indirectly leads to higher citation counts. Men also tend to establish cross-citation networks more easily. In male-led groups, women often work more independently and face greater challenges. Men also have more time for public relations, whereas women, despite often working more, remain in the background. Furthermore, men's research is perceived as more reliable and frequently relies on data that are less accessible to women, such as specific fieldwork.

Some female colleagues highlighted additional challenges in balancing career and personal life. Women pursuing academic careers often face difficulties in finding a partner and starting a family. Professional commitments, long working hours, and social expectations can complicate the balance between personal and professional life, sometimes forcing women to choose between career advancement and family responsibilities. Family duties frequently coincide with periods of intense work activity, making it harder to keep pace with male colleagues. Later in life, caring for aging parents, though rewarding, can reduce the time and energy available for managerial roles requiring significant presence. Some women also noted that male colleagues tend to collaborate exclusively with other men, excluding women from professional projects as well as logistical or technical tasks.

7. Conclusion

In conclusion, the gender gap in this academic field, as for other STEM disciplines, is well documented and thus more complex than it may initially appear. While women are significantly underrepresented at all academic career stages (from 20 to 30%), those who achieve this rank demonstrate the same degree of publication productivity as their male colleagues. However, this research performance doesn't correspond to higher citation metrics, suggesting that women's scientific contributions are systematically less likely to be recognized.

For women, the significant numerical minority, the slightly lower rate of publication and lower impact of their publications through citations could generate an obstacle

to career progression that collectively contributes to the gender gap in this academic field at every career stage.

The authorship patterns provide additional evidence that achieving gender equity requires attention not only to numbers of women's representation, but also to the nature of roles, recognition of their contributions and research leadership opportunities available to women in Academia.

The survey results highlight a greater difficulty in maintaining a good balance between work and private life during maternity and the periods of childcare. When women have kids, they often struggle to keep their careers on track, while managing family responsibilities. Men typically do not face the same kinds of pressures. The result is lower efficiency among women in both the number of publications and publication quality, as confirmed by data coming from the female Associate professor category, which typically corresponds to the average age when women are most engaged in childcare. This reduced scientific productivity naturally translates into fewer opportunities for career advancement. Thus, effective national and/or European legislation should protect women during this specific and complex period of their career including, for example, extended paid maternity leave, flexible working arrangements and financially supported childcare options.

Therefore, the results show that addressing gender inequity in this field will require several interventions at multiple levels such as improving recruitment of female Researchers to reduce the numerical gap, enhancing promotion to academic careers, ensuring equal recognition of scientific contributions regardless of publication type or gender of the author and introducing laws that support women during the childcare period.

The data clearly shows that increased consciousness alone is insufficient to recover the gender gap and create a balance, even among the younger generation of researchers.

Acknowledgements. The authors thank colleagues Lisa Borgatti, Stefania Da Pelo, Manuela Lasagna, Claudia Meisina, Giovanna Pappalardo, and Daniela Valigi for their valuable suggestions and support during the development of the first stage of this study. The authors are also deeply grateful to the two anonymous reviewers for their constructive comments and insights, which significantly contributed to improving the quality of this work.

References

Abramo G., Aksnes D.W., and D'Angelo C.A., (2021). Gender differences in research performance within and between countries: Italy vs Norway. Journal of Informetrics, 15(2), 101144. https://doi.org/10.1016/j.joi.2021.101144.



- Adambayeva I., (2024). Gender Inequality and Women's Leadership in Scientific Fields: The Case of Kazakhstan. Master's thesis, University of Padua. https://thesis.unipd.it/retrieve/81f87634-7a0f-4057-8c42-26ff3b3ea774/Adambayeva_Indira.pdf (accessed 17 September 2025).
- Agnini C., Pamato M.G., Salviulo G., Barchi K.A., Nestola F., (2020). Women in geosciences within the Italian University system in the last 20 years. Advances in Geosciences, 53, 155-167. https://doi.org/10.5194/adgeo-53-155-2020.
- Casad B.J., Franks J.E., Garasky C.E., Kittleman M.M., Roesler A.C. et al., (2021). Gender inequality in academia: Problems and solutions for women faculty in STEM. Journal of Neuroscience Research, 99(1), 13-23. https://doi.org/10.1002/jnr.24631.
- European Commission, (2025). A Roadmap for women's rights Commission Communication and Annex to the Roadmap on Women's Rights Declaration of principles for a gender-equal society. https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality/gender-equality-strategy_en (accessed 17 September 2025).
- Falco V., Cuntrera D., and Attanasio M., (2023). Gender differences in career advancements in Italian universities over the last 20 years. Genus, 79(1), 14. https://doi.org/10.1186/s41118-023-00189-7.
- Jaccheri L., (2024). Women and Software Engineering. ACM SIGSOFT Software Engineering Newsletter. 49 (2), 16-18. https://doi.org/10.1145/3650142.3650147.
- OECD, (2023). Reporting Gender Pay Gaps in OECD Countries: Guidance for Pay Transparency Implementation, Monitoring and Reform. OECD Publishing, Paris. https://doi.org/10.1787/ea13aa68-en.
- Rosa R., and Clavero S., (2022). Gender equality in higher education and research. Journal of Gender Studies, 31(1), 1-7. https://doi.org/10.1080/09589236.2022.2007446.
- Ross M.B., Glennon B.M., Murciano-Goroff R., Berkes E.G., Weinberg B.A., et al., (2022). Women are credited less in science than men. Nature, 608(7921), 135-145. https://doi.org/10.1038/s41586-022-04966-w.
- Smith S.L., (2025). Editorial: Women's experience and gender bias in higher education. Frontiers in Education, 10. https://doi.org/10.3389/feduc.2025.1554082.
- van Norel N.D., (2013). Female full professors in the Netherlands: Differences between research areas. Master Thesis. Master Public Administration, Tweente University. Retrieved from https://purl.utwente.nl/essays/63659 (accessed 17 September 2025).

*Corresponding author: **Rita Tufano**e-mail: rita.tufano@unina.it
© 2025 Istituto Nazionale di Geofisica e Vulcanologia

All rights reserved

Annex 1. Questionnaire with results showing percentage of responses

	20 participants (some answers were not provided)						
1	Do you feel that you have been discriminated against compared to men in accessing your job positions	42	58				
2	Do you feel that you have been discriminated against compared to men in the performance of your work (for example, because women's contributions are considered less important than men's and/or because women are seen as less suited for fieldwork)	68	32				
3	Over the course of your career, have you received any kind of "attention" from male colleagues (often facilitated by excursions or summer schools involving overnight stays)	37	63				
4	Did the colleagues who "paid attention to you" play a higher role and therefore could influence your future career	71	29				
	If you have experienced motherhood during your career, do you think that male colleagues have supported you or did they "overtake" you in your career by taking advantage of your absence and/or reduced participation in research						
	I did not experienced motherhood during my career						
5	I was supported by my male colleagues						
	I was overtaken in my career by my male colleagues						
	I was overtaken in my career by my female colleagues)				
	I was not affected in my career						
6	Do you have problems reconciling work and family (children, partners, elderly parents)	68	32				
7	Do you think that the responsibility for managing family and household still falls mainly on women	100	0				
8	Do you believe that in your Department/University women face difficulties in attaining high-ranking/leadership positions	47	53				
9	Women in Engineering Geology and Hydrogeology face the same discrimination, prejudices, and challenges as other female scientists in geology, but these are exacerbated by the fact that their field is closer to predominantly "male" disciplines such as engineering sciences. Did you know that, in terms of career progression, the gender gap has decreased over the past 23 years, but mostly in entry-level positions, while for full professorships the gap remains significant (18% versus 82%)	79	21				
10	The number of published articles is comparable and, in some cases, higher for women in Engineering Geology and Hydrogeology compared to men, while men have significantly higher H-index values. Would you be able to provide a preliminary interpretation of these data (possibly also considering those mentioned in the previous point)						
11	If you wish, you may add any further comments/observations below						