

International gender equity in soil science

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Abstract

Previous studies have indicated that diversity is a concern in soil science, including how this relates to gender equity. However, gender equity data for soil science are extremely limited, with only the USA having a current relatively extensive study published in the scientific literature. Therefore, this study was undertaken to gain a preliminary understanding of gender equity issues in a range of countries worldwide using the gender data of membership of national soil science societies, international conferences and journals. Data for 2020 membership was supplied by 44 soil science societies, providing a broad geographic representation. Thirty-seven of the 44 societies had more male members than female. Only 32% of the soil science society members were women, although the highest percentage for an individual society was 69% female membership. Regionally, Asia had the lowest female membership at 22%, whereas Africa had the highest at 40%. Only 20% of the national soil science societies who are members of the International Union of Soil Sciences had female presidents, indicating that women are under-represented in the top leadership roles in our professional societies. Women were under-represented as keynote speakers at conferences and on many editorial boards. This initial scoping study demonstrates that there is an urgent global need to address gender equity within the soil science profession. However, gender equity extends beyond just the number of women in our profession: it also includes equal access to wages, leadership roles and decision making. We conclude that it is critical that individual countries undertake detailed studies of gender equity so we have a more complete picture of the national and international scale of this issue.

Highlights

- There is still gender inequity in soil science
- Soil science is a male-dominated field in most countries worldwide
- Gender equity is critical to advancing the discipline of soil science
- There is a need for comprehensive national studies of gender equity
- Equity includes many issues beyond just equality in numbers of men and women in the profession.

KEYWORDS

British Society of Soil Science, diversity, International Union of Soil Sciences, National soil science societies, STEM fields, sustainable development goals, women in science

1 | INTRODUCTION

Gender equity (provision of fairness and justice in the distribution of benefits and responsibilities between women and men; https://www.un.org/en/un75/women_girls_closing_gender_gap) remains a concern in all science disciplines across the world. Gender perspectives and attention to the goal of gender equality are central to all activities: policy development, research, promotion of dialogue, legislation, resource allocation, planning, implementation, and monitoring of programmes and projects (United Nations, 2001). As half of the current global population and human capacity (United Nations, 2020), women need to be part of all these subjects (at all levels) that are central to human life. Vaughan et al. (2019) investigated a number of gender equity issues for soil science in the USA and concluded there was evidence that women got caught in intermediate levels of employment, the level of female attrition in the profession was much higher than for male attrition, recognition of women's accomplishments lagged behind recognition for men, and women were under-represented in leadership positions in professional societies. Women earn nearly half the advanced soil science degrees awarded in the USA, but only represent about a quarter of the soil science workforce (Vaughan et al., 2019). The main issues raised regarding inequity in soil science specifically have been lower percentages of women working as soil scientists than there are in the general population, fewer chances to serve on committees or to communicate as invited speakers at scientific meetings, unconscious bias, tensions with work–life balance, poor funding and low relative pay, lack of career progression and a lack of networking opportunities (de Vries, 2020; Vaughan et al., 2019). The Royal Society of Chemistry (RSC) recently looked at the situation for chemistry, a field closely related to soil science, in the UK. They showed that 44% of undergraduate chemists are women, whereas only 9% of professors are women (RSC, 2018). The RSC is also researching whether gender bias exists within scientific publishing, the mainstay of a research career.

Women have made important contributions to the sciences throughout history but have consistently been under-represented at all levels. However, advances in adjusting that balance have been made in many countries. For example, women received only 13% of all science master's degrees and 8% of all doctoral degrees in the USA in 1966, but those numbers increased to 46 and 41%, respectively, in 2017 (Vaughan et al., 2019). Nevertheless, major discrepancies still exist in many scientific fields and countries (Işık et al., 2015; Pereira, 2014; RSC, 2018; Thornbush, 2016; Vaughan et al., 2019). In soil science and many related fields (e.g., agronomy and crop science

(McIntosh & Simmons, 2008), chemistry (RSC, 2018), geosciences (Pereira, 2014; Thornbush, 2016) and physics (Saitovitch, Barbosa, Funchal, de Pinho, & de Santana, 2015; Shastri et al., 2015)), women are still a distinct minority. Their representation at conferences as keynote speakers, on editorial boards, as reviewers and on grant funding panels has been viewed as too low (de Vries, 2020). Some networks exist to encourage women in such roles, such as the one created by Franciska T. de Vries (<https://franciskadevries.wordpress.com/women-in-soil-science/>), which now has over 300 members (de Vries, 2020). This network was developed as a resource for conference organizers, funders and journal editors to draw upon and invite female speakers. The spatial distribution of these members probably reflects the marketing and promotion of such a platform, with Twitter, LinkedIn and Facebook being the main platforms used. Most of the members were in the USA and UK, suggesting that awareness raising is urgently required across other nations, including China, the Far East and some African countries (Figure 1) (de Vries, 2020).

Until now, there have been very few evaluations of gender equity issues in the field of soil science, which include representation across the nations. Vaughan et al. (2019) took a fairly detailed look at many aspects of soil science gender equity in the USA, but such data have not been collected for many countries. Therefore, this scoping study is a first attempt to begin an international gender equity analysis for the soil science profession.

2 | MATERIALS AND METHODS

A review of global gender equity in soil science was undertaken by requesting anonymous gender data for membership from 70 national soil science societies around the world. The specific request was for the current number of male and female members in each society. In three cases, societies also included the number of members who did not identify their gender; in these cases, this was a small percentage of the membership (<6% in all cases, <2% in two of the three) and only the male and female numbers were used for this analysis. The initial requests for data were sent via email on 21 August 2020, with a follow-up email to societies who had not yet responded on 31 August 2020, and all data used in this paper had arrived by 25 September 2020. Therefore, the data are for the 2020 membership year. The national soil science societies were identified using the Food and Agriculture Organization's (FAO) database (FAO, 2020a). In instances where national societies supplied more information than requested, such as comments on how membership gender distribution was

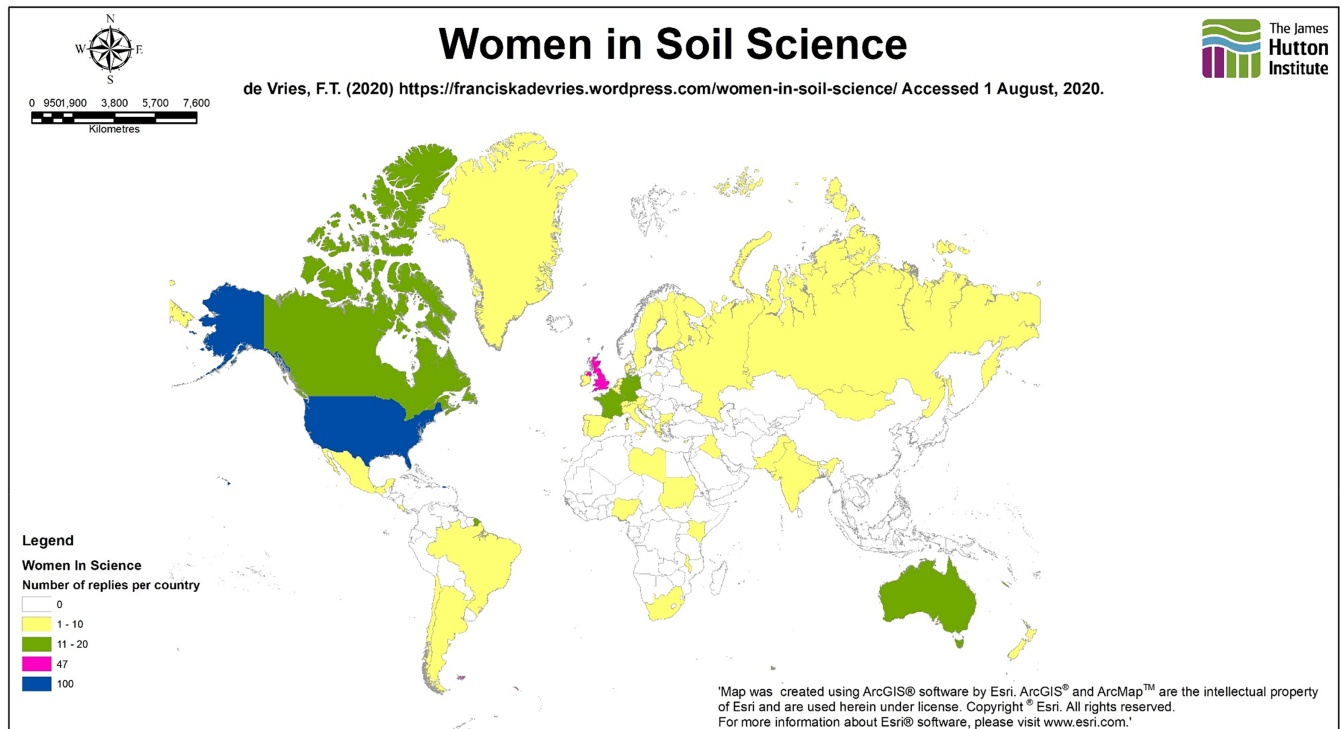


FIGURE 1 The number of women, by country, working in soil science who have registered with the “Women in soil science” project set up by de Vries (2020); data sourced 1 August 2020. <https://docs.google.com/spreadsheets/d/128r71XIVYW6knER37fpAeT990zp8EYyYsRBP rI6hY4/htmlview>

changing or if there was a big difference between student membership gender distribution and professional membership distribution, it was catalogued and used to expand statements that could be made in those areas. Data were analysed by country and by region (Africa, Asia, Europe, Latin America, North America and Oceania) to observe the types of trends that could be identified.

Information on women acting as keynote speakers at international soil science conferences was obtained from the records of past conferences of the International Union of Soil Sciences (IUSS) (<https://www.iuss.org/meetings-events/world-soil-congress/>), the Soil Science Society of America (SSSA) (<https://www.acsmeetings.org/future-past-meetings/>) and the European Geosciences Union Soil System Sciences division (EGU-SSS) (<https://www.egu.eu/awards-medals/philippe-duchaufour/>). The IUSS search was for keynote speakers at the 2002, 2006, 2010, 2014 and 2018 World Congresses of Soil Science (WCSS), with the exception of 2014. No speakers identified as “keynote” speakers were found in the 2014 conference proceedings, but there was a group of “invited” speakers, and these were used to represent keynote speakers for the 2014 Congress. The SSSA search was for “keynote”, “plenary” and “lectureship” speakers for all meetings from 2005 to 2020. For EGU-SSS the list of Philippe

Duchaufour Medal winners was consulted. One Medal is awarded each year, with the recipient giving the premier SSS presentation (i.e., the keynote address) for the SSS at that year’s EGU General Assembly. Information from the 2018 Latin-American Congress on Soil Science (<https://clacs.org/>) and upcoming 2021 Eurosoil Conference (<https://eurosoil-congress.com/#section-speakers>) was also consulted, as they provided two more recent data points of relevance.

Information regarding women on journal editorial boards was collected using the editorial board pages on the journal websites. Nine journals were utilized for this purpose: Applied Soil Ecology (ASE), Biology and Fertility of Soils (BFS), Catena, Geoderma, European Journal of Soil Biology (EJSB), European Journal of Soil Science (EJSS), SOIL, Soil Biology and Biochemistry (SBB), and the Soil Science Society of America Journal (SSSAJ). These journals were selected because they are Q1 soil science journals and their editorial board pages supplied enough information to identify each editor’s gender using photographs. This involved consulting photographs of the editors on the journal’s editorial board page, or seeking information to source photographs of each editor on other sites, such as their employer’s website, Research Gate, Google Scholar, etc. Although each journal’s editorial structure is somewhat unique, most of the journals

TABLE 1 Gender equity data from national soil science societies that responded to a request for information in 2020

Society	Region	Total males	Total females	Total members	% male	% female
Asociación Argentina de la Ciencia del Suelo	Latin America	248	249	497	50	50
Soil Science Australia	Oceania	456	158	614	74	26
Austrian Soil Science Society	Europe	195	120	315	62	38
Soil Science Society of Bangladesh	Asia	181	40	221	82	18
Belarus Society of Soil Science and Agrochemistry	Europe	56	42	98	57	43
Soil Science Society Belgium	Europe	65	29	94	69	31
Sociedad Boliviana de la Ciencia del Suelo	Latin America	30	10	40	75	25
Sociedad Brasileña de la Ciencia del Suelo	Latin America	287	108	395	73	27
Bulgarian Soil Science Society	Europe	20	45	65	31	69
Canadian Society of Soil Science	North America	134	89	223	60	40
Sociedad Chilena de la Ciencia del Suelo	Latin America	56	24	80	70	30
Sociedad Colombiana de la Ciencia del Suelo	Latin America	27	23	50	54	46
Asociación Costarricense de la Ciencia del Suelo	Latin America	113	34	147	77	23
Sociedad Cubana de la Ciencia del Suelo	Latin America	100	80	180	56	44
Czech Society of Soil Science	Europe	87	48	135	64	36
Danish Soil Science Society	Europe	28	12	40	70	30
Sociedad Dominicana de la Ciencia del Suelo	Latin America	20	6	26	77	23
Sociedad Ecuatoriana de la Ciencia del Suelo	Latin America	49	15	64	77	23
Egyptian Soil Science Society	Africa	123	228	351	35	65
Estonian Soil Science Society	Europe	12	17	29	41	59
Finnish Society of Soil Sciences	Europe	87	137	224	39	61
Association Française pour l'Étude du Sol	Europe	172	85	257	67	33
Asociación Guatemalteca de la Ciencia del Suelo	Latin America	15	0	15	100	0
Asociación Hondureña de la Ciencia del Suelo	Latin America	5	3	8	62	38
Hungarian Soil Science Society	Europe	150	112	262	57	43
Indian Society of Soil Science	Asia	1836	388	2,224	83	17
Soil Science Society of Iran	Asia	296	166	462	64	36
Italian Society of Soil Science	Europe	99	36	135	73	27
Lithuanian Soil Science Society at the Lithuanian Academy of Sciences	Europe	18	36	54	33	67
Sociedad Mexicana de la Ciencia del Suelo	Latin America	114	48	162	70	30
Dutch Soil Association	Europe	151	54	205	74	26
Soil Science Society of Nigeria	Africa	300	56	356	84	16
Sociedad Panameña de la Ciencia del Suelo	Latin America	6	4	10	60	40
Sociedad Paraguaya de Ciencia del Suelo	Latin America	14	6	20	70	30
Asociación Peruana de la Ciencia del Suelo	Latin America	38	12	50	76	24
Soil Science Society of Poland	Europe	158	102	260	61	39
Portuguese Society of Soil Science	Europe	35	25	60	58	42
Slovak Soil Science Society	Europe	50	24	74	68	32
Sociedad Española de la Ciencia del Suelo	Europe	325	239	564	58	42
Soil Science Society of Sri Lanka	Asia	245	106	351	70	30
Swiss Soil Science Society	Europe	302	179	481	63	37

TABLE 1 (Continued)

Society	Region	Total males	Total females	Total members	% male	% female
British Society of Soil Science	Europe	525	219	744	71	29
Soil Science Society of America	North America	4,011	1793	5,804	69	31
Sociedad Venezolana de la Ciencia del Suelo	Latin America	30	35	65	46	54
TOTAL		11,269	5,242	16,511	68	32

TABLE 2 Gender equity data from the British Society of Soil Science (BSSS) in 2019–2020 across membership category type

Member Category in BSSS	Total members	Female members	Male members	Prefer not to say
Early Careers	176	84 (48%)	86 (49%)	6 (3%)
Fellow	97	10 (10%)	87 (90%)	0
Full	310	103 (33%)	204 (66%)	3 (1%)
Associate	23	6 (26%)	15 (65%)	2 (9%)
Honorary	20	2 (10%)	18 (90%)	0
Life	10	0	10 (100%)	0
Retired	88	10 (11%)	78 (89%)	0
Technical	20	4 (20%)	16 (80%)	0
TOTAL	744	219 (28%)	525 (71%)	11 (1%)

TABLE 3 Gender equity by global region

Region	Total countries	Total males	Total females	Total	% male	% female
Africa	2	423	284	707	60	40
Asia	4	2,558	700	3,258	78	22
Europe	19	2,535	1,561	4,096	62	38
Latin America	16	1,152	657	1809	64	36
North America	2	4,145	1882	6,027	69	31
Oceania	1	456	158	614	74	26

had some version of a three-tier structure, with an increasing number of editors at each lower level. Therefore, data were collected for three levels for each journal, starting with the highest level. The exception to this was SOIL, which has two levels of editors. In the case of SOIL, the second level of editors was placed with the third level of the other journals when analysed as a group, because the number of editors in SOIL's second level was most similar to the number of editors in the other journals' third level and this avoided having the SOIL numbers dominate the second level grouping.

3 | RESULTS

Forty-four societies responded to the survey request; the reported data are summarized in Table 1. The percentage

of soil science society members who were female ranged from 0 to 69%. Thirty-seven of the 44 societies had more male than female members; the global average was 68% male and 32% female, as calculated based on total global male and female memberships divided by total global memberships. Some societies (Denmark, Egypt, Finland, Mexico, Netherlands, Peru) reported that women make up a majority of the younger soil science generation, or of the students majoring in soil science in their countries at this time (2020, when the data were collected), or that women make up a larger percentage of the younger membership than of the total membership in their society. Similarly, data for the year 2019 to 2020 in the United Kingdom for the British Society of Soil Science (BSSS) showed that the female and male genders were split equally across the early career members (student members), but the percentage of females decreased

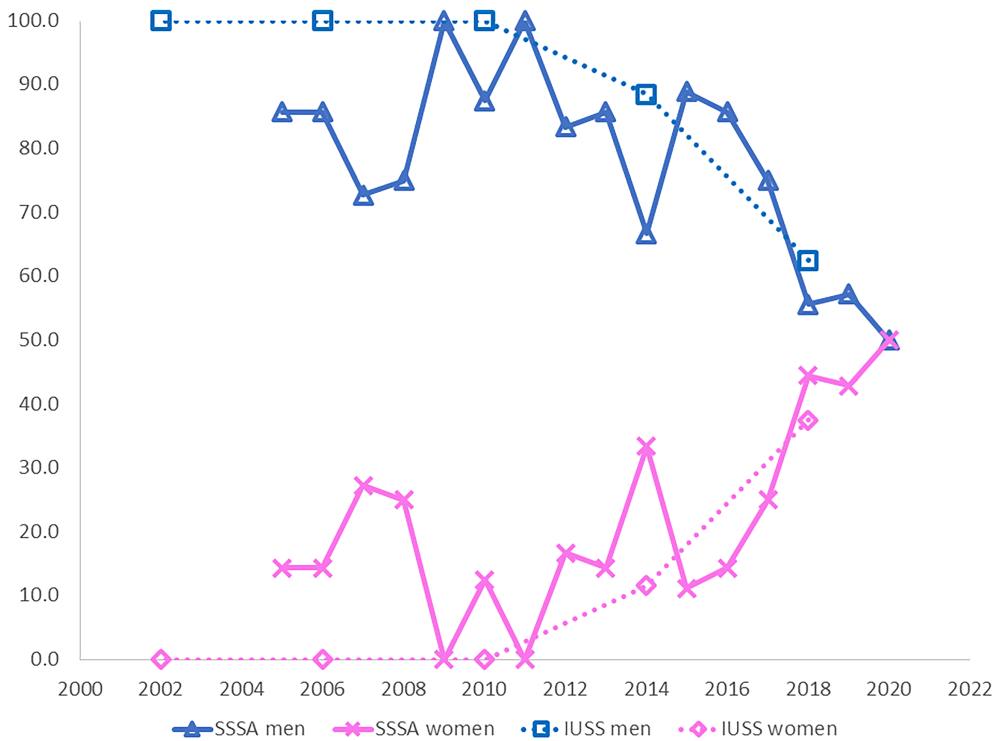


FIGURE 2 The percentage of male and female keynote speakers at Soil Science Society of America (SSSA) meetings from 2005–2020 and at the International Union of Soil Science’s (IUSS) World Congresses of Soil Science in 2002, 2006, 2010, 2014 and 2018

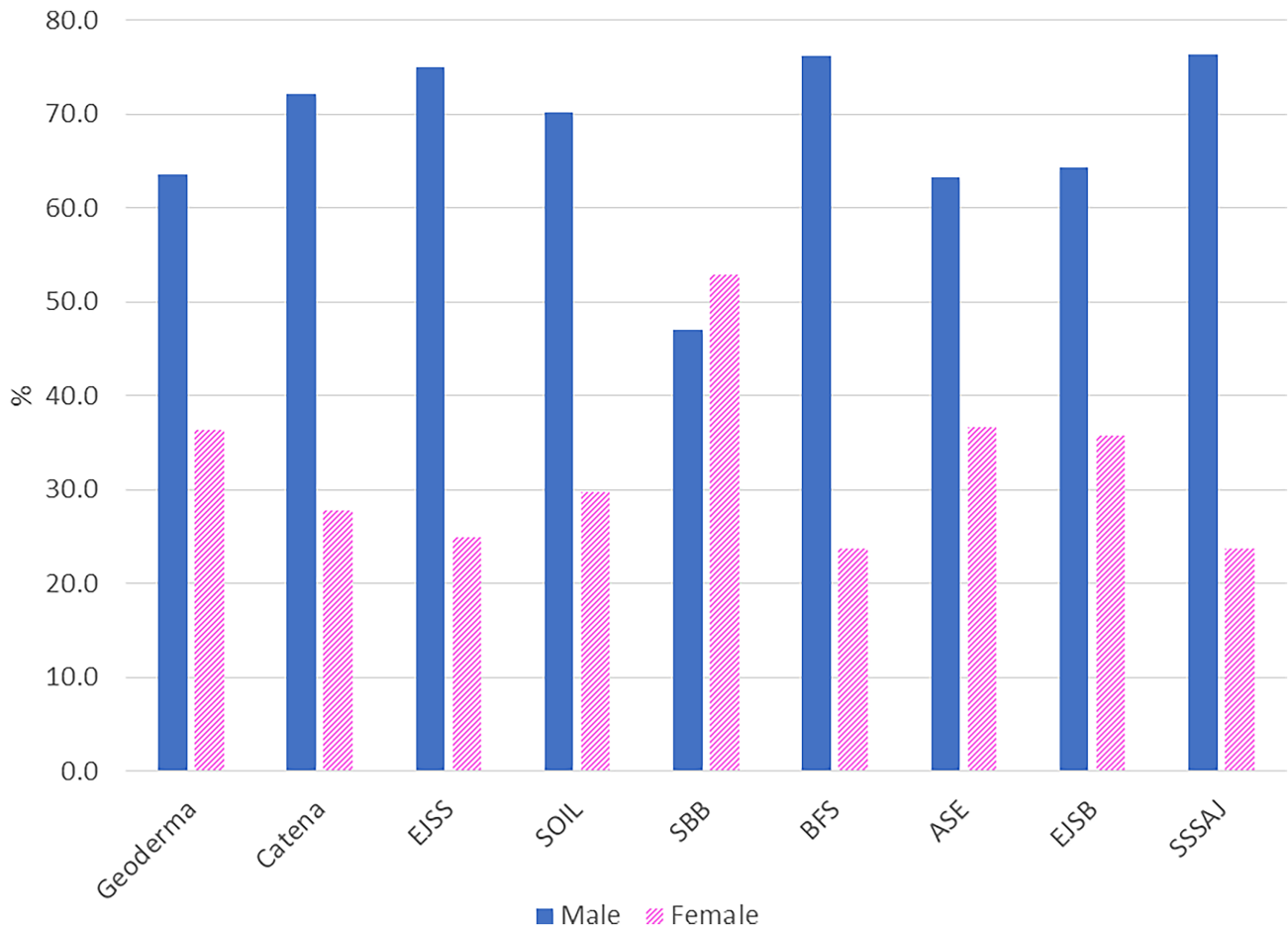


FIGURE 3 The percentage of male and female editors (all levels) at each of the journals investigated in this study. EJSS, European Journal of Soil Science; SBB, Soil Biology and Biochemistry; BFS, Biology and Fertility of Soils; ASE, Applied Soil Ecology; EJSB, European Journal of Soil Biology; SSSAJ, Soil Science Society of America Journal

substantially within every other category (Table 2). When investigated by region of the world, Africa had the highest percentage (40%) of female soil science society members and Asia had the lowest (22%) (Table 3). It is important to note that returns from Africa and Asia were both very low, so these numbers may or may not be representative for these regions overall. Twenty percent of the soil science societies that belong to the IUSS currently have female presidents (Brazil, Chile, Costa Rica, Croatia, Finland, Honduras, Italy, Malaysia, Slovak Republic, Switzerland, Turkey, Uzbekistan, the Latin American Soil Science Society and IUSS).

Overall, 6% of the keynote speakers at the WCSS and 21% of the keynote speakers at the SSSA meetings were women. Women made up 38% of the keynote speakers at the 2018 WCSS and 50% of the keynote speakers at the 2020 SSSA meeting. These percentages represented all-time highs for the time periods investigated, and both meetings showed a trend of increasing the participation of women as keynote speakers over time (Figure 2). The EGU only selects one Philippe Duhaufour Medal recipient each year; 24% of the recipients have been women. However, three of the last seven recipients (43%) have been women, with only one woman receiving the medal prior to 2015. Of the 22 keynote speakers planned for the 2021 Eurosoil meeting, 55% are women, but only 14% of the keynote speakers at the 2018 Latin-American Congress on Soil Science were women.

When the editorial boards for all investigated soil science journals were combined, 30% of the board members were women. For individual journals, female membership ranged from a low of 24% (BFS and SSSAJ) to a high of 53% (SBB) (Figure 3). When grouped by level, women made up 19% of the editors at the highest level (equivalent to editor-in-chief at EJSS), 27% of those at the second level (deputy editors at EJSS) and 31% of those at the third level (associate editors at EJSS), showing decreased representation at higher levels of editorship. However, four of the nine journals did not strictly follow this trend when analysed individually.

4 | DISCUSSION

4.1 | Insights from national soil science societies

Equity of all types within the science, technology, engineering and mathematics (STEM) fields is critical. Unfortunately, the report by Vaughan et al. (2019) about the USA suggests that both soil science and many related STEM fields still need much progress in the area of gender equity. The fact that the soil science societies of some

countries reported that women make up the majority of their younger generation of soil scientists, or that women are a higher percentage of the younger subset than of the total membership, indicates that there may be some progress in gender equity in these countries. However, although Vaughan et al. (2019) found high percentages of females among soil science graduate students in the USA, they also reported a high attrition rate for females as students moved into professional positions, which is a concerning trend. Therefore, higher numbers of female students are only a long-term positive indication of gender equity improvement if they move into and stay in the soil science workforce. Also, although there was a recent increase in female enrolment in undergraduate soil science classes in the USA, the percentage of women in those classes declined relative to male enrolment, because male enrolment increased more rapidly than female enrolment (Brevik et al., 2018). This led to a loss in gender equality even though the total female numbers increased.

In some cases, women are becoming a solid majority of soil science society members within certain countries (e.g., in Bulgaria, Egypt, Finland and Lithuania) (Table 1). However, higher numbers of women in the discipline of soil science does not always mean the reasons for the increase are positive. For example, the Bulgarian Soil Science Society reported that women were a majority of their soil scientists because soil science in Bulgaria does not pay well as a career, and therefore Bulgarian men are not attracted to soil science as a profession, leaving opportunities for women. Certainly, the potential for salary inequity is also a problem that needs to be addressed.

Twenty percent of the national soil science societies belonging to the International Union of Soil Sciences (IUSS) currently have a woman as their president. However, this is less than the average female membership (32%) of these societies. This indicates that women are under-represented in such societal leadership roles. Vaughan et al. (2019) obtained similar findings regarding women in leadership roles in soil science in the USA, particularly when comparing the number of female presidents in the history of the Soil Science Society of America (2% of the society's total presidents, 6% since 1985) to the number of female presidents for related societies such as the Geological Society of America (8% total, 29% since 1985) and Ecological Society of America (14% total, 41% since 1985). The national societies with female presidents that we have membership data for in this study (Brazil, Chile, Costa Rica, Finland, Honduras, Italy, Slovakia and Switzerland) had female memberships that range from 23 to 61%, with an average of 35%, similar to the overall 32% average for all soil science societies. One of the eight

(13%) societies had more female than male members, similar to the 16% of societies overall (seven out of 44) that have more female than male members. The data from this study do not indicate that having a larger female membership makes it more likely that a society will have a female president, but these data reflect only a single-year snapshot of this issue. It would be interesting to see longer-term presidential and membership gender data for multiple national soil science societies.

The soil science society data presented here only provide a brief view of the gender equity issue. There are several weaknesses in this initial dataset, including: (a) some individuals are members of more than one society, and therefore were counted multiple times; (b) the data only give a snapshot of gender equity numbers from 2020, so they do not allow for trend analysis to determine if global gender equity in soil science is improving or worsening; (c) these data do not allow analysis of career advancement, pay equity, award recognition, etc.; (d) this snapshot only includes soil scientists who are members of their national soil science society; and (e) only 44 national societies responded to this study, with particularly poor response rates from Africa, Asia and Oceania, which limits the representativeness of the geographical coverage. The study by Vaughan et al. (2019) attempted to address many of these issues for the USA, and we suggest that similar nation-specific studies should be conducted in other countries to better understand gender equity issues and trends globally within the soil science discipline.

4.2 | Insights from the keynote speaker and editorial board data

The average values for representation of women as keynote speakers over the years covered in the study were considerably lower than the average female membership in the soil science societies, indicating an under-representation, as stated by de Vries (2020). However, the most recent WCSS and the three most recent SSSA meetings had women as keynote speakers at higher percentages than the soil science society membership found in this study, as does the upcoming Eurosoil conference. This indicates a definite improvement in recent years regarding the keynote speaker issue (Figure 2) and is a trend that de Vries (2017) acknowledged for a selection of soil science conferences a few years ago. However, the low percentage of women presenting keynotes at the 2018 Latin-American Congress on Soil Science, a meeting that falls into the same time period as the most recent WCSS and SSSA meetings mentioned above and after de

Vries' (2017) observations, indicates that more progress is needed globally on this front.

Although the lowest-level editorial board numbers (31% female) were essentially identical to the overall female membership in soil science societies (32%), women were vastly under-represented at the highest level of editorship (19%). This agrees with the findings of Vaughan et al. (2019), which indicated women are under-represented in soil science leadership roles. On a positive note, de Vries (2017) investigated female membership on some of the same journal editorial boards that our study did, and the numbers indicate an upward recent trend. In 2017 de Vries found that 34% of the SBB board members were women, whereas we found 53% in 2021. Other comparisons that can be made between de Vries (2017) and this study's data are for EJSS (21% women in 2017, 25% in 2021) and SOIL (20% in 2017, 30% in 2021). A total number of three journals is a small sample size, but all three at least show potential movement in a more equitable direction. It is also interesting that SBB has women as more than 50% of its editorial board. Vaughan et al. (2019) found that 51% of the soil biology and ecology faculty in USA soil science programmes were women, the SSSA Soil Biology and Biochemistry division had the second highest percentage of female membership of all the SSSA divisions (behind only Soil Education and Outreach), and Brevik et al. (2018) found that soil biology/microbiology courses had the highest female enrolment rates among the soil science courses investigated. Therefore, it appears that there is a strong movement towards higher percentages of women within the soil biology community as compared to soil science as a whole. ASE also had a higher percentage of female board members (37%; second highest) than the overall journal average, but BFS, another journal with a focus on soil biology, tied for the lowest percentage of female editorial board members (24%), so the picture is not clear nor simple.

4.3 | How to move towards gender equity in the soil sciences?

The question of how and at which level initiatives should be encouraged to promote global gender equality, particularly in developing nations, in soil science needs to be addressed. This could be implemented at the community level to get buy-in and support from all stakeholders. For example, in Chile the FAO focused on supporting public policymaking in the agricultural sector, focusing on rural women. Working groups on rural women can serve as a forum for dialogue and coordination between governments and women's organizations. Such an approach

could promote gender equality and change discriminatory rules (FAO, 2020b). Some projects such as SoilCare, a project working on sustainable crop production in Europe and involving soil scientists working with farmers and policymakers (Claringbould et al., 2020), consider gender distribution and encourage equality. Such initiatives where soil scientists, including women, are working closely with stakeholders should be fostered. Results from the SoilCare project found that male stakeholders usually make the main decisions. The most balanced gender decision-making numbers applied to decisions regarding improving soil cropping systems (57% men and 43% women), with the biggest gender difference by the land users found to be in the area of implementation of soil-improving cropping systems (94% men and 6% women).

Gender equity in soil science is not only about numbers; it is not just about increasing the number of women participating in the soil science society or in development programmes involving soil and agriculture that have already been decided by others without considering women's contributions, knowledge, priorities and needs. Gender equity is about providing women with the values, educational tools, skills, confidence and opportunities for real *inclusion* in all aspects of life. *Inclusion* starts early when ideas are gathered and programmes defined by men and women working together. There are important steps that could be taken towards creating gender equity in soil science, including:

1. Equal labour charges.
2. Equal pay for the same job.
3. Same opportunities for access to education.
4. Same job promotion opportunities.
5. Expectation for the same type of work (e.g., women are often expected to provide additional service or to be more interested in the teaching aspects of academic jobs at the expense of their research activities; Misra, Lundquist, Holmes, & Agiovritis, 2011).
6. Equal workloads at home.
7. The same guarantees of job stability (which is clearly important for pregnant women or women with children, as women usually provide the majority of childcare; Mason, Wolfinger, & Goulden, 2013).
8. Equitable participation in the executive committees, boards of directors, editorial boards and similar leadership activities of professional societies.
9. Equal opportunities as keynote speakers, recipients of awards, and other means that recognize professional accomplishments.
10. Equal opportunities to participate in political decisions.

National and international soil science societies across the world must ensure that women are

consulted regularly and allowed to contribute to decisions about their strategic plans. At the same time, both women and men must promote female participation in decision-making and planning processes, from their communities, schools and universities to the professional fields in which they are active. An inherent part of gender inequality is the practice of non-inclusion, which is currently all too prevalent in many nations, in particular in the developing nations. For that reason, all science communities need to campaign to change the present situation because ensuring an *inclusive and equitable quality education promoting lifelong learning opportunities for all* is the main point of and cross-cutting link between all the United Nations sustainable development goals (SDGs) (Reyes-Sánchez, 2018).

Soil science societies across the world face the challenge of not allowing discriminatory practices by taking forceful actions to avoid them and to move towards gender equity, allowing their scientific organizations to become leaders in providing *inclusive* professional bodies. For the International Science Council (ISC), freedom and responsibility in science are indispensable requirements for the equitable practice of the sciences, including soil science (ISC, 2020). Freedom is a right, but the freedom to fight for our rights also includes responsibilities. Women and men need to understand that rights imply duties, and our principal responsibility is to respect every person, irrespective of their gender, in order to reach real equity. Soil science societies, universities, institutions, schools and other organizations need to guarantee respect for all and in all of their communications to close the gender gap.

A rethinking of gender equity (SDG 5) and education (SDG 4) is needed to create a new paradigm that allows us:

1. To create an inclusive perspective that encourages respect, collaboration and solidarity between the genders. An education based on the full understanding that “equality does not mean that women and men will become the same but that women's and men's rights, responsibilities and opportunities will not depend on whether they are born male or female” (UN Women, 2001).
2. An education system that recognizes the soil is not only a natural resource, but also a social, economic, cultural, political and *patrimonial* good. The soil not only allows humans to live on it, and through their work to obtain food, water and a legitimate sustenance that allows them to overcome poverty, but also to construct an identity, culture and economic independence for all genders equally.

Therefore, *legitimate land ownership is a key element in achieving gender equality for the construction of a just and equitable life and ending all forms of discrimination against women and girls, since gender has historically been an important determinant of the power and resources held by men and women* (Reyes-Sánchez, 2018). To improve equity in the sciences, including soil science, we need to educate in a way that changes the gender stereotypes that link science to stereotypes about masculinity. *There is no equality without economic independence, and there is no economic independence without equal access to land ownership and land care.*

5 | CONCLUSIONS

As measured by numbers of women in national soil science societies, gender equity within the field of soil science is lacking in most of the world's countries. However, gender equity goes far beyond just having equal numbers of men and women in the profession. For example, if we end up with more women in soil science, but this happens because soil science does not pay well and men have moved to other more profitable careers, we still have not achieved true gender equity; or if more women move into the profession, and they are not fairly distributed among the management levels at work, are not included in leadership positions in our professional societies, and do not have their achievements recognized with honours such as invitations to deliver keynote addresses and act as editors of scientific journals, we still have not achieved true gender equity in soil science. This study provides a basic baseline for the equity status of soil science in 44 countries around the world in 2020, as well as looking at the current gender status of some of our field's leading journals and the keynote speaking situation at select conferences featuring soil science. Nevertheless, more in-depth studies are needed for each of these items, and others, that look at a wide range of gender equity measures and report these results to the international soil science community. Achieving equity of all types (gender, racial, etc.) is critical, but the first step to reaching equity is understanding where and how we are falling short. The next step is to tackle the inequity.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Lorna Dawson: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; writing-original draft; writing-review & editing. **Eric Brevik:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; writing-original draft; writing-review & editing. **Laura Reyes-Sánchez:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; writing-original draft; writing-review & editing. All authors: conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; writing – original draft; writing – review and editing.

DATA SHARING AND DATA ACCESSIBILITY STATEMENT

Data available on request from the authors.

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