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# Editorial: Women in Soil Science

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## Editorial on the Special Issue

## Women in Soil Science

Welcome to this special edition of *Women in Soil Science*. The Spanish Journal of Soil Science is proud to offer this platform to celebrate the achievements of women in the field of Soil Science and hopefully inspire the next generation of female soil scientists.

Led by Dr. Andrea Vidal, Dr. Michele Francis and Prof. Rosa Maria Poch, this Special Issue highlights the latest research from women in the Soil Science field from across the globe.

At present, less than 30% of researchers worldwide are women. For example, in the US women represent only 24% of the soil scientists in academic faculty positions. Long-standing biases and gender stereotypes are discouraging girls and women away from science-related fields, and STEM research in particular. It is essential for both the progress of the field and the fulfilment of the UN Sustainable Development Goals (SDG) to change traditional mindsets and promote gender equality within the Soil Science field, as well as science more broadly.

In this edition, we celebrate the women working in the wider field of Soil Science and we recognise their struggles to become scientists, especially in countries where the playing field is not level. Without an early education focused on strong reading and mathematical skills, a scientific career cannot follow.

The eight papers presented here highlight the diversity of research performed across the entire breadth of Soil Science led by women. Four of the papers deal explicitly with the issue of gender in soil science, either from historical or geographical perspectives, giving visibility to women soil scientists whose contribution to Soil Science has not been given the recognition it merits. The remaining four papers illustrate soil research carried out or led by women in Mexico, Spain, Canada and Brazil showing excellence in science regardless of the authors' gender.

Díaz-Raviña and Caruncho are the authors of the interesting review: "*A brief analysis of the contribution of women to Soil Science*." They present data on female soil scientist ratios in several countries from a time perspective, along with the socioeconomic and political reasons for their evolution. They explain what makes research led by women necessary for the advance of soil science and give reasons for its promotion from the early school years. Special attention is given to Russian and former soviet female soil scientists. Gerasimova's contribution entitled "*Maria Glazovskaya -A pioneer soil scientist and geochemist ahead of her time* (*1912–2016*)" gives an account of one of these "forgotten" Russian soil scientists, who made essential contributions to the knowledge of the world soils and of soil geochemistry, establishing the bases for quantitative soil classification and putting forward some concepts considered hot issues today such as soil carbon pools and emissions; and environmental time bombs applied to soil pollution.

The paper "*Reevaluating diversity and the history of Women in soil sciences: a necessary step for a real change*" (Reyes-Sánchez and Irazoque) deals with the implications of low diversity in the sciences. This review highlights how increasing diversity benefits the field in general. The authors present valuable data on historical discrimination of indigenous peoples and knowledge in Soil

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Science, female versus male participation in science programs and societies, inclusion statistics in the field of Soil Science, and the history of several notable women in geology, earth science, and soil science.

"*Gender equality in soil science in Italy: wishful thinking or reality?*" (Adamo et al.) analyses the role of women in the Soil Science field in Italy. Soil Science has been a traditionally male-dominated area of study. Although there is still a strong male-female bias, the results show that women are increasingly more present in high-responsibility positions in Italian research institutions. Also, the authors highlight that, when scientific production is evaluated, no difference appears between women and men at all career levels. Therefore, despite the favourable trend, gender equality has not been achieved yet in Italy in this field of study. Better investment, improved public resources and political changes are needed to achieve a more gender-balanced reality.

González-Vargas and Gutiérrez-Castorena in their paper "*Brightness values-based discriminant functions for classification of degrees of organic matter decomposition in soil thin sections*" used image processing to classify *in situ* organic matter at different stages of decomposition. The decomposition of soil organic matter is a complex process due to its diffuse nature, and understanding it is fundamental to understanding carbon dynamics. Using images of *in situ* organic matter in soil thin sections, they created classification models using linear discriminant analysis, considerably reducing the volumes of information for data processing. The results will help researchers to quantify soil organic matter decomposition which is fundamental in understanding the dynamics of *in situ* carbon in the soil.

The paper "*Changes in soil phosphorus pools in long-term wheat-based rotations in Saskatchewan, Canada with and without phosphorus fertilization*" (Cade-Menun) reports on soil P and crop yield dynamics as a function of field and crop management. The study is from an unusually long experimental period in a long-term rotation study in Swift Current, SK Canada. There are only a handful of studies like this across North America, and there are even fewer studies that include long-term soil P data. The results are of great relevance for fertilisation planning for good crop yields that are compatible with the protection of aquatic media.

Marques et al. in their paper "*Land recovery and soil management with agroforestry systems*" analysed experiences and studies from different countries in tropical areas. They compiled information from secondary sources about the implementation of agroforestry and its benefits to the soil. The data show that the main problems related to soil degradation in these areas are soil erosion and decreased soil fertility. The authors conclude that the adoption of agroforestry systems improves many aspects of soil quality, which reaffirms agroforestry as a sustainable alternative for conventional agricultural systems to achieve the UN Millenium Development Goals (MDGs). However, more research and quantitative data are needed to be able to widely recommend agroforestry, with specific selection and management of species, in different regions, climates and soils.

Álvarez et al. in "*Quantification of gypsum in soils: Methodological proposal*" apply different field and laboratory methods to measure gypsum contents in a soil from the Ebro valley and discuss their validity and feasibility. Their findings allow the authors to propose a methodological path to quantify gypsum in soils, taking into account field observations, which has relevance in e.g., soil classification and land evaluation.

The editors would like to thank the contributors and reviewers, without whom this Special Edition would not have been possible. It provided a unique opportunity to highlight the role of women in Soil Sciences, both historically and in the present. It has revealed both how far we have come, despite the difficulties, and how far we still need to go. To achieve gender equality, an honest commitment from institutions and funding agencies is needed. We also would like to point out that besides the gender imbalance, there is a funding imbalance between developed and developing countries that needs to be tackled. Soil Science is a multifaceted discipline that needs a multifaceted and diverse group of minds to solve the next generation of questions.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.