



## WOMEN IN AGRARIAN SCIENCES

## ORIGINAL ARTICLE

**Women as key actors in agricultural research:  
A 30-year scientometric analysis of Pesquisa Agropecuária Gaúcha**Sandro da Silva Camargo<sup>1, 2</sup> \* 

**Abstract** – Pesquisa Agropecuária Gaúcha (PAG) has served as a primary vehicle for the dissemination of agricultural research in southern Brazil over three decades, yet gender dimensions within this scientific journal remain largely unexplored. This study examines women's contributions to PAG throughout its history, evaluating publication productivity, structural positions in the co-authorship network, and institutional affiliations. All 578 articles published since the journal's inception were analyzed, and the gender of 1,376 authors was identified using IBGE's National Gender Information System. Women account for 33.21% of PAG authorship and hold structurally central positions within the collaboration network. The 30 most productive female authors were identified, with many displaying high degree, betweenness centrality, and PageRank values, highlighting their roles as key connectors and influential actors in the scientific community. The majority are affiliated with public research institutions, particularly the Secretariat of Agriculture of Rio Grande do Sul (SEAPI-RS) and associated units, underscoring the importance of state structures in supporting female participation in agricultural science. The results demonstrate significant contributions by women to regional agricultural research and their essential role in sustaining and shaping PAG's collaborative ecosystem.

**Keywords:** Agricultural research. Gender. Scientific collaboration. Scientometrics. Social Network Analysis.

**Mulheres como atores-chave na pesquisa agropecuária:  
Uma análise cienciométrica de 30 anos da Pesquisa Agropecuária Gaúcha**

**Resumo** – A Pesquisa Agropecuária Gaúcha (PAG) tem atuado como veículo central para disseminação da pesquisa agropecuária no sul do Brasil ao longo de três décadas, mas dimensões de gênero neste periódico científico permanecem amplamente inexploradas. Este estudo examina contribuições das mulheres para a PAG ao longo de sua história, avaliando produtividade em publicações, posições estruturais na rede de coautoria e afiliações institucionais. Todos os 578 artigos publicados desde a criação do periódico foram analisados e o gênero de 1.376 autores foi identificado por meio do Sistema Nacional de Informações de Gênero do IBGE. Mulheres representam 33,21% da autoria da PAG e ocupam posições estruturalmente centrais na rede de colaboração. Foram identificadas as 30 autoras mais produtivas, muitas apresentando altos valores de grau, centralidade de intermediação e PageRank, indicando seus papéis como conectores-chave e atores influentes na comunidade científica. A maioria delas está vinculada a instituições públicas de pesquisa, especialmente à Secretaria da Agricultura do Rio Grande do Sul (SEAPI-RS) e unidades associadas, ressaltando a importância das estruturas estaduais no apoio à participação feminina na ciência agropecuária. Os resultados evidenciam contribuições significativas das mulheres para a pesquisa agropecuária regional e seu papel essencial na manutenção e conformação do ecossistema colaborativo da PAG.

**Palavras-chave:** Pesquisa agrícola. Gênero. Colaboração científica. Cientometria. Análise de Redes Sociais.

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## Introduction

Gender inequality in scientific authorship is most commonly examined through bibliometric analyses designed to quantify the representation, visibility, and academic influence of women and men across the research publication system. Such analyses are central to understanding structural patterns of inequality because they provide measurable indicators of participation, recognition, and scientific prestige (González-Salmón; Chinchilla-Rodríguez; Robinson-Garcia, 2025). Key metrics typically assessed include the proportion of female authorships, the distribution of authorship roles, female-to-male odds ratios for attaining prestigious positions, and composite measures such as the prestige index and the female first author index (Bendels *et al.*, 2018; Brück, 2023).

The literature identifies several core approaches for evaluating gender inequality in scientific publishing. One commonly used metric is the female-to-male odds ratio, which quantifies the relative likelihood of women versus men occupying key authorship roles. This method captures disparities that extend beyond simple proportional differences, providing a more refined assessment of inequities in access to prestigious authorship positions (Bendels *et al.*, 2018; Holman; Stuart-Fox; Hauser, 2018). In addition to authorship patterns, numerous studies examine gender representation within editorial boards and among editors-in-chief. These positions exert substantial influence over peer-review processes, publication decisions, and the broader scientific agenda of journals. Persistent gender imbalances in these roles indicate unequal access to academic authority and may perpetuate systemic biases within the publication ecosystem (Gea-Caballero *et al.*, 2023).

Citation-based approaches also play a central role in quantifying gender disparities. Analyses comparing

citation rates and journal impact factors for articles authored by women versus men provide critical insights into differences in research visibility and scholarly influence (Bendels *et al.*, 2018; Yi *et al.*, 2025). Furthermore, the distribution of women across first, co-, and last (senior) authorship positions remains one of the most widely employed strategies for assessing gender inequality. These patterns not only reflect gendered barriers to career advancement but also reinforce cumulative cycles of visibility, recognition, and scientific leadership within the academic community (Bendels *et al.*, 2018; Braz *et al.*, 2024; Yi *et al.*, 2025).

Composite indices offer additional tools for synthesizing these patterns. The Prestige Index, for example, incorporates weighted authorship positions to generate a summary measure of gender disparity across publication records (Bendels *et al.*, 2018). Similarly, the Female First Author (FFA) Index assesses the proportion of female first authors within the publication outputs of senior researchers, providing a targeted measure of mentorship, collaboration dynamics, and opportunities for early-career women scientists (Chary *et al.*, 2021).

Building upon these established measurement frameworks, the present study seeks to extend gender-focused analyses by identifying the most influential women authors in the history of PAG through an examination of its co-authorship network. By mapping patterns of collaboration and author prominence, the study aims to evaluate the contributions of these researchers to the journal's development and its consolidation as a central platform for disseminating agricultural research at both regional and national scales.

## Materials and Methods

This study is characterized as applied research





with a descriptive objective, employing a quantitative approach and a documentary research design. Data was collected exclusively from publicly accessible information available on the PAG journal's website, ensuring that no editorial processes were influenced or altered. The analytical focus centers on comparing patterns of women's co-authorship and examining the structural properties of the journal's scientific collaboration network across its publication history. This work extends the analysis presented in Camargo (2025), broadening the scope to incorporate gender-sensitive metrics consistent with contemporary scientometric approaches. The methodological framework draws upon established concepts from scientometrics and Social Network Analysis (SNA) (Ullah *et al.*, 2022; Schäfermeier; Hirth; Hanika, 2023).

The data collection procedures followed those described in Camargo (2025). Metadata was obtained for all articles published between volume 1, issue 1 (1995), and volume 30, issue 1 (2024), thereby covering the full 30-year publication history of PAG. Data was collected in May 19, 2025. The resulting dataset comprises 578 publications, authored by 1,376 distinct individuals and linked by 3,757 co-authorship interactions. The methodological innovation introduced in the present study lies in the development of an R-based script designed to infer the gender of each of the 1,376 authors. The script extracts the first name of each author and queries the Brazilian National Gender Information System (SNIG) of the Brazilian Institute of Geography and Statistics (IBGE). This query returns the relative frequency of men and women associated with that given name, and gender assignment is performed by selecting the category with the highest proportion.

Following data collection, a co-authorship network was constructed and represented as an undirected graph, in which nodes correspond to authors

and edges denote co-authorship relations within PAG publications. The analysis employed classical graph-theoretical metrics (Gross; Yellen, 2023), adding gender as an analytical variable previously applied in Camargo (2025):

- Gender: Assigned as male or female using the proportional gender distribution retrieved from the SNIG database.
- Publications (Pub): Count of all manuscripts in which an author is listed as a contributing co-author.
- Degree: Number of unique collaborators with whom the author has established co-authorship ties.
- Betweenness Centrality (BC): Quantifies the extent to which an author occupies strategic intermediary positions that facilitate information flow between otherwise weakly connected network segments.
- PageRank (PR): Estimates the author's positional significance within the collaboration structure by weighting connections according to the prominence of neighboring authors.
- Community (Com): Cohesive clusters of authors characterized by dense internal collaboration, delineated using the Louvain modularity optimization method; Community 1 designates the largest detected cluster.
- Institutional affiliation: Defined according to the institutional information associated with the author's most recent published contribution.

The construction, visualization, and analysis of the co-authorship network; including the calculation of PageRank, betweenness centrality, and community structure; were performed using Gephi (version 0.10.1) (Bastian; Heymann; Jacomy, 2009). The spatial arrangement of the network was derived using the Fruchterman–Reingold force-directed layout algorithm.

To promote transparency and reproducibility, all datasets employed and generated in this study are





openly accessible in the following repository:  
<https://github.com/Sandrocamargo/publications/tree/main/pag25/mulheres>.

## Results and Discussion

A total of 1,376 identified authors were subjected to the gender classification procedure, resulting in the assignment of 890 men (64,68 %) and 457 women (33,21 %). Additionally, the gender of 29 authors (2,1 %) could not be determined because their first names were not present in the SNIG database; most of these cases corresponded to foreign or otherwise uncommon names. To address this limitation, an individual, manual verification process could be applied to these cases in future research, allowing for a more accurate classification of names not covered by the database.

The gender classification results reveal a substantial imbalance in the authorship composition of PAG, with men representing nearly twice the number of identified women (890 vs. 457). This distribution is consistent with broader patterns frequently reported in scientometric research, which document persistent gender asymmetries in scientific production across multiple fields, particularly within the agricultural and natural sciences (Elias *et al.*, 2024; Islam; Jannat; Al Rafi, 2024; Šubová, 2025). The predominance of male authorship suggests underlying structural factors that shape participation in scientific research, including historical gender disparities in access to academic positions, research funding, leadership roles, and professional networks. As previous studies have indicated, such imbalances may influence not only authorship patterns but also visibility, collaboration dynamics, and career progression trajectories for women in science.

The presence of 29 authors whose gender could

not be determined highlights an important methodological limitation inherent in name-based gender inference systems. The SNIG database, although highly reliable for Brazilian first names, has limited coverage of foreign, rare, or unconventional names. Consequently, authors with international backgrounds or culturally diverse naming conventions may be disproportionately excluded from gender classification, potentially introducing a minor but noteworthy bias into the analysis. While the number of unclassified authors is relatively small, their exclusion underscores the need for complementary validation strategies when conducting gender-based bibliometric assessments, particularly in journals with significant international participation.

Building upon the overall gender distribution of authorship, additional insights emerge when examining the positional roles of authors within publications.

Out of the 578 analyzed papers, 177 (30.62 %) had a female first author, whereas 380 (65.74 %) were led by male first authors. In 21 cases (3.63 %), it was not possible to determine the gender of the first author due to limitations in name-based classification. This distribution indicates a clear predominance of male researchers in the leading authorship position, which is often associated with primary responsibility for the research and manuscript preparation. The lower proportion of female first authors suggests that gender disparities extend beyond overall participation and may also affect leadership roles in scientific production.

A similar pattern is observed in the analysis of last authorship, a position frequently interpreted as indicative of seniority, supervision, or leadership within research groups. Among the evaluated papers, 159 (27.51 %) had a female last author, while 405 (70.07 %) had a male last author. In 14 cases (2.42 %), gender identification was not possible. The even more pronounced imbalance in last authorship reinforces the





notion that women remain underrepresented in senior academic positions, which may reflect structural barriers related to career advancement, recognition, and access to leadership opportunities in the field.

When considering the gender composition of entire author teams, further disparities become evident. A total of 244 papers (42.21 %) were authored exclusively by men, whereas only 42 papers (7.27 %) included exclusively female authors. The remaining 293 papers (50.7 %) involved mixed-gender collaborations, including both male and female authors. This substantial difference highlights the limited presence of all-female research teams and suggests that male-dominated collaborations are significantly more common. Additionally, in one paper (0.17 %), the gender of all co-authors could not be determined, again reflecting the limitations of the classification method for certain names.

Taken together, these findings reinforce the existence of persistent gender asymmetries not only in overall authorship but also in key authorship positions and collaborative structures. The underrepresentation of women as both first and last authors, as well as the relatively low number of exclusively female-authored papers, points to systemic factors influencing participation and leadership in scientific research. These patterns align with broader discussions in the literature regarding gender inequality in academia, emphasizing the need for policies and initiatives aimed at promoting greater inclusion, equity, and visibility of women in scientific production.

Table 1 presents the ranking of the 30 most productive women authors over the 30-year history of the PAG journal. The table is organized in descending order according to four network indicators: number of publications, degree, betweenness centrality, and PageRank. Owing to space limitations, only the authors

with the three highest values for each metric were included in the narrative discussion, and their corresponding values were highlighted in bold to facilitate the identification of the most prominent contributors across network dimensions.

The analysis of the ranking of women authors across the 30-year history of the PAG journal provides important insights into the collaborative dynamics shaping agrarian research in southern Brazil. The top position is held by B. M. E. (Rank 1), affiliated with Embrapa Clima Temperado, followed by V. R. dos S. W. (Rank 2) and R. P. da S. (Rank 3), both from the Department of Agricultural Research and Diagnostics (DDPA). Each author contributed ten publications, highlighting the prominent and sustained involvement of DDPA researchers in advancing regional agricultural science. However, this concentration of highly productive authors within a limited number of institutions suggests a centralization of scientific production, which may reflect unequal access to research infrastructure, funding, and institutional support. While such concentration can enhance productivity and coordination, it may also limit the diversification of perspectives and reduce opportunities for broader participation, particularly from less represented institutions.

Beyond publication counts, the degree metric, which reflects the number of distinct co-authors, provides insight into the breadth and diversity of a researcher's collaborative network. L. S. C. (Rank 5), from DDPA, exhibits the highest degree (34), followed closely by B. M. E. (Rank 1), with 32 collaborators. K. C. T. de B. (Rank 6), also affiliated with DDPA, demonstrates similarly extensive connectivity with a degree of 28. These highly connected authors act as key structural nodes within the collaboration network, bridging institutional and disciplinary boundaries. From





a critical perspective, however, this pattern also indicates a potential dependency of the network on a small number of highly connected individuals, which may create vulnerabilities in terms of knowledge flow and collaboration resilience. Networks heavily reliant on central actors can become less robust if these individuals reduce their activity or exit the system.

**Table 1.** Top 30 female authors in the history of the *Pesquisa Agropecuária Gaúcha* Journal (1995–2024), along with their bibliometric indicators and institutional affiliations.

| Rank | Author          | Pub | Deg | BC       | PR       | Com | Institution             |
|------|-----------------|-----|-----|----------|----------|-----|-------------------------|
| 1    | B. M. E.        | 10  | 32  | 0.012443 | 0.003276 | 7   | Embrapa Clima Temperado |
| 2    | V. R. dos S. W. | 10  | 21  | 0.014482 | 0.002858 | 6   | DDPA                    |
| 3    | R. P. da S.     | 10  | 17  | 0.007275 | 0.002521 | 2   | DDPA                    |
| 4    | L. R. R.        | 9   | 26  | 0.031355 | 0.002745 | 7   | FEPAGRO                 |
| 5    | L. S. C.        | 8   | 34  | 0.012500 | 0.003040 | 3   | DDPA                    |
| 6    | K. C. T. de B.  | 8   | 28  | 0.004867 | 0.002627 | 3   | DDPA                    |
| 7    | J. R. de A. M.  | 8   | 25  | 0.018283 | 0.002683 | 7   | Embrapa Sorgo e Milho   |
| 8    | M. H. F.        | 7   | 25  | 0.037145 | 0.001948 | 3   | SEAPI                   |
| 9    | I. F. C.        | 7   | 23  | 0.017509 | 0.002225 | 5   | SEAPI                   |
| 10   | S. M. B.        | 7   | 10  | 0.000015 | 0.001739 | 22  | FEPAGRO                 |
| 11   | B. R.           | 6   | 25  | 0.022853 | 0.001785 | 2   | UFRGS                   |
| 12   | D. S. L.        | 6   | 13  | 0.019771 | 0.001440 | 1   | SEAPI                   |
| 13   | I. F. T.        | 5   | 19  | 0.026570 | 0.001552 | 8   | SEAPI                   |
| 14   | A. M. R. O.     | 5   | 16  | 0.034292 | 0.001618 | 2   | SEAPI                   |
| 15   | A. F. da R.     | 5   | 12  | 0.004625 | 0.001492 | 3   | SEAPI                   |
| 16   | A. C. C.        | 5   | 6   | 0.000773 | 0.001151 | 1   | FZB                     |
| 17   | C. L.           | 5   | 6   | 0.000773 | 0.001151 | 1   | FZB                     |
| 18   | J. M.           | 4   | 17  | 0.000839 | 0.001581 | 5   | DDPA                    |
| 19   | G. P. K. S.     | 4   | 17  | 0.000839 | 0.001581 | 5   | DDPA                    |
| 20   | C. M. O. M.     | 4   | 14  | 0.001883 | 0.001366 | 2   | DDPA                    |
| 21   | N. D. R.        | 4   | 10  | 0.014647 | 0.001224 | 7   | UFSM                    |
| 22   | M. F. G. O.     | 4   | 9   | 0.001281 | 0.001131 | 10  | FEPAGRO                 |
| 23   | C. E. P.        | 4   | 9   | 0.000778 | 0.001328 | 6   | PUCRS                   |
| 24   | C. I. P. J.     | 4   | 6   | 0.006906 | 0.001245 | 4   | FEPAGRO                 |
| 25   | A. B.           | 4   | 6   | 0.001549 | 0.000870 | 9   | FEPAGRO                 |
| 26   | D. C. F.        | 4   | 6   | 0.000395 | 0.000755 | 9   | UFRGS                   |
| 27   | N. C. R.        | 4   | 6   | 0.000002 | 0.001089 | 22  | FEPAGRO                 |
| 28   | E. P. D.        | 3   | 15  | 0.000019 | 0.001272 | 2   | SEAPI                   |
| 29   | L. G. O.        | 3   | 13  | 0.000096 | 0.001478 | 14  | FEPAGRO                 |
| 30   | S. M. T.        | 3   | 12  | 0.014335 | 0.001045 | 13  | FEPAGRO                 |

Rank: Position in the ranking. Pub: number of publications of the author. Deg: degree. BC: Betweenness Centrality. PR: Pagerank. Com: Community ordinal number.





Centrality measures provide additional insight into the influence and strategic positioning of researchers within the co-authorship network. M. H. F. (Rank 8), from SEAPI, exhibits the highest betweenness centrality (0.037145), highlighting her role as a key intermediary connecting otherwise weakly linked research groups. A. M. R. O. (Rank 14), also from SEAPI, and L. R. R. (Rank 4), from DDPA, likewise display substantial centrality values. These researchers function as structural brokers, enhancing cohesion within the PAG research community. Nevertheless, the prominence of a limited number of brokers suggests that information flow may be unevenly distributed, potentially reinforcing hierarchical structures within the network and limiting the integration of peripheral researchers, including early-career scientists and those from underrepresented groups.

The PageRank (PR) metric provides a more nuanced assessment of an author's structural importance within the co-authorship network. B. M. E. (Rank 1) stands out with the highest PR value (0.003276), indicating that her collaborations are not only numerous but also linked to highly connected and influential researchers. L. S. C. (Rank 5) and V. R. dos S. W. (Rank 2) also exhibit elevated PR scores, reflecting their integration into prominent clusters of scientific collaboration. While high PageRank values are typically associated with influence and visibility, they may also indicate preferential attachment dynamics, whereby already well-connected researchers continue to accumulate collaborations. This process can reinforce existing inequalities within the network, making it more difficult for less connected researchers, particularly women at earlier career stages, to gain visibility and access to high-impact collaborations.

The institutional affiliations of the 30 most productive women authors in PAG underscore the

dominant role of public research, extension, and regulatory institutions in southern Brazil. Notably, the Secretariat of Agriculture, Livestock, Sustainable Production, and Irrigation of Rio Grande do Sul (SEAPI-RS), together with its subordinate units, including the Department of Agricultural Research and Diagnostics (DDPA), the former State Foundation for Agricultural Research (Fepagro) (Silva; Azevêdo, 2020), and the now-extinct Zoobotanic Foundation (FZB) (Hohendorff; Both, 2020), accounts for 24 of the top-ranked authors. This concentration reflects SEAPI-RS's longstanding and central contribution to applied agricultural research, particularly in supporting state-level technological development, diagnostics, and innovation. Embrapa also plays an important role, contributing two highly productive authors affiliated with different research centers: Embrapa Corn and Sorghum and Embrapa Temperate Climate. Academic institutions are represented as well, with two authors affiliated with the Federal University of Rio Grande do Sul (UFRGS), and one author each from the Federal University of Santa Maria (UFSM) and the Pontifical Catholic University of Rio Grande do Sul (PUCRS). This institutional distribution highlights the strong integration between state public research bodies and the academic sector, illustrating a collaborative ecosystem that underpins the advancement of agricultural science and regional innovation capacity in southern Brazil. However, the limited diversity of institutional participation points to potential structural barriers that restrict broader inclusion, which may ultimately constrain the sustainability, resilience, and expansion of collaborative research networks over time.

Women are most prominently represented in several key communities within the co-authorship network. The second-largest community (Com 2) includes five of the top 30 ranked women authors, four



of whom are affiliated with SEAPI/DDPA and one with UFRGS. Fig. 1 displays the core female authors of PAG across its 30-year history, comprising the top-ranked researchers as well as those with at least three publications. Node size is proportional to the number of publications per author, and edge thickness reflects the frequency of co-authorship interactions. Node colors represent the eight largest co-authorship communities identified in the network, while gray nodes correspond to authors belonging to smaller communities ranked ninth or lower. Specifically, Community 1 is shown in lilac, Community 2 in green, Community 3 in blue, Community 4 in dark gray, Community 5 in orange, and Community 7 in dark green. The sole representatives of Communities 6 and 8 are depicted in pink and light brown, respectively. While the visualization highlights the presence of influential female researchers, it also makes visible the structural concentration of collaborations, with a limited number of large clusters dominating the network. This pattern reinforces the quantitative findings and suggests that collaboration opportunities may not be evenly distributed.

Taken together, these findings underscore the central female contributors and the public research institutions that have played a decisive role in shaping the scientific trajectory of the PAG journal. By revealing how leading women researchers occupy structurally influential positions, whether through productivity, connectivity, or network centrality, this analysis provides valuable insights into the dynamics of collaboration within agrarian sciences. These structural features may partially explain the broader gender imbalances observed in authorship and leadership positions, as they can influence visibility, resource allocation, and career advancement. Such evidence is particularly relevant for researchers and policymakers seeking to strengthen gender-inclusive research

environments and promote equitable, high-impact scientific networks.

The analysis of 42 publications authored exclusively by women reveals a pattern that closely mirrors, yet subtly diverges from, the overall authorship structure of the journal. Among these papers, the most frequent configuration is two authors (18 articles), followed by three (9 articles) and four authors (7 articles), with fewer instances of single authorship (5 articles) and only rare cases of larger teams (two papers with five authors and one with seven authors). In the broader corpus of 578 articles, authorship is likewise centered around small to medium-sized teams, with a median of three authors, an interquartile range from two to four authors, and an upper whisker reaching seven authors. This comparison indicates that women's collaborative patterns are largely aligned with the general structure of the journal, particularly in the predominance of two- to four-author teams. However, the relatively lower frequency of larger all-female teams suggests that women may be less represented in more expansive collaborative arrangements, with potential implications for network reach, access to resources, and scientific visibility.

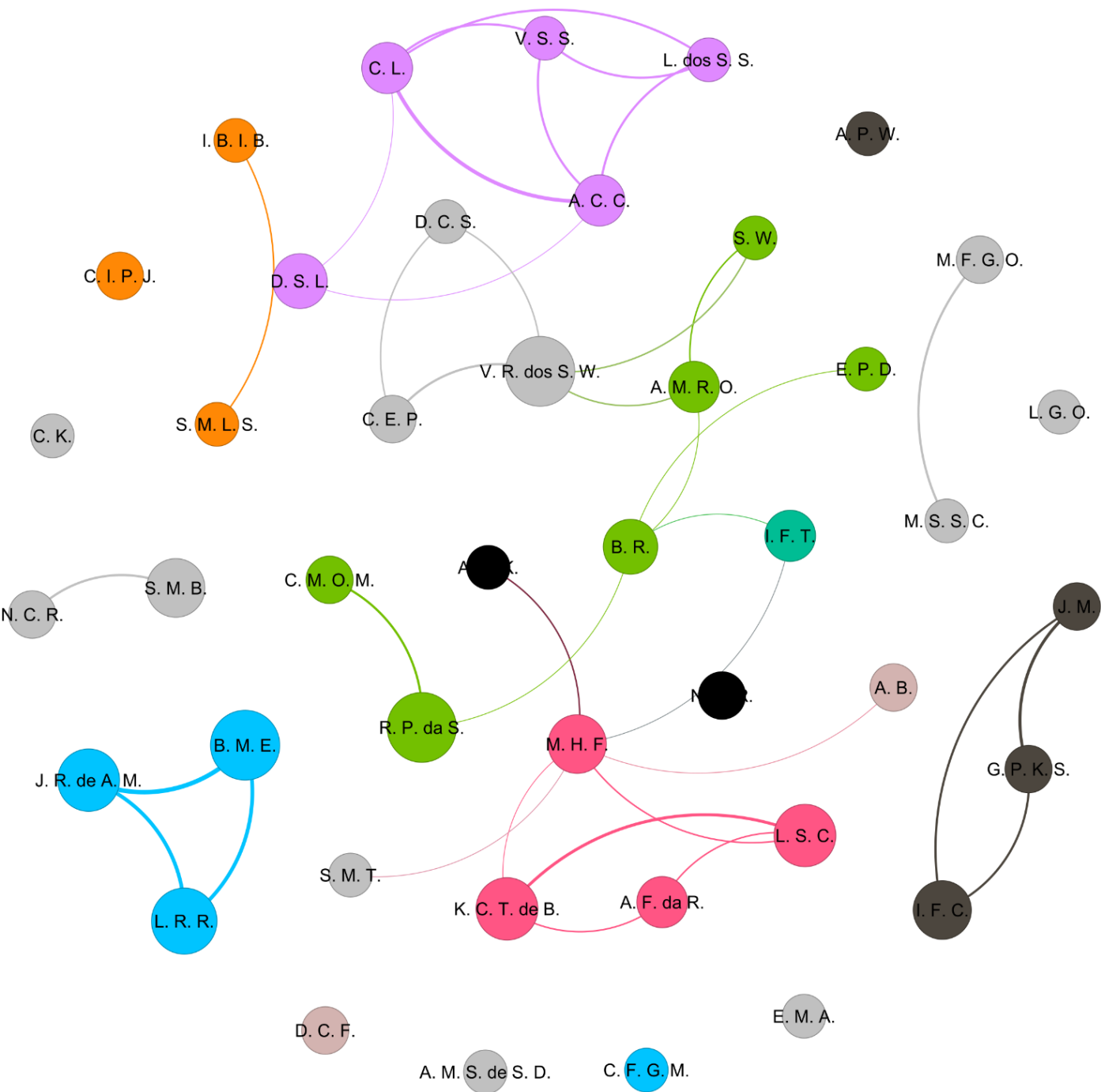
A complementary examination of thematic content highlights a diverse yet coherent set of research interests within agricultural science. The most frequent keyword, *cochonilhas* (scale insects), appears four times, indicating a notable focus on pest management and plant protection. Other recurring keywords further emphasize the breadth of topics addressed, including germination (three occurrences), pointing to research on plant development and seed physiology, and aquaculture, reflecting engagement with aquatic production systems. Additional terms such as pine bark (*casca de pinus*), forest seeds (*sementes florestais*), and ecological management (*manejo ecológico*) suggest a





strong emphasis on forestry, sustainability, and environmental management. The presence of keywords related to animal health, such as animal health defense

(defesa sanitária animal), swine health (sanidade suína), and wild boars (javalis), indicates active contributions to veterinary and livestock research.



**Figure 1.** Collaborative network illustrating co-authorship relationships among the most productive female authors in *Pesquisa Agropecuária Gaúcha* history.





It is important to acknowledge that the relatively limited number of exclusively female-authored papers constrains the application of more robust statistical analyses of thematic trends. Nevertheless, a descriptive and exploratory approach remains informative. Taken together, these findings demonstrate that women-only research teams contribute across multiple domains of agricultural science, spanning plant protection, forestry, animal health, and sustainable management. Rather than being concentrated in a narrow set of topics, these publications reflect a multidisciplinary engagement aligned with key areas of regional agricultural relevance. From a critical perspective, this diversity suggests that women are not confined to specific niches but are actively participating in both traditional and emerging areas of agricultural research, reinforcing their role in shaping a broad and integrated scientific agenda.

The study presents certain limitations. First, institutional affiliations were derived from the author's most recent publication in the journal, which for several contributors occurred more than a decade ago. As a result, some affiliations may no longer correspond to the authors' current professional positions. Second, the names and organizational structures of governmental secretariats and departments have undergone changes throughout the study period. To ensure consistency and comparability across time, all historical denominations related to the Secretariat of Agriculture of Rio Grande do Sul were standardized under the acronym SEAPI. Despite these constraints, the findings provide a meaningful representation of long-term patterns in collaboration and institutional participation among women in agrarian research.

## Conclusion

This study provides a comprehensive assessment of the co-authorship structure and institutional

landscape of the Pesquisa Agropecuária Gaúcha (PAG) journal over its 30-year history, with particular emphasis on gender dynamics and the contributions of its most prominent female authors, who represent 33.21 % of all PAG contributors. By integrating scientometric indicators with Social Network Analysis (SNA), we identified the top 30 most productive female researchers, characterized their structural roles within the co-authorship network, and examined the institutions that have most significantly shaped the journal's scientific output. The prominent presence of women across several core communities highlights their essential role in sustaining collaborative research practices and advancing agricultural science in southern Brazil.

The ranking of the top 30 most productive female authors underscores the centrality of public research institutions, particularly SEAPI-RS, its former units such as Fepagro, and two Embrapa units, in driving regional scientific production. Universities, such as UFRGS, UFSM and PUCRS, also feature prominently, demonstrating the strong synergy between academic institutions and state-level applied research systems. This institutional interplay has fostered a collaborative environment where knowledge exchange, interdisciplinary links, and long-term partnerships have supported the advancement of agrarian sciences.

The prominent participation of female authors, particularly their concentration in several of the most structurally influential communities, demonstrates their pivotal role in sustaining collaborative networks, driving knowledge integration across institutions, and contributing to the journal's long-term vitality.

## Conflict of Interest

The authors declare that the research was conducted in the absence of any potential conflicts of





interest.

### Ethical Statements

The authors confirm that the ethical guidelines adopted by the journal were followed by this work, and all authors agree with the submission, content, and transfer of the publication rights of the article to the journal. They also declare that the work has not been previously published nor is it being considered for publication in another journal. Review by the Ethics Committee was waived because only secondary, unidentified and free-access data have been utilized. The authors assume full responsibility for the originality of the article and may incur on them any charges arising from claims, by third parties, in relation to the authorship of the article.

The authors used ChatGPT (OpenAI) solely as a language-editing tool to improve grammar, clarity, and writing style. No scientific content, data analysis, interpretation, or conclusions were generated by the Artificial Intelligence system. All revisions were critically reviewed by the authors, who assume full responsibility for the final manuscript.

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