

Empowering women farmers in rice agriculture: A bibliometric review of gender-inclusive strategies for sustainable development

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Abstract. This study presents a comprehensive bibliometric analysis to understand changing research trends related to rice, specifically emphasising its associations with gender equality (SDG 5) and reduced inequalities (SDG 10). The study used data from the Scopus database from 1962 to 2023, employing bibliometrics with VOSviewer 1.6.18 software and text-mining methods with RStudio software. The research identifies prevailing themes, detects publication patterns, and determines the most impactful global contributions within the field. The study results from 472 documents exported indicate that agricultural activities highlight the worldwide focus on integrating sustainable farming methods with wider socio-economic goals. The bibliometric data reveals the multifaceted role of rice beyond its basic function of providing sustenance. The analysis highlights the dynamic nature of the rice research community, where collaborative endeavours contribute to generating innovative insights. The significant role of rice in promoting sustainable development pathways and emphasises its potential to drive socio-economic transformation, particularly in the Asian context. Simultaneously, governments must reorient their policy frameworks to facilitate and promote rice research, which will create a favourable environment that encourages innovation and inclusivity.

1 Introduction

As an essential staple crop of significant global importance, rice has historically received substantial scholarly attention due to its pivotal role in agricultural practices and human nutrition [1,2]. The cultivation of rice has historically been intricately intertwined with socio-economic and cultural structures, particularly in Asian regions [3,4]. Over several decades, scholars have increasingly recognised women's substantial and pivotal role in rice cultivation. This position involves various responsibilities, such as planting, harvesting, and participating in post-harvest procedures [5,6].

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The Sustainable Development Goals (SDGs) represent a comprehensive and inclusive appeal for global action to eradicate poverty, preserve the environment, and promote shared prosperity for all individuals by 2030 [7–9]. The set of 17 interrelated objectives signifies a comprehensive worldwide dedication to tackling a wide array of significant issues confronting humanity, encompassing areas such as hunger, health, education, and equality. SDG 5, known as gender equality, emphasises the inherent entitlement of women and girls to lead lives devoid of discrimination, violence, and impediments that impede their socio-economic progress [10,11]. The attainment of gender equality is not solely a matter of ethics, but also a crucial factor in facilitating societal and economic advancement.

Empowering women frequently yields wider-ranging societal advantages, including improved family well-being, enhanced economic prosperity, and greater social cohesion. The Sustainable Development Goals 10 or reduced inequalities, hold equal significance. The objective of this initiative is to tackle the deeply rooted inequalities both within and between nations. These inequalities frequently contribute to the perpetuation of poverty cycles, impede the achievement of sustainable economic development, and exacerbate social tensions. This objective highlights the significance of ensuring equal opportunities for individuals, regardless of age, gender, disability, race, ethnicity, nationality, religion, or any other social or personal characteristic. In a globally interconnected society, the endeavour to achieve gender equality and mitigate inequalities is not solely a matter of equity, but rather a means to establish a harmonious, prosperous, and sustainable future for all individuals.

The scholarly investigation of the relationship between rice production and gender equality has gained prominence since establishing the SDGs, particularly Sustainable Development Goal 5. Acknowledging the capacity for women's empowerment through involvement in rice farming across different areas is the reason for this phenomenon [12,13]. The literature indicates a diverse range of implications associated with rice, surpassing its mere nutritional worth and highlighting its influential contribution to the formation of gender roles, income distribution, and strategies for sustainable development.

The main aim of this study is to address the existing gap in knowledge by conducting a bibliometric analysis of research patterns related to rice and their potential implications for SDGs 5 and 10. We aim to examine and evaluate articles obtained from the Scopus database comprehensively. This analysis seeks to reveal the prevailing themes, primary contributors, and the progression of research about rice within the framework of gender equality and the mitigation of inequalities. By undertaking this endeavour, we aim to shed light on the importance of rice beyond its nutritional worth and emphasise its diverse contribution to fostering sustainable development, equality, and societal advancement.

2 Methodology

We examined the current research trends on rice and its relevance to SDGs 5 and 10 using well-established bibliometric techniques. By incorporating text mining techniques, the analytical methodology was enhanced and themes, important terms, publication patterns, and global distribution could be identified. Consequently, the conclusions above were supported by earlier bibliometric analyses [14,15].

The primary source of rice research data for our investigation was the Scopus database, which was retrieved on September 6, 2023. Over 25,100 volumes from a global network of 5,000 publishers make up the large compilation, which spans a wide range of academic topics (Elsevier). Figure 1 shows the approach and the filtering criteria. The search was customised to concentrate on "rice" and its related phrases, emphasising English-language articles (as shown in Figure 1). A total of 472 articles were found to be relevant due to the process outlined above.

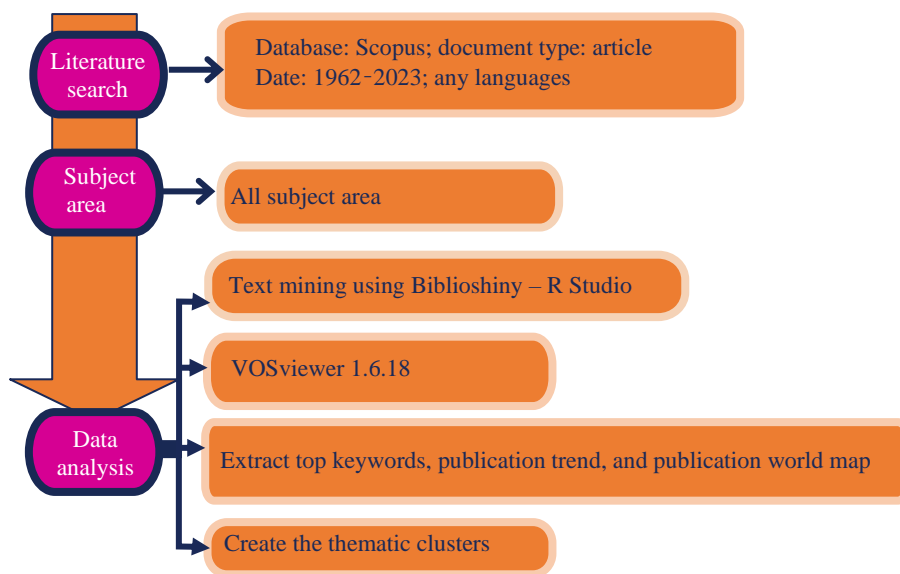


Fig. 1. The methodology followed in this research.

The Biblioshiny tool in the R-studio programming language was employed to process the Scopus data, which is widely acknowledged as a dependable approach for conducting bibliometric assessments [16]. The subsequent analysis encompassed several parameters, such as annual publication rates, document types, citation metrics, and noteworthy contributions. Additionally, it sheds light on the leading countries, institutions, and scholars in rice research. Moreover, the application of VOSviewer software facilitated the integration of fragmented author identifications into coherent profiles, thereby ensuring the precision of the data [17].

Furthermore, utilising VOSviewer inside the text mining domain has facilitated investigating relationships and correlations among writers, nations, and keywords [17]. During our investigation of the most important research areas in rice studies, we looked at the 441 most important index phrases. The updated list is now clearer because it no longer contains overused or generic phrases. The maps were made to draw attention to the collaborative efforts of world-class researchers and countries in the field of rice research, with a particular focus on SDG 5 and SDG 10.

3 Results and discussion

The dataset thoroughly explains how rice research has developed and relates to SDGs 5 and 10 from 1962 to 2023. It is taken from a comprehensive collection of 472 documents that were obtained from 343 different sources, including books, journals, and more. Looking at the annual trajectory, one can observe that it grew quite slowly until the early 2000s. The field grew steadily over the ensuing decades, peaking in 2022 and 2023 with 22 papers, as Figure 1 shows. This steady output shows how important rice is for reducing inequality and promoting gender equality, with a 5.2% annual growth rate. Moreover, Figure 2 showcases the vital data points associated with our study on rice and its connection to SDGs 5 and 10 from 1962 to 2023. It encompasses the volume, sources, analytical tools, and primary themes, giving readers an immediate understanding of the study's scope. This summary is a convenient reference throughout the paper, highlighting the historical progression and the field's interdisciplinary nature.

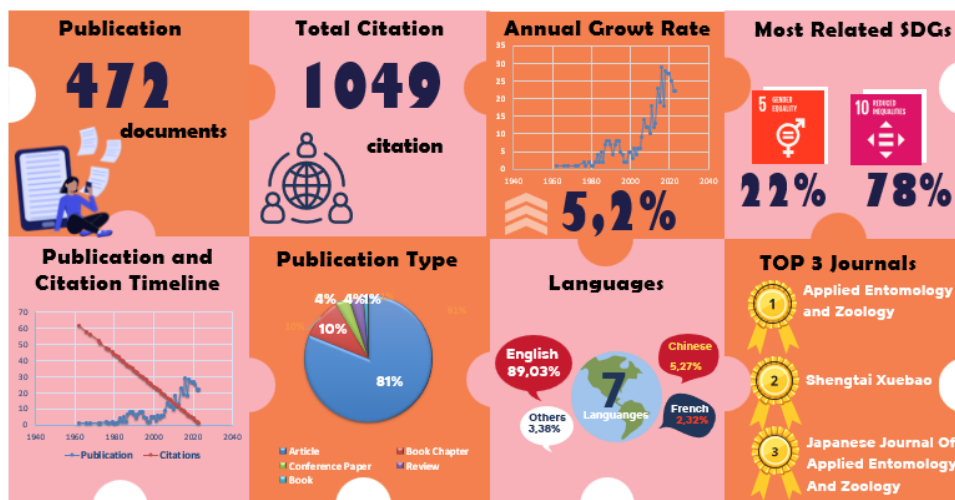


Fig. 2. General bibliometric qualities of rice publications to SDG 5 (gender equality and SDG 10 (reduced inequalities)).

The studies' remarkable average citation rate of 16.23 times per document within this corpus of research highlights the significance and effect of the research. The main areas of the research are further detailed by 1,333 Author's Keywords in addition to a total of 2,188 keywords. The observable distinction between the two keyword sets may indicate that the academic community has contextualised the work more broadly than just the author's area of expertise. The field is clearly collaborative, as evidenced by the 1,325 unique authors who have contributed. The majority favoured teamwork, with foreign co-authorships accounting for 24.57% of all collaborations. This worldwide collaboration demonstrates the interdisciplinary and international appeal of the field. Moreover, the presented dataset offers a rich tapestry of insights that connect rice research with SDGs 5 and 10, underscoring its multifaceted importance. A few points of discussion that emanate from the dataset are:

1. The pivotal role of rice in addressing SDGs: the steady increase in research articles concerning rice, especially in the last two decades, resonates with the global narrative of sustainable agricultural practices. The profound linkage between rice and SDGs 5 and 10 elucidates the grain's centrality in promoting gender equality and reducing inequalities. Rice farming often acts as a catalyst in empowering women in many regions, ensuring economic sustenance and playing a pivotal role in reducing income disparity.
2. Emerging research paradigms: the high average citation rate emphasises that the discourse around rice isn't merely academic; it's pivotal and influential. The disparity between keywords plus and the author's keywords suggests that while researchers have specific foci, the broader academic community sees the implications in a larger, more contextual framework. It could indicate a move towards holistic research paradigms encompassing socio-economic, cultural, and environmental facets.
3. Global collaboration and diverse perspectives: the significant percentage of international co-authorships reinforces that the challenges and solutions surrounding rice cultivation, gender equality, and reduced inequalities are universally pertinent. This collaborative research approach provides diverse perspectives, experiences, and strategies from different regions, enriching the discourse and potentially leading to more holistic and globally relevant solutions.
4. Rice as a conduit for social change: the major themes identified from the dataset are gender equality in rice farming, income disparity in rice production, and rice's relation to social inequalities, illustrating the multi-dimensional role of rice. Beyond being a staple

food, rice cultivation and distribution are deeply entwined with societal structures. As research evolves, it will be intriguing to see how policy frameworks adapt to incorporate these findings, potentially leveraging rice as a conduit for positive social change.

5. Future directions: with the increasing relevance of rice in the backdrop of SDGs, future research might explore how technological innovations, climate change, and evolving societal norms impact rice production and its multifaceted implications on gender and income disparities.

The dataset thoroughly explains the intersections between agriculture, climate, and socio-economic issues in various regions, particularly Asia. Based on the bibliometric analysis using VOSviewer, displayed in Figure 3, distinct patterns emerge that elucidate this multidisciplinary field's evolution:

1. Rice and agriculture: with the term "rice" having the highest weight of 49, it's evident that rice cultivation and research play a central role in this dataset. Related terms like "agriculture", "crop", "cultivation", and "crop production" further highlight the importance of agricultural practices and their implications.
2. Climate and environmental factors: terms like "climate change", "temperature", and "weather" underscore the significance of environmental factors on agriculture. These terms suggest research on how climatic conditions impact crop yields, distribution, and potential migration patterns of pest species.
3. Socio-economic aspects: "poverty", "food security", "livelihood", "income", and "gender" point towards the socio-economic dimensions in the study. There's a notable emphasis on gender, with terms like "female", "male", "gender role", and "gender disparity" suggesting investigations into gender roles in agriculture and how they impact food security, income, and migration.
4. Migration and movement: human and animal migrations are a significant theme. While terms like "emigration", "immigration", and "population migration" possibly relate to human movements due to factors like climate change, economic challenges, or agricultural shifts, terms such as "animal migration", "animal dispersal", and specific names like "*Nilaparvata lugens*" (a pest species) suggest research on pest movements and their implications on crops.
5. Regional focus: the prominence of specific geographic labels like "China", "Vietnam", "Indonesia", "Thailand", and "Mekong Delta" indicates a regional concentration in the research, focusing on Asian countries and their agricultural, climatic, and socio-economic challenges.
6. Pests and crop health: terms like "*Hemiptera*", "*Planthopper*", "*Sogatella furcifera*", and "*Nilaparvata lugens*" emphasise the research on pest species that affect rice and other crops, investigating their life cycles, movements, and impact on crop health.
7. Gender and societal roles: the emphasis on "domestic violence", "equity", "gender roles", and "women's status" implies a deeper investigation into societal norms, women's roles in agriculture, and the broader implications of these roles on economic and food security.
8. Development and inequality: terms like "sustainable development", "income inequality", and "microfinance" suggest studies into strategies for sustainable agricultural growth, financial solutions for rural areas, and challenges posed by income disparities.

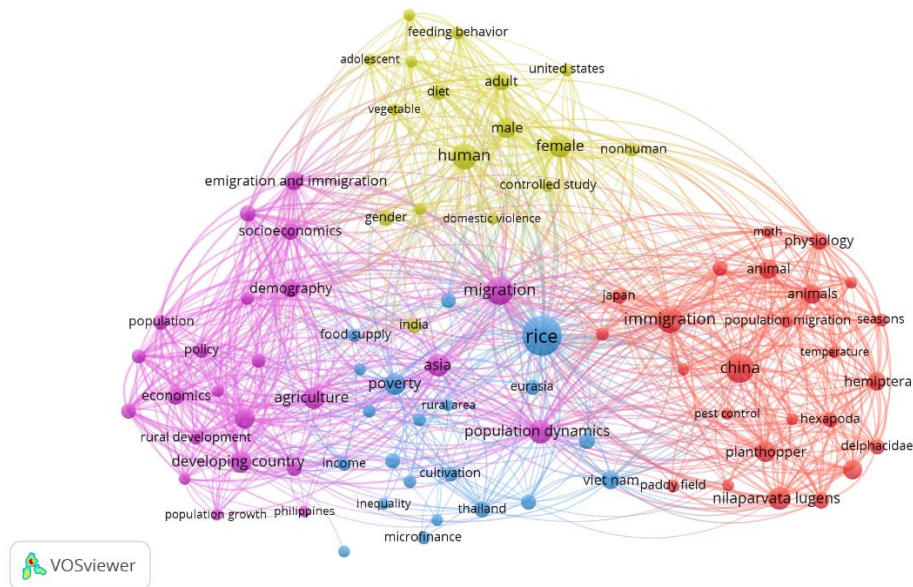


Fig. 3. Thematic clusters of the top keywords in rice (concerning SDGs 5 and 10).

Given the diverse implications of rice research concerning SDGs 5 and 10, it is crucial to foster interdisciplinary cooperation among scholars from various fields, such as agriculture, sociology, and gender studies. There is a need to intensify endeavours to encourage women's active participation in rice farming through empowerment initiatives and incorporating advanced technologies to improve productivity and ensure the adoption of sustainable practices. Recognising the interdependence between climate conditions and rice farming underscores the need to implement agricultural approaches that can effectively withstand fluctuations and shifts in climate patterns.

In addition, the government can consider various policy recommendations to optimise gender balancing in the rice sector, and these may include:

1. Promoting gender equality: implementing policies that ensure equal opportunities and access for both men and women in the rice sector. It can involve eliminating discriminatory practices, providing equal rights to land ownership, and promoting equal wages and employment opportunities [18].
2. Capacity-building and training programs: providing training and capacity-building programs specifically targeted at women in the rice sector. These programs can help enhance their skills, knowledge, and productivity, enabling them to be more active in the sector.
3. Access to finance and resources: facilitating access to credit and financial resources for women farmers to support their rice cultivation activities. It can involve providing microfinancing options, establishing women-focused agricultural credit programs, or ensuring equitable access to agricultural inputs and resources [19].
4. Support for women-led initiatives: encouraging and supporting women-led initiatives in the rice sector, such as women farmer cooperatives or self-help groups. These initiatives can provide a platform for women farmers to collaborate, share resources, and market their products more effectively [20].
5. Data collection and monitoring: ensuring gender-disaggregated data is collected and monitored in the rice sector. It can help identify gaps and disparities between men's and women's participation, access to resources, and economic contributions. Based on this

data, evidence-based policies and interventions can be developed and monitored for their effectiveness [21].

In conclusion, it is imperative to establish robust monitoring and assessment systems to guarantee the successful alignment of rice production with the intended SDGs outcomes. It will enable rice to serve as a symbol of socio-economic transformation.

4 Conclusions and policy recommendations

The comprehensive examination of rice research in the context of SDG 5 (gender equality) and SDG 10 (reduced inequalities) has shed light on the diverse significance of this fundamental cereal crop. Rice has historically been esteemed for its nutritional qualities and has emerged as a significant player in the wider socio-economic sphere. The function of food has expanded beyond its initial purpose, transforming into a representation and tool for societal advancement and empowerment. As countries confront the complexities of gender inequality and income disparity, rice cultivation, distribution, and research serve as mechanisms to address these issues, ultimately contributing to establishing a more equitable and fair global society.

Moreover, our dataset not only offers a detailed examination of the scholarly discussion regarding rice but also demonstrates the wider contextual interaction between agriculture, climatic, and socio-economic factors. The nexus between cultural, economic, and agricultural factors is particularly pronounced in Asia due to rice's significant role in these domains. The results of our study indicate that, as the phenomenon of climate change persists and exerts significant influence on agricultural methods, it becomes crucial to comprehend the significance of rice to develop sustainable, adaptable, and fair resolutions. This analysis highlights the capacity of collaborative, interdisciplinary research to facilitate well-informed strategies, thereby ensuring the realisation of sustainable development as more than a mere aspirational objective but rather as a concrete reality. At the same time, government support is required to reorient their policy frameworks to facilitate and promote rice research in line with SDGs 5 and 10. It will contribute to creating an enabling environment that encourages innovation and integration.

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