

A Five-Decade Journey of Women Dynamics in Global Agriculture

Sheeba D, Prabu Christopher B*

Vellore Institute of Technology Business School (VITBS), Vellore Institute of Technology, Vellore-632014, Tamil Nadu, India.
*Corresponding Author's Email: prabuchristopher.b@vit.ac.in

Abstract

Women play a vital and indispensable role in the advancement of agriculture. Women's participation in agriculture varies significantly across different regions, both in terms of their role and level of engagement. This study used the SPAR-4-SLR framework as a methodological approach to improve the thoroughness and comprehensiveness of the literature assessment over the past 50 years. The previous studies were lag to use R software to ensure an organized investigation of agricultural women's perspectives from 1974 to 2024. This methodology enables a comprehensive and measurable evaluation of research patterns, frequencies of keywords, and contributions from various countries, with citation analysis providing a more empirical understanding of the topic. The study investigates the relationship between gender relations, women's status, and employment in relation to the social, economic, demographical, and technical components of agricultural development across globe. There was less research on examining the allocation of available resources, decision-making capacities, and obstacles to the adoption of technology. The Europe and the United States of America adopted Industry 5.0 in agriculture, whereas research on other countries are spares. Researchers rarely investigate themes such as gender inequity, women's empowerment in rural areas, food security, alternative agriculture, and agriculture diversification in countries like India, Uganda, Malawi, and Bangladesh. The future research questions aim to promote women's empowerment and attain sustainable development in developed, developing and underdeveloped countries. The methodological approach, analysis tools, and comprehensive, nuanced exploration of the multifaceted role of women in agriculture and related fields across different global contexts anchor the novelty.

Keywords: Agriculture, Gender Disparities, Industry 5.0, Women Employment, Women Status.

Introduction

The participation of women in agriculture is a crucial element of rural economies, particularly in developing nations where agriculture serves as a primary economic pursuit (1). Women encounter a multitude of obstacles that have a significant influence on their professional and personal life, despite their essential contributions. Women play a substantial role in agriculture, engaging in a range of positions from workers to landowners. They engage in activities such as sowing, planting, weeding, and harvesting, among several other jobs. Women in certain regions, particularly in Asia and Africa, bear the primary responsibility for food production and ensuring food security within their households (2). Women frequently face restricted and disparities like access to resources such as land, financing, and agricultural inputs such as seeds and fertilizers, despite their significant contributions (3, 4). This disparity not only threatens their effectiveness but also their capacity to contribute to the advancement and

sustainability of agriculture. Promoting and improving the responsibilities of women not only fosters gender parity but also boosts agricultural output and enhances the welfare of families. Female individuals involved in the agricultural sector encounter complex socio-economic obstacles and land ownership is one of the most important factors (5, 6). Women's capacity to own and inherit land is sometimes impeded by cultural norms and legal restrictions in numerous societies (7). Consequently, their access to credit and other resources is restricted, as they frequently necessitate collateral. In addition, women typically receive limited education and training in agricultural techniques compared to men, resulting in decreased production and lower quality results (3).

The involvement of women in agriculture is crucial for the long-term viability of the sector and the overall economy. Recognizing and addressing the socio-economic challenges that women encounter

This is an Open Access article distributed under the terms of the Creative Commons Attribution CC BY license (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted reuse, distribution, and reproduction in any medium, provided the original work is properly cited.

(Received 02nd May 2024; Accepted 20th July 2024; Published 30th July 2024)

and acknowledging their achievements is not only an issue of achieving gender equity, but also a smart economic approach (1). Enacting policies that promote the inclusion of women in the agricultural sector will not only enhance their empowerment but also strengthen agricultural productivity and sustainability (3). Therefore, it is imperative that these policies are integrated as a fundamental component of agricultural development initiatives on a global scale. Extensive research has been conducted on the role of women in agriculture, specifically examining the inequalities, difficulties, and prospects encountered by women in agriculture field (8). While significant advancements have been achieved in comprehending the involvement of women in agriculture, there are still several elements that have not been well investigated. The emergence of feminist movements and the promotion of women's rights, especially during the 1970s, have had an impact on women's involvement in different industries, including agriculture. Initiatives such as the United Nations' Decade for Women (1976-1985) and subsequent campaigns have brought attention to gender equality, influencing the involvement of women in agriculture. The last five decades have seen significant changes in societal roles and gender dynamics, making it a critical period to study how women's contributions in agribusiness have evolved. This study focuses on the changing backdrop of women's role in agriculture during the previous decades, which has not been extensively discussed in numerous studies. This paper seeks to explore the diverse and complex role of women in agriculture, analysing both extensively studied aspects and less familiar aspects. The aim is to emphasize the crucial contributions made by women, reveal ongoing disparities in research, and propose new avenues for further investigations. The purpose of this research is to investigate the ontological nature of women's contributions to agriculture using bibliometric analysis. With the evidence from the aforementioned literature the study aims seek results for the following research questions, what have been the trends and patterns on contribution of women in agriculture in publications and citations over the past five decades? What is the most impactful source for the authors to publish on the topic women in agriculture? Who are the most cited authors, and

what are their citations on the h index and g index on women in agriculture? Which countries are the most prolific based on total citations over the past five decades on women in agriculture? From 1974 to 2024, what were the themes of research on women in agriculture? What are the topics and keywords used by women in agriculture over the past five decades?

Methodology

Bibliometric analysis refers to a collection of quantitative methodologies used to analyse scientific and technological literature. The study used R open-source software for bibliometric analysis, a method not typically used to investigate the role of women in agriculture in the previous studies. R, a widely-used opensource programming language for statistical computing and graphics, provides advanced tools and packages that greatly enhance these analyses (9). R is well-suited for these activities since it has a wide variety of packages specifically designed for manipulating data, conducting statistical analysis, and creating visual representations (10). These tools facilitate the automation of data extraction, processing, and display, hence simplifying the management of enormous datasets commonly seen in bibliometric investigations.

SPAR-4-SLR Approach

Paul et al., (11) proposed the SPAR-4-SLR approach (Scientific Procedures and Rationales for Systematic Literature Reviews). SPAR-4-SLR explains the 3 major "A" phases assembling, arranging, and assessing. The 6 minor phases include identification, acquisition, organization, purification, evaluation, and reporting. The detailed phases and their items are explained in Figure 1.

Phase 1 Assembling: In SPAR-4-SLR, data assembly refers to assembling pertinent information from existing secondary sources such as databases and published literature. Identification and acquisition are the two minor phases of assembly. Where the database Scopus is characterized as the dominant research field, research topics, source type, and source quality. Based on the objectives, the Scopus database was chosen for data collection throughout the month of April 2024. According to (12), the Scopus database contains the bulk of social science papers and has over 60% more coverage than the Web of Science

(WOS) database. The following search string was used for this purpose: "Women in agriculture" and "Female in agriculture" in specific subject Business accounting and management and Economics, Econometrics. This covers all of the major research themes included in the Scopus database in article titles, abstracts, and keywords. Initially, a total 3210 articles were retrieved and reduced to 173 documents and selected for analysis.

Phase 2 Arranging: The arranging phase includes two minor phases organization and purification. The organization was involved in coding all the selected documents for analysis and to find the

results. This study includes structuring to ensure the data analysis is clear and cohesively. Authors provides an all-encompassing comprehension of the prevalent theories, contexts (countries and industries), characteristics (interconnections of key variables), and methods (research approaches and analysis techniques) that have been addressed in prior studies pertaining to this subject matter (12). The second minor phase is the purification of data which includes data screening and data reduction. Only 173 documents selected based on the subject area in English language for further analysis.

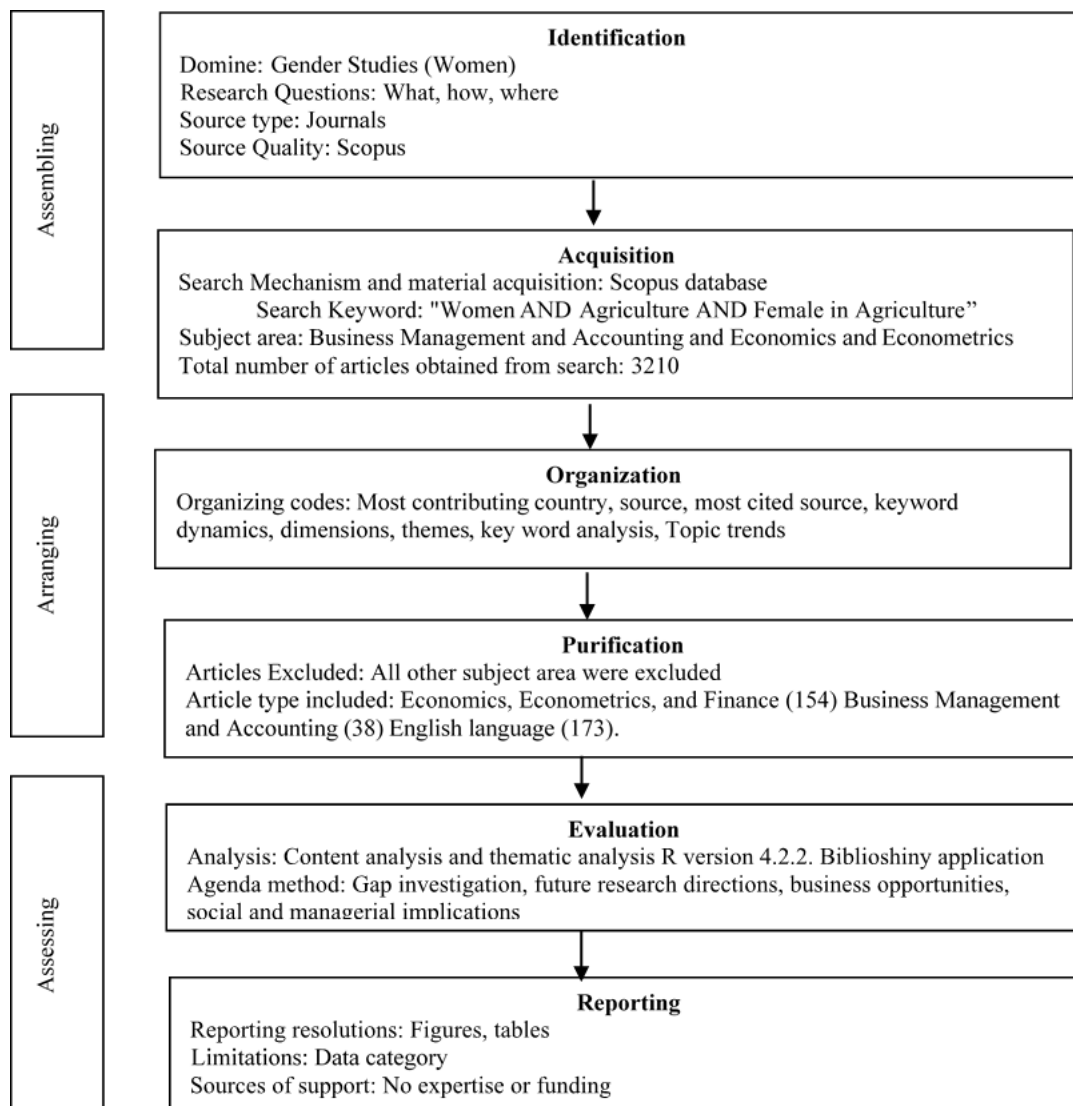


Figure 1: SPAR-4-SLR Approach

Phase 3 Assessing: Assessing in SPAR-4-SLR approach deals with evaluation and reporting using R programming software version 4.2.2 and Biblioshiny application. Based on the gap analysis this study suggested theories to be used in future

studies, future research agenda, business opportunities in agriculture, and managerial and social implications and practical implication with respect to Asian business. The limitations of this study are also justified in the conclusion part.

Results

The Trends and Patterns In Publications

The main information from the Scopus database ranging from the time span 1974 to 2024, which consist of 173 articles authored by 379 authors.

The annual growth rate of production per year is 1.4 % and the Document average age is 10 years and 5 months and citations per document is 24.5. The documents contain totally 7488 references and citations. The authors used 512 key works for highlighting their documents.

Table 1: Summary Statistics

Description	Results
Timespan	1974:2024
Sources (Journals, Books, etc)	100
Documents	173
Annual Growth Rate %	1.4
Document Average Age	10.5
Average citations per doc	24.5
References	7488
Document Contents	
Keywords Plus	605
Author's Keywords	512
Authors	
Authors	379
Authors of single-authored docs	58
Authors Collaboration	
Single-authored docs	62
Co-Authors per Doc	2.32
International co-authorships %	23.12
Document Types	
Article	173

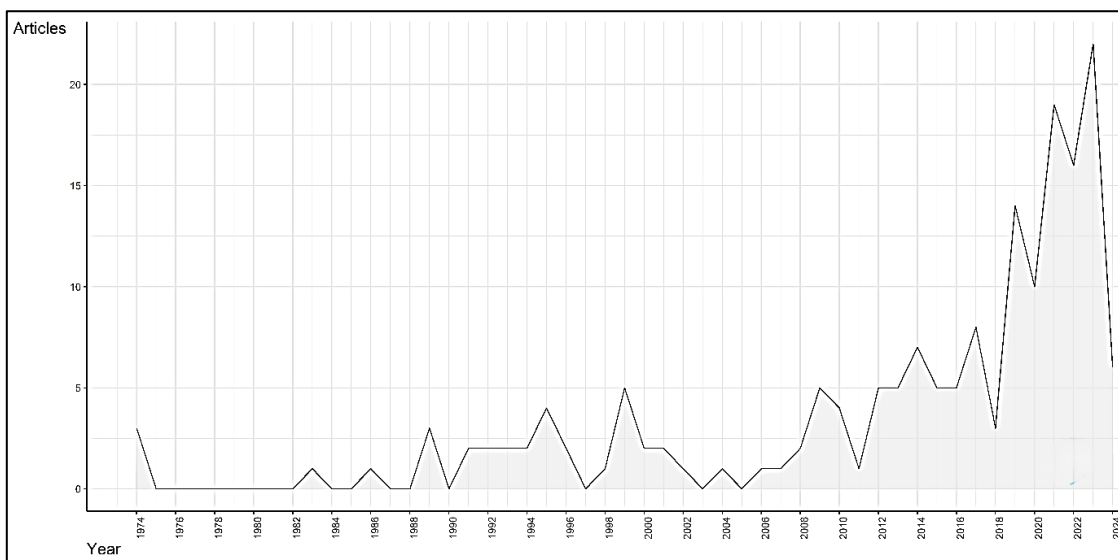


Figure 2: Annual Scientific Production

The annual scientific production of documents in Scopus database is depicted in the Figure 1. The Annual Scientific production ranging from 1974 to 2024 where the mid-point of the production period is 1999. This graph shows that compare to 1999

the production was limited 1 to 5 documents per year. But later from 2000 the graph attained its peak in the year 2016 and during the last year even it dramatically increased to 20 documents in the year 2023. This graph depicts that the annual

production of research in women in agriculture per year drastically and significantly increased after 2018.

The Most Impactful Source

The source impact is depicted in Figure 3. The chart spans from 1974 to 2022, that's a range of 48 years. To split the years equally for analysis, Timeframe is segments into four roughly equal periods as follows.

1974 - 1987 (Early Period): During this time, we can see that all lines are at the lower part of the graph, indicating that there were relatively few publications. There is a flat line for "World

Development Perspectives," suggesting that this journal either did not exist or was not included in the data during this period. The publication counts for the other journals are quite close to each other, with "Food Policy" and "World Development" showing a slight lead toward the end of this period. **1988 - 2001 (Development Period):** There is a gradual increase in publication occurrences for all journals, with "World Development" beginning to show a more pronounced lead. This could suggest a period of growth in the field of development economics, possibly due to increasing global focus on development issues.

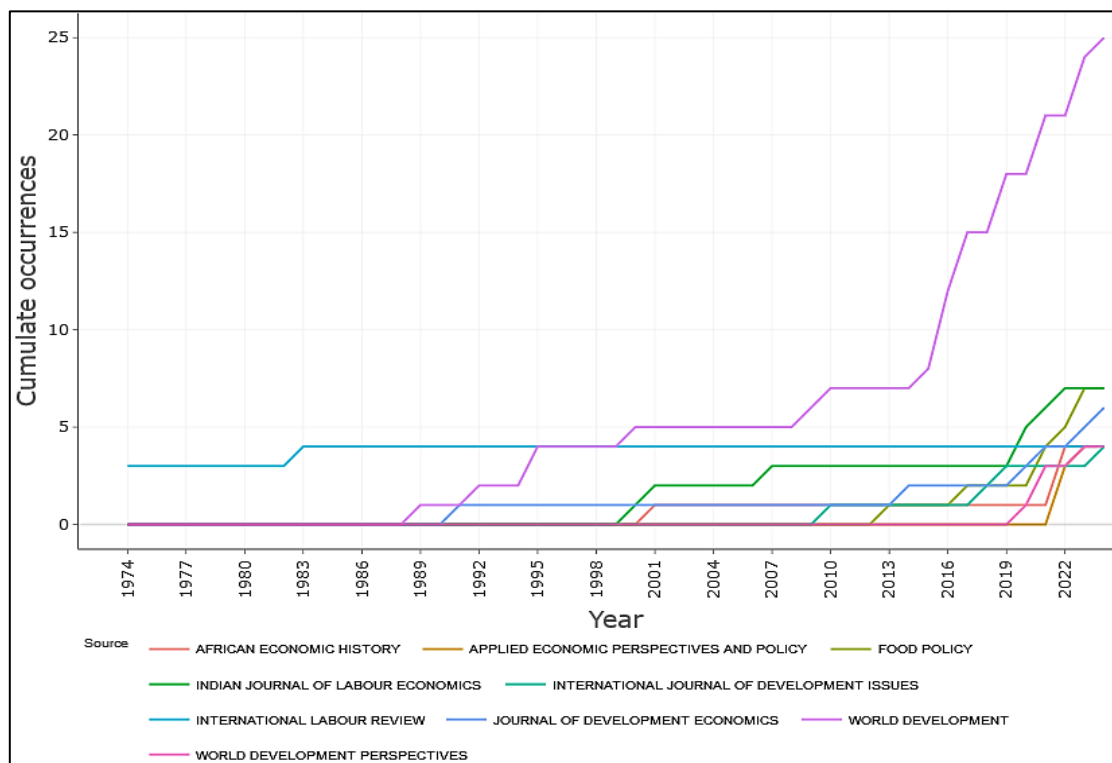


Figure 3: Source Impact Document

2002 - 2015 (Expansion Period): This period shows a more noticeable separation between "World Development" and the other journals, indicating a surge in publications from "World Development." The other journals also show growth, but at a more moderate pace. The lines start to diverge more clearly, suggesting different rates of publication growth among the journals.

2016 - 2022 (Recent Period): "World Development" shows a very steep increase, suggesting a significant boost in publication frequency, possibly indicating the journal's major influence or a surge in research output in this study. "World Development Perspectives" shows up on the chart and grows quickly, which could

indicate either the journal's recent establishment or recent inclusion in the dataset. The other journals continue to grow but at a slower rate compared to "World Development." These observations suggest a field that is not only growing but also becoming more diversified in terms of where research is being published. The growth pattern of "World Development" could reflect its position as a leading journal in the field. Meanwhile, the emergence of "World Development Perspectives" could indicate a new venue for specialized research dissemination. The data could reflect broader trends in economic research, the increasing importance of certain topics, or changes in the journals' scopes and policies. Moreover, the

sharp increase in recent years for some journals could be due to digitalization and better access to

The Most Predominant Sources, Authors and Their Citations

Table 2 depicts that Journal world development is having a greater number of papers (NP) when compared to any other journal source. World development is the Journal having h-index 17 and

publishing platforms, increasing the visibility and citation potential of newer articles.

g-index 25 the journal has publications since 1989. Similarly Agricultural Economics is having low h and g index.

The Table 3 depicts that author Alesina who contributed in Quarterly Journal of Economics is having highest citations with 788.

Table 2: Source Impact Document

Element	h_index	g_index	m_index	TC	NP	PY_start
World Development	17	25	0.472	1129	25	1989
Food Policy	4	7	0.333	221	7	2013
Indian Journal of Labour Economics	4	6	0.16	36	7	2000
Journal of Development Economics	4	6	0.118	252	6	1991
International Journal of Development Issues	3	3	0.2	14	4	2010
International Labour Review	3	4	0.059	31	4	1974
World Development Perspectives	3	4	0.6	19	4	2020
African Journal of Economic and Management Studies	2	2	0.4	35	2	2020
Agrekon	2	2	0.333	6	2	2019
Agricultural Economics	2	2	0.056	8	2	1989

Table 3: Most Locally Cited Documents and Source List

Paper	DOI	Total Citations	TC Per Year	Normalized TC
Alesina A, 2013, Quarterly Journal of Economics (13)	10.1093/Qje/Qjt005	788	65.67	3.91
Quisumbing Ar, 2010, World Development (14)	10.1016/J.Worlddev.2009.10.006	260	17.33	3.14
Ali Da, 2014, Journal of Development Economics (15)	10.1016/J.Jdeveco.2013.12.009	160	14.55	4.75
Palacios-Lopez A, 2017, Food Policy (16)	10.1016/J.Foodpol.2016.09.017	144	18.00	2.99
Carney J, 1993, Economic Geography (17)	10.2307/143593	138	4.31	1.92
Mehrotra S, 2017, World Development (18)	10.1016/J.Worlddev.2017.05.003	115	14.38	2.39
Croppenstedt A, 2013, World Bank Research Observer (19)	10.1093/Wbro/Lks024	108	9.00	0.54
Ma W, 2020, Electronic Commerce Research (20)	10.1007/S10660-018-9323-X	98	19.60	5.57
Jacoby Hg, 1995, Journal of Political Economy (21)	10.1086/262009	96	3.20	1.98
Kotsadam A, 2016, World Development (22)	10.1016/J.Worlddev.2016.01.007	93	10.33	2.10

The Figure 4 is the multivariate analysis of citation or scatter plot from a bibliometric are the result of a citation analysis. The chart has two dimensions (Dim 1 and Dim 2), which likely represent principal components derived from a multivariate analysis of citation. These dimensions explain a percentage of the variability in the dataset, with Dimension 1 explaining 47.69% and Dimension 2 explaining 22.43%. The higher the percentage, the more variance that dimension explains in the data. Each point represents a specific publication, identified by the author's last name, the publication year, and the journal or the field of

study (e.g., "world dev" for World Development). The proximity of points to each other suggests similarity in the context of the analysis. For example, publications that are often cited together or share similar keywords will be closer to each other. The plot appears to use colour coding (one red point can be seen, the others are blue), which represents two different clusters or categories identified by the analysis. Which means that (23), "World Development" (the red point) has a distinct characteristic that separates it from the other studies.

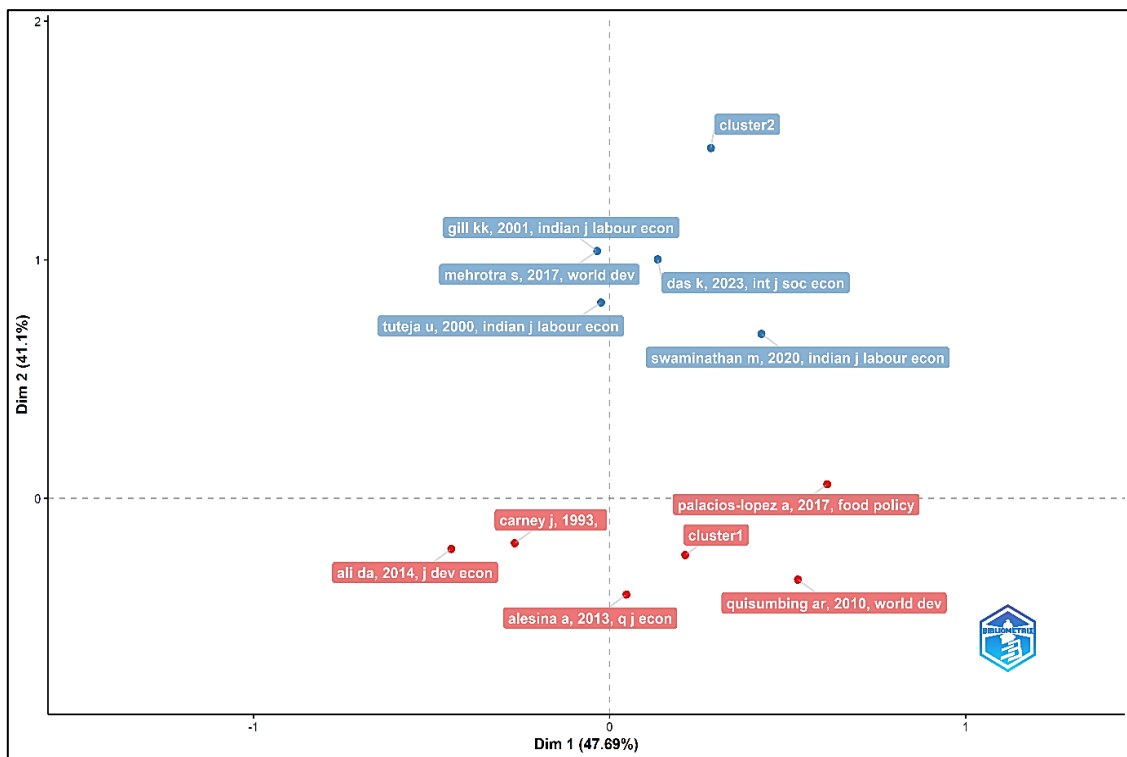


Figure 4: Multivariate Analysis of Citation

The annotations 'cluster1' and 'cluster2' suggest that the analysis has identified groups of publications that are similar in some way. For example, 'cluster1' represents a set of publications from "world development" that are closely related. The way in which the previous researchers are interrelated is indicated by their proximity on the plot. For instance, Indian journal of labour and economics" (23) and Indian of labour and economics" (24, 25) are close to each other, suggesting a strong relationship perhaps they share a common topic, methodology, or are frequently cited together as shown in the figure. The point (15) is far from the others on the left side, indicating it is an older, foundational piece

that is distinct in its focus or impact from more recent publications.

It looks like publications from the same journal, such as "Indian of labour and economics" tend to cluster together. However, over time, there is a spread along the principal components, which might reflect the evolution of research themes within the journal. This type of visualization helps researchers understand the structure of the scientific literature in a study are identified that the most influential studies are produced by World Development, most cited country is United States of America (USA) and most cited author is Alesina, Quarterly Journal of Economics.

Table 4: Most Relevant Authors

Authors	Articles	Citations	H index	g index	TCpY	PY started	Articles Fractionalized
Burnette J	3	87	3	3	3.7	1996	3.00
Bellows Ac	2	9	2	2	4.9	2020	0.75
Bojčić R	2	25	2	2	3.6	2018	0.67
Deiningner K	2	51	2	2	20.2	2016	0.58
Fisher M	2	17	2	2	4.4	2001	0.53
Giuliano P	2	810	2	2	67.9	2014	1.33
Goldstein M	2	268	2	2	23.5	2014	0.67
Jacoby Hg	2	159	2	2	4.7	1991	2.00
Knežević G	2	25	2	2	3.6	2017	0.67
Kondylis F	2	19	2	2	6.9	2020	0.58

"Articles Fractionalized" is used to account for each author's contribution to a co-authored publication. When an article is fractionalized, the credit for each author's contribution to the publication is given proportionately, instead of the author being credited for writing the entire document; three items totalling a fractionalized score of three dollars. This implies that researchers (26) either wrote these articles by themselves or that each co-author's work was regarded equally, earning each article a full credit score. The Burnette is the author having high h index (3) and high g index (3). The author having high citations is Giuliano with the total citation 810 and he started his publication in the year 2014. His total citation per year is 67.9.

The Most Prolific Countries Based on Total Citations

Most Contributing Countries

The top 15 contributing countries are selected based on citations in which the top cited country is USA with 651 citations followed by United Kingdom (UK) with 146 citations and India with 124 citations. The difference between USA and UK citations are 505. The least contributing country is Ghana with 17 citations.

Bojici, Goldstein, Kenzevic, Deninger, and Knezevic are the authors use Gender as a main theme in different country context like USA, India, UK, Kenya, Nigeria, Ghana, Germany, Serbia, and China. The middle column has flows that connect to 'India', indicating that the entities on the left are associated with or contribute to India in some way. India is often associated with concerns such as 'women,' 'agricultural,' and maybe 'empowerment' and 'labour.'

This suggests that the individuals or authors are listed in the AU column have carried out research, authored publications, or have some form of affiliation with the fields of study or work relevant to India. Furthermore, it is evident that the 'India' mentioned in the middle column is linked to the 'India' mentioned in the right column. This connection implies the possibility of a recipient or co-authorship association within the Indian context. The thickness of the flows typically indicates the magnitude or intensity of the relationship – a thicker flow signifies a stronger or more substantial link. The figure visually illustrates the interconnections between things in the context of themes and highlights the relative significance of themes within the Indian linkages. The literature emphasises that there are inadequacies in the application of agricultural consulting and extension services that may cause farmers, particularly women farmers, to have unequal access to resources and information. The results of statistical and geographical analysis show that, in comparison to their male counterparts, women in Liberia have less agency to make decisions at home and in the community (27). Women have fewer access to leadership possibilities, credit, and information and communication technologies. In India the state Punjab kept moving backwards in terms of giving women equal job possibilities. The situation for women seeking work became more difficult due to the high mechanisation of agriculture and the slow expansion of the non-agricultural economy (6). Policies promoting gender equality that aim to provide women with assets, especially land, have frequently fallen short of their objectives in India,

China and Indonesia (28). The well-being and empowerment of women resulting from migration workers are influenced by the socio-cultural environment in which it occurs. The literature documents both positive and negative consequences for women who are left behind, yet the deliberate choice to be left behind and its long-term presence in a society are subjects of debate (29). Researchers (30) stated that there is the gender difference in the adoption and performance outcomes of maize produced by smallholder farmers in the Kwa Zulu Natal province in South Africa. The researchers investigated issues like

food security, alternative farming, gender inequality, female empowerment in rural areas, and agricultural diversification in countries like Bangladesh, Uganda, Malawi, and India. In this digital era gender disparity still exists in employment opportunities, decision making, access to leadership and assets, credit, information and communication technologies. The shift in women access to technology, assets and finance will create employment opportunities which will result in effective leadership and decision making to attain self-reliant economy and sustainability.

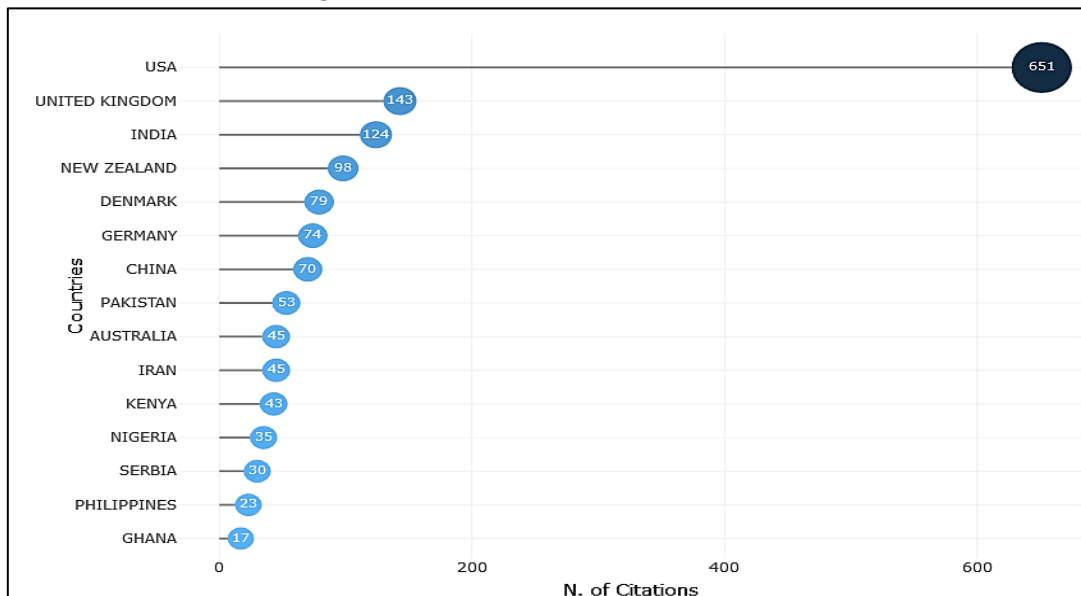


Figure 5: Most Contributing Countries

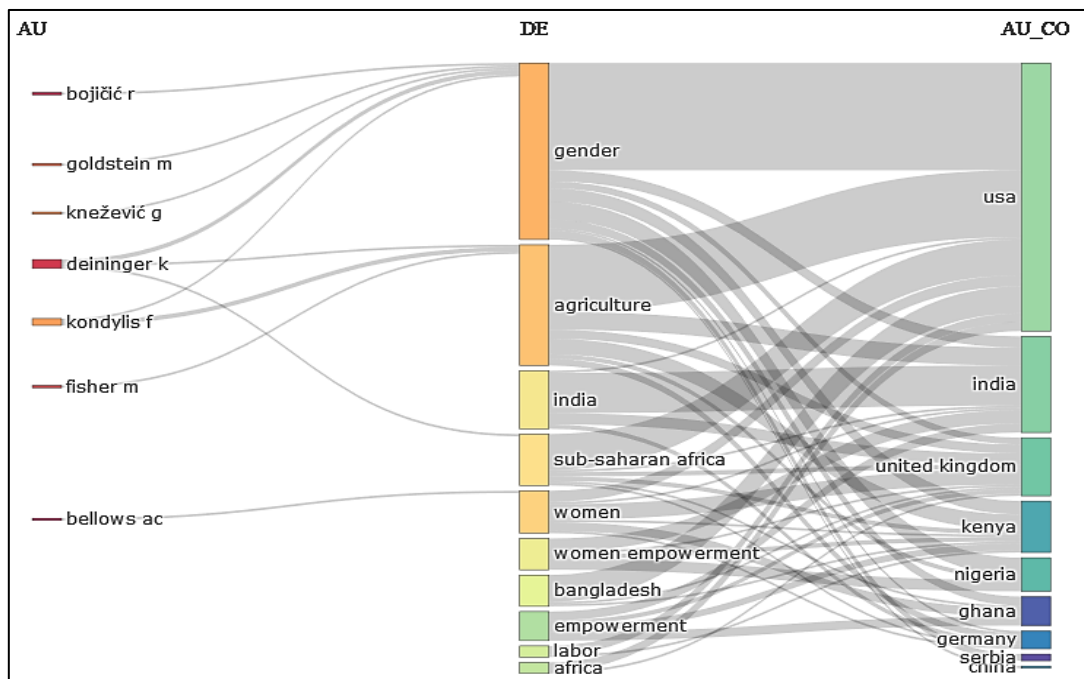


Figure 6: Three Dimension Analysis of Authors, Keyword, and Country

The Themes of Research on Women In Agriculture from 1974 to 2024

Trend Analysis

The text graphical representation of the frequency of specific phrases in a dataset as it changes over time. The chart is presented in a 'lollipop' format, with each 'lollipop' representing a term and the horizontal axis indicating the years. The terms are listed on the vertical axis, and the location of each dot on the horizontal axis indicates the year(s) in which the term was relevant, prevalent, or utilized in the dataset. The size of the dots presumably corresponds to the frequency or a metric of significance/weight of the term during that particular year.

To analyse the trends, we can divide the years from 1974 to 2022 into three equal parts. 1974 – 1988, During this time frame, the chart shows a random occurrence of a few terms near the beginning. By the mid-1970s, terms such as 'age factors,' 'rural population,' 'socioeconomic factors,' and 'women' began to emerge.

This was soon followed by the appearance of 'population dynamics' and 'developing countries.'

The limited level of activity indicates that these issues were in the early stages of development within the context of the dataset. From 1989 to 2004, there was a notable rise in both the occurrence and variety of terms. The scope of the topics expands to encompass areas such as 'economic development,' 'agricultural development,' 'environment,' and 'demography.' There is a noticeable rise in the discussions pertaining to 'agricultural labour' and 'developing country.' This may suggest a heightened interest or concern in these domains during this time period. From 2005 to 2022, the last era exhibits the highest concentration of terms, suggesting that certain topics have become significantly more widespread or extensively researched. The phrases 'agricultural labour,' 'gender,' 'agricultural labourer,' and 'crop production' are commonly used in the context of agriculture. There has been a noticeable rise in the usage of gender-related phrases, such as 'gender disparity,' 'gender relations,' 'women's employment,' and 'empowerment.' This indicates a substantial change in emphasis towards gender concerns in the field of agriculture and development.

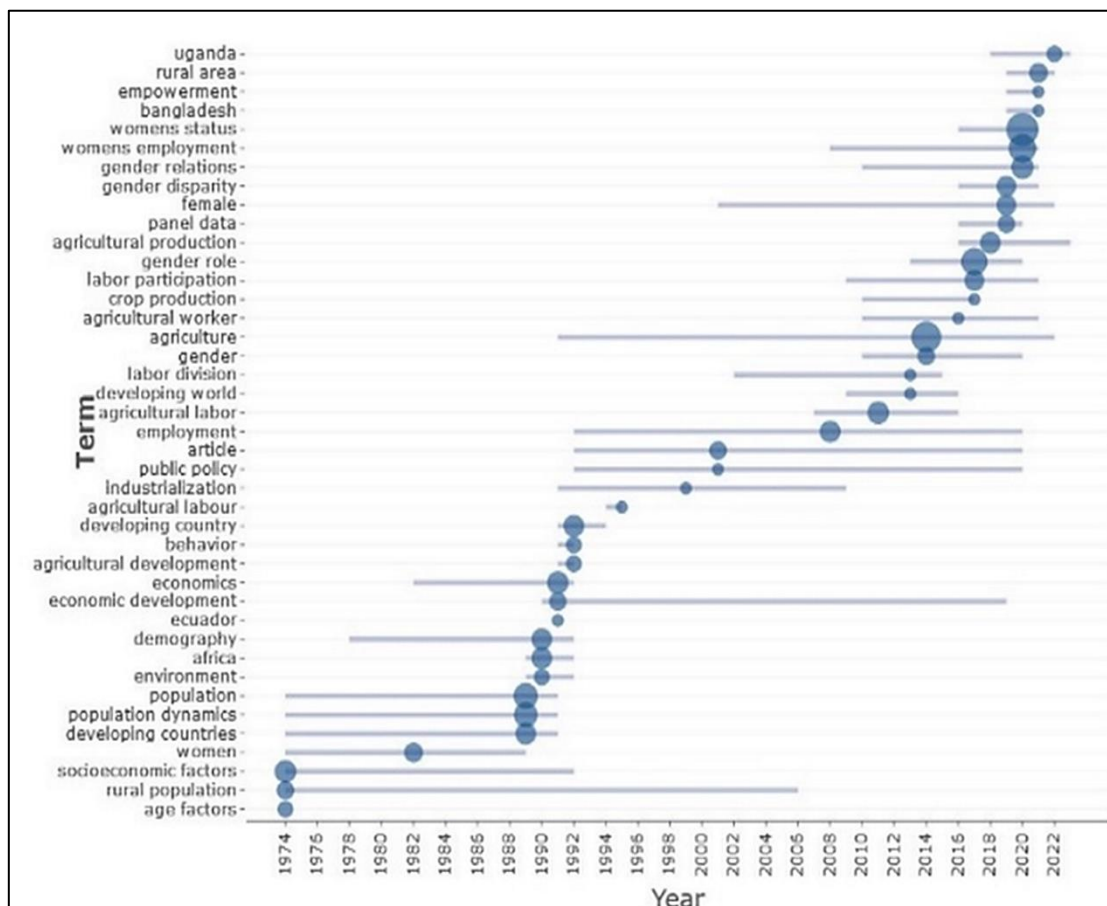


Figure 7: Keyword Evolution

Theme 1: Gender Dynamics in Agriculture:

Keywords occurred in the theme 1 are women's status, women's employment, agricultural labour, agricultural production, labour division. The prominence of these terms suggests a significant interest in understanding how gender roles are defined and negotiated within the agricultural sector. It is inferred that there are critical need to analyse the contributions of women in agriculture, the disparities in labour division, and the socio-economic factors influencing women's employment in this sector.

Theme 2: Socioeconomic and Demographic Analysis:

Population dynamics, demographic factors, socioeconomic factors, economic factors, population growth are the keywords used in this theme 2. There is a clear trend toward investigating the interplay between population metrics and economic conditions. The future researcher could deduce that in-depth studies on how demographic shifts affect and are affected by economic changes are vital. This might be particularly relevant in developing countries where agriculture is a major part of the economy.

Theme 3: Policy and Development Studies:

Keywords used in the theme 3 are public policy, developing country, developing world, rural development, rural economy. The data indicates a scholarly focus on policy implications for development, especially in rural contexts. It is concluded that there is an ongoing effort to align public policies with the goals of sustainable

development and economic empowerment in rural areas, which often hinge on agricultural success.

Theme 4: Geographic-Specific Studies:

Keywords used in the theme 5 are India, Africa, Bangladesh, Uganda, and rural area. These keywords hint at regional studies that are crucial for understanding localized social, economic, and agricultural conditions. There is a need to compare and contrast these regional studies to glean insights into the universality or particularity of gender roles and economic conditions across different geographic locations.

Theme 5: Cultural and Social Examination:

Keywords used in the theme 5 are gender role, gender relations, gender disparity, culture, empowerment. There is an evident interest in the cultural and social aspects of gender as they pertain to economic roles. Despite the economic focus of other themes, there is an acknowledgment that cultural norms and social structures significantly shape economic outcomes, particularly for women. Thus, there is a need to address cultural barriers to achieve true empowerment and equality.

The Figure 8 is the strategic diagram or a thematic map from a bibliometric analysis, typically used to visualize the structure of a research field by plotting themes or topics based on two dimensions: centrality and density. The diagram suggests the research field is broadly concerned with themes related to "agriculture," "employment," and "rural development," as these topics appear to be foundational to the field.

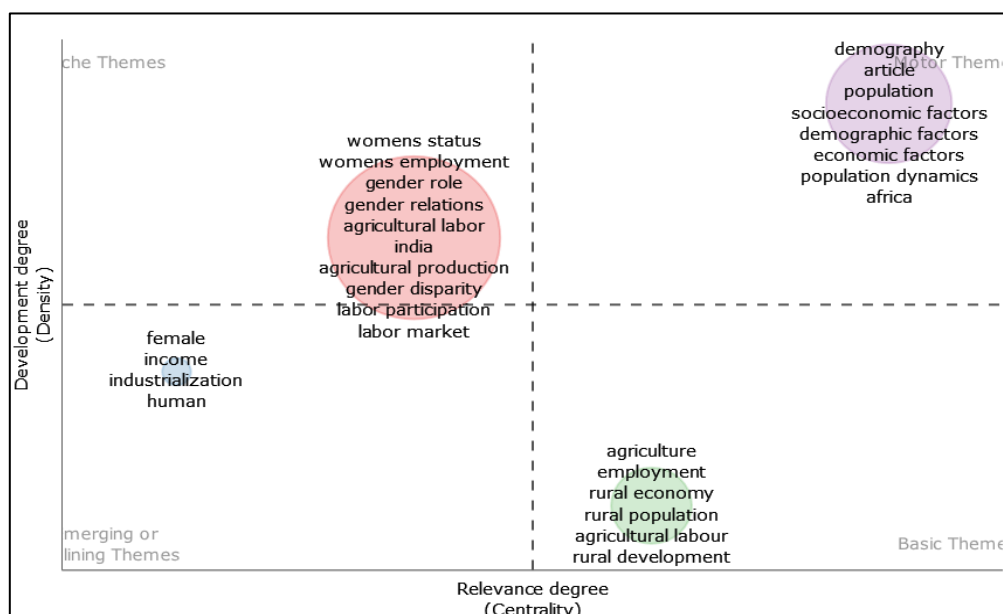


Figure 8: Thematic Mapping

Horizontal Axis (Centrality): This axis represents the importance or influence of a theme within the overall research network. Higher centrality indicates a topic is more central and influential in the field, often a fundamental or well-established area of research.

Vertical Axis (Density): This axis indicates the development of the theme, with higher density reflecting a tightly clustered and well-developed theme, suggesting internal cohesion among the studies within that theme.

Upper Right (Motor Themes): Themes here are both well-developed and central to the field. These are mature topics with extensive research and high relevance, often setting the direction for the field. The motor themes indicate that demographic aspects and socio-economic factors are currently the most influential and developed, which could suggest that recent research is particularly concerned with the impact of population dynamics on agriculture and rural development.

Lower Right (Basic Themes): These themes have high centrality but lower development. They are fundamental to the field but might be more diverse in terms of development, or they may represent emerging areas of research that are becoming central. Basic themes such as "agriculture," "employment," and "rural development" indicate foundational aspects of the research area.

Upper Left (Niche Themes): These are well-developed but not yet central in the field. They could be specialized topics that are well-studied within a smaller community or emerging topics gaining cohesion. Niche themes include "women's status," "gender role," and "gender relations," suggesting focused, mature areas of research that are perhaps less central in the field. "Female," "Income," "Industrialization," and "Human" are in the lower left quadrant, indicating these are either emerging or declining topics with lower centrality and development.

Lower Left (Emerging or Declining Themes): These themes have low centrality and development, indicating they are either new and not yet well developed or possibly areas that are losing traction within the field. Emerging themes like "human" and "industrialization" may represent new, less-explored areas, or declining interest if the topics are moving out of focus. This strategic diagram is a powerful tool for researchers and policymakers to understand the evolution of a research field, identify key themes, and direct future research efforts. The graph does not cover the latest technological advances in agriculture (like precision agriculture or biotechnology), specific policy analysis, or the impact of climate change on women in agriculture if those areas have not been prominent or well-established in the literature up to the present time.

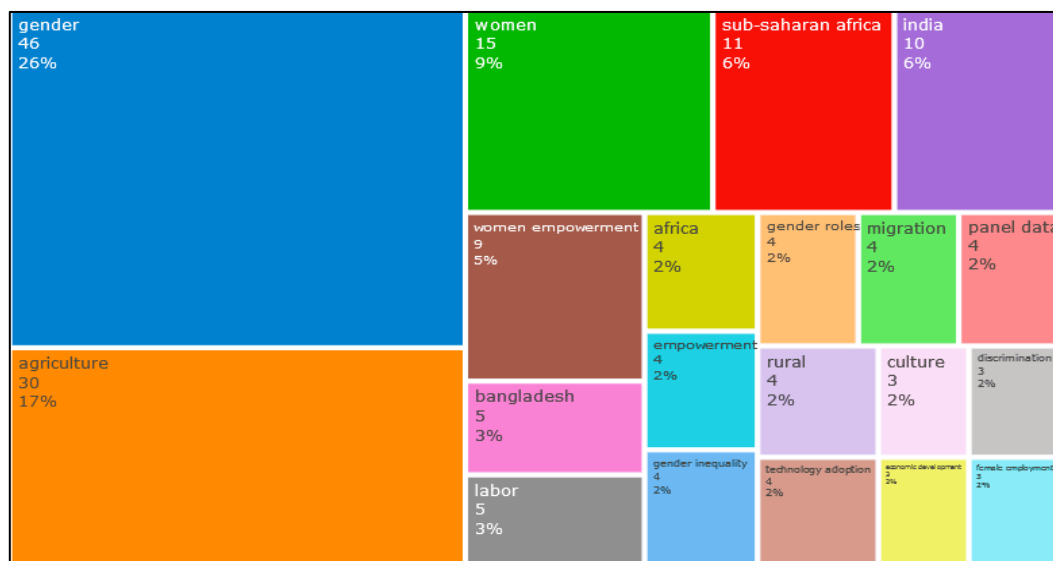


Figure 9: Tree Map

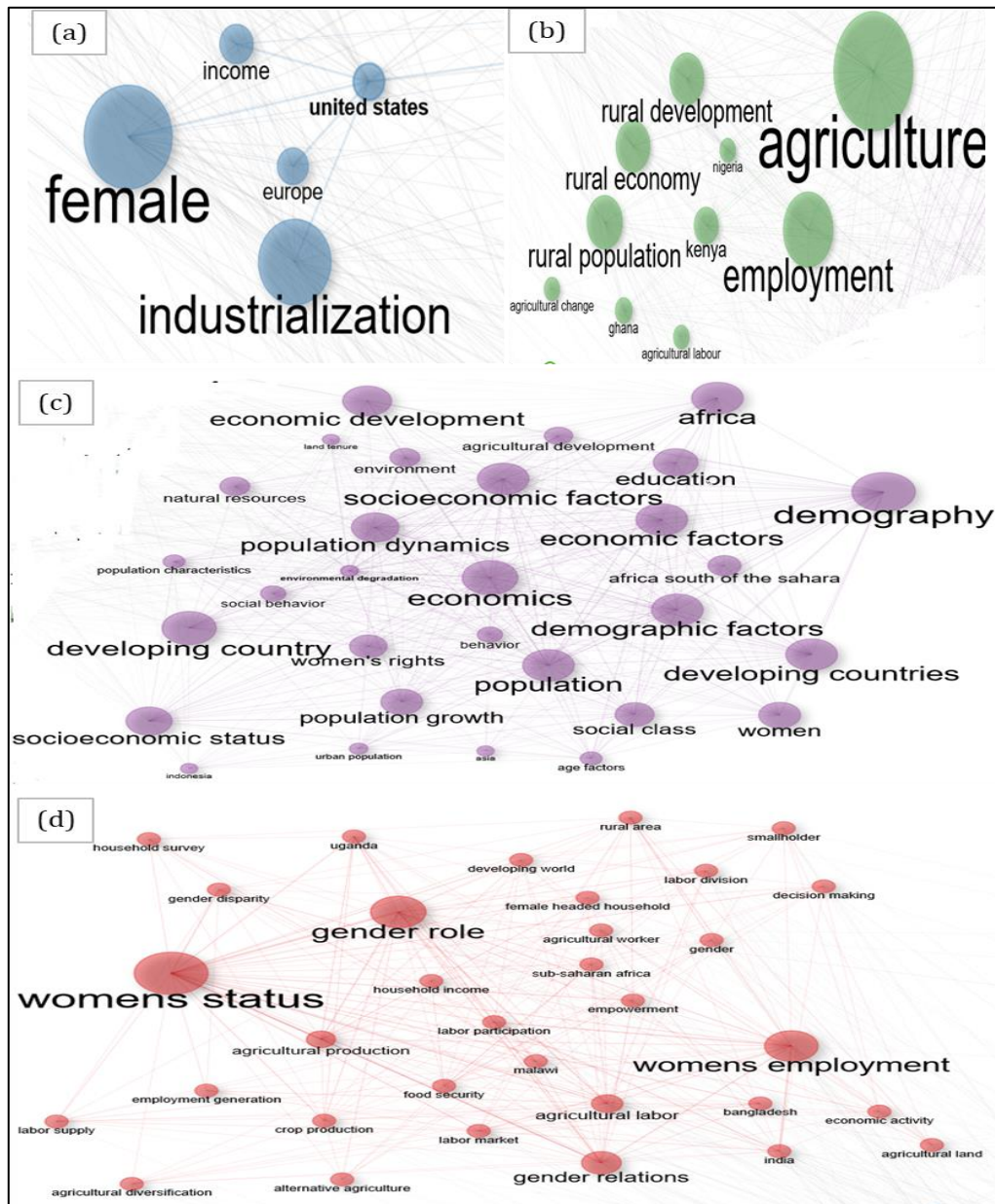


Figure 10: Core research areas, (a) cluster 1, (b) cluster 2, (c) cluster 3, (d) cluster 4

The Revolving Topics and Keywords Over The Past Five Decades

Tree Map (Figure 9): The tree map shows the distribution of research topics by the frequency of occurrence. Larger areas represent more heavily researched topics. Most researched topic is "Gender" (26%) and "Agriculture" (17%) are the two largest areas, indicating they are the most researched topics. Niche researched keywords are smaller areas like "labour" (3%), and "culture" (3%) whereas, "economic development", "female employment", "discrimination" and "technology adoption" with (2%) represent more niche topics, which are specific but less frequently occurring in the dataset.

Network Visualization: This visual representation emphasizes the frequency of terms by their size. Most researched keywords are "Agriculture" in blue cluster and "Women Status" in red cluster are prominently displayed, corroborating the findings from the network visualization that they are central themes in the research field. Niche researched are in smaller terms like "food security," "economic development," "technology adoption", "gender equality, gap, discrimination, and roles", "rural empowerment", "female employment", "agricultural companies", "gender inequality", and "rural culture" indicate niche topics that are present in the literature but not as dominant. The

most researched topics across both figures seem to centre on "Gender," "Agriculture," and "Women," particularly their roles and status in agriculture and development. Themes related to demographic aspects, socioeconomic factors, and employment are also central and well-developed, highlighting their importance in the field.

Core Research Areas: "Women's status", "agriculture", "Economics", "Industrialization" are the four clusters and heavily researched topics and central to discussions in this field. There are strong thematic clusters around these four core areas, indicating subtopics or related fields of study that are interrelated.

Keyword Network visualization has four clusters are explained below and depicted in Figure 10A cluster 1, Figure 10B Cluster 2, Figure 10C Cluster 3, and Figure 10D Cluster 4.

Cluster 1: Industrialization is connected with female, income, Europe, and USA where these are developed nations with industry 5.0. The Fifth Industrial Revolution is a nascent stage of industrialization where humans collaborate with advanced technology and Artificial Intelligence power-driven robots to improve agriculture technology procedures.

Cluster 2: Agriculture is another cluster related with the keyword's rural development, economy and population in the developing nations like Ghana, Kenya, and Nigeria through employment agriculture labour and changes

Cluster 3: Various factors like economic, social, demographic factors are majorly researched in Africa and further the same factors researched niche are Asian countries which include Indonesia. The very least concentrated topics like social behaviour and behaviour of women with age factors.

Cluster 4: Women Status is another cluster with major used topics like gender relations, employment and women employment. Whereas the topics that are researched less are gender disparity, women empowerment in rural areas along with food security, alternative agriculture, agriculture, diversification in countries like India, Uganda, Malawi, and Bangladesh. The future research will to create employment opportunities for women and leads to women empowerment.

Discussion

The present study aimed to find the most contributing author, source, trending topics over

the selected period using bibliometric analysis in open-source software R. The occurrence of publications from various economic and business journals over time, from 1974 to 2024 the range of 50 years considered for the present study. In the earliest period, the authors used similar research terms like "gender" (31), "employment" (32), and "public policy" (33) appear, suggesting foundational research in gender roles in agriculture. We see a continuation of these terms, with a notable appearance of "labour division" and "agricultural labour" (34). This may indicate a growing focus on the specifics of women's roles in the agricultural workforce. The focus shifts slightly with terms like "gender disparity" and "female" appearing more frequently, possibly reflecting an increasing interest in the inequalities faced by women in agriculture are related to the previous literature (22). There is a specific emphasis on women's roles in agriculture in certain countries or regions, Uganda (19), Bangladesh (35), Kenya (36) and India (23) which may indicate a targeted research interest in the agricultural practices, challenges, and policies specific to these areas are in line with the earlier research. The study results shows that US has the high citation score compare to any other country. The least cited countries like Ghana, Nigeria, Serbia, Philippines, Australia, Iran, Kenya are having the citation less than 50. Hence these countries can concentrate on agricultural women studies so that the unexplored problems faced by agricultural women can be explored. Further the researchers can contribute more to the development of contribution of women in agriculture. The term "rural area" suggests that the current research is likely addressing rural development issues face by women, recognizing that the majority of agricultural activity and the workforce in many developing countries are situated in rural regions (24). The appearance of terms like "empowerment" and "women's status" points to a research concentration on the social and economic empowerment of women within the agricultural sector and their overall status in society are previously studied (35). "Women's employment" implies an ongoing investigation into the labour dynamics, job opportunities, employment conditions, and economic contributions of women in agriculture. The term "gender relations" encompass a variety of topics, from gender-based division of labour to access to

resources and decision-making, technology adoption and various hindrances faced by women within agricultural settings. This indicates a multifaceted approach to understanding and enhancing the role of women in agriculture, focusing not only on their labour but also on the broader social and economic implications of their work. The emphasis on empowerment and status reflects a global trend towards achieving gender equality and the Sustainable Development Goals (SDGs), particularly SDG 5, (gender equality) which seeks to achieve gender equality and empower all women.

Understanding the historical role of women in agriculture helps to acknowledge women's substantial contributions that have often been overlooked or undervalued. Women have played crucial roles in food production, resource management, and agricultural innovation across different cultures and eras. The overall trend suggests an expanding and deepening of research interests over time, moving from broad concepts of gender and employment to a nuanced exploration of women's roles in agriculture, focusing on specific issues of disparity, empowerment, and the impact on particular regions or aspects of agriculture. "Empowerment," "women's status," and "women's employment" suggest a broader concern with the social dimensions of women's work in agriculture, possibly reflecting an intersectional approach to gender studies in agricultural contexts. In the most recent period depicted in the chart (roughly around 2023), the topics with the largest bubbles, indicating the highest frequency or concentration, include "Uganda," "rural area," "empowerment," "Bangladesh," "women's status," "women's employment," and "gender relations." These suggest that the current focus in the context of women in agriculture includes geographic focus, rural development, empowerment status, employment practice, gender relations.

The present study emphasis mostly on economic and demographic issues faced by women in the field of agriculture in global context. However, as time progresses, there is a transition towards

comprehending the socioeconomic elements, such as labour dynamics and empowerment of women. This may indicate a more comprehensive knowledge of development, acknowledging that economic advancement should be followed by societal advancement for the agribusiness women. The persistent occurrence of agricultural labour and production-related terminology on women in agriculture sector across the timeline 1974 to 2004 indicates a continuous emphasis on the agriculture field as a vital element of rural development, particularly in developing nations such as India, Kenya, Nigeria, Ghana, Germany, Serbia, Africa, Bangladesh, Uganda and China. The policy makers of these countries can encourage more research on this context. The ramifications of this situation could involve ongoing investment and innovation in agricultural methods, with the goal of enhancing productivity and sustainability by reducing gender disparity.

To address the complex themes of Sustainable Development, Women and Gender Studies, and Women Empowerment in a more context-specific manner and aligned with developments such as Industry 5.0, research questions can be adapted to explore variations across different levels of national development and technological progress. Here are similar research questions framed within the context of developed, developing, and underdeveloped nations, and considering the implications of Industry 5.0. The research questions have a significant result providing the recent topics to be explored in the future for future researchers and academicians. By framing these questions within the context of different national development levels and considering the implications of Industry 5.0, researchers can develop targeted strategies that recognize and utilize the unique challenges and opportunities present in each context and suggest the policy makers of the country to attain sustainable development. The potential future research questions were framed for the academicians and researchers to explore more and to find the viability in this research area are listed in Table 5.

Table 5: Potential Future Research Directions for Agribusiness Women in Global Context

Clusters	Developed Nations	Developing Nations	Underdeveloped Nations
Sustainable Development	How do advanced technological tools and policies in developed nations contribute to reducing gender inequalities in agriculture?	What are the key barriers and facilitators to gender equality in developing countries, especially in relation to environmental sustainability in agriculture?	In underdeveloped nations, which interventions are most effective at initiating gender equality movements, especially in rural and isolated communities in agriculture? How do issues of resource scarcity impact gender bias and what are sustainable solutions to mitigate these effects?
	What role do high educational levels play in reducing gender biases and promoting sustainability in developed countries?	How can mediation and moderation models be utilized to understand the impacts of cultural and economic factors on gender equality in developing nations?	
Women Empowerment	Investigate the impact of high-quality education and advanced economic structures on women empowerment in developed nations.	Explore the relationships between health, empowerment, and technology adoption in developing countries with varying access to technological resources.	Identify the factors that inhibit or promote quality education for young women in underdeveloped regions and the impact on empowerment.
	How do Industry 5.0 innovations, like AI and big data, influence women's empowerment in high-income countries?	What are the specific challenges and opportunities for women's empowerment through technology and education in regions transitioning from low-income to middle-income statuses?	How can minimal access to technological advancements and information be improved to empower women effectively in underdeveloped areas?
Industry 5.0 and Agricultural Innovation	How can the principles of Industry 5.0 enhance gender-sensitive agricultural innovations, particularly in terms of automation and smart farming technologies? Compare and contrast the adoption of agricultural innovations by women across different developmental stages of nations (developed, developing, and underdeveloped).		
Technology and Gender	How are mobile technologies transforming women's roles in agriculture and entrepreneurship in different types of economies? What future research can be directed towards understanding the impact of Industry 5.0 on women's participation in family businesses and informal sectors?		

Practical and Policy Implications

Customised agricultural education and training initiatives designed specifically for women will boost their expertise and understanding, empowering them to embrace contemporary farming methods, enhance crop productivity, and participate in more environmentally friendly

agricultural approaches. The National Institute of Agricultural Extension Management (MANAGE) and various state agricultural universities in India conducts women-specific training programs to enhance their expertise in contemporary farming methods. The Kenya Agricultural and Livestock Research Organization (KALRO) runs training

programs focused on women's involvement in agriculture. Enhancing women's education and training will result in enhanced employment opportunities and economic empowerment, ultimately resulting in higher income and improved living standards for their families and communities. BRAC's agriculture and food security program in Bangladesh focuses on enhancing women's training to improve their employment opportunities and economic empowerment. The Nigerian Women in Agriculture Programme (WIA) provides training and support to enhance women's roles in agriculture. In Uganda the Agri-Skills for You (AS4Y) program targets women and youth to foster agripreneurship through skills development and support. The Agricultural Transformation Agency (ATA) in Ethiopia promotes women's involvement in agribusiness by removing barriers and providing necessary support. By removing obstacles to women's involvement in agriculture and fostering female agripreneurs, there will be an increase in the number of women who engage and excel in agribusiness. The Grameen Foundation's digital agriculture in Ghana initiatives aims to equip women with technological skills to improve their farming efficiency and market access. The Ministry of Agriculture and Animal Resources (MINAGRI) in Rwanda support initiatives that provide women with technology and resources to enhance their agricultural productivity. The Philippine Rice Research Institute (PhilRice) has developed user-friendly mobile apps to assist women farmers in adopting technology. Digital Green's initiatives in Nepal focus on integrating user-friendly technology interfaces for women in agriculture. Equipping women with technological skills and giving them with the essential resources will enhance their efficiency, broaden their market prospects, and raise their earnings. Integrating user-friendly technology interfaces into farming methods will facilitate the adoption of technology by women. Women who receive training in innovative farming techniques and are provided with assistance in utilising technology are expected to experience an upsurge in both production and revenue. The Tanzania Agricultural Development Bank (TADB) collects gender-disaggregated data to address specific challenges faced by women in agriculture. The Zambia Agriculture Research Institute (ZARI) focuses on gender-disaggregated data to inform policy

decisions and program efficiency. Emphasising the collection of gender-disaggregated data will assist in identifying and tackling the obstacles encountered by women in the field of agriculture. This can have a positive impact on the overall economic expansion and alleviation of poverty in rural regions. The Brazilian Agricultural Research Corporation (Embrapa) collaborates with NGOs and government bodies to prioritize gender issues in agricultural programs. The Department of Agriculture, Forestry and Fisheries (DAFF) in South Africa works with various national and international organizations to implement gender-sensitive agricultural policies. The cooperation of governments, national organisations, and NGOs will offer essential resources, expertise, and assistance for agricultural programmes that prioritise gender issues. These collaborations will improve the execution and efficacy of gender equality strategies.

Limitations

The contribution of women in agriculture aimed to explore the trending topics over the period of years from 1974 to 2024. The study is limited to subject areas like Economics, econometrics, and finance and Business management and accounting in Scopus database. There is more subject area to be explored in other database like Web of Science, JSORT, and PubMed. The future study can apply more qualitative methods for a comprehending understanding of the research field. The systematic literature review, bibliometric analysis using other software's like Vos viewer, and NVivo. The approaches like meta-analysis, and Theory country context method (TCCM) can be applied in the future.

Conclusion

This study highlights the critical challenges and persistent gender disparities in the agricultural sector, particularly for agribusiness women, across various regions. The inadequacies in agricultural consulting and extension services have resulted in unequal access to resources and information, hindrances faced by women in agriculture. Despite policies aimed at promoting gender equality and providing women with assets such as land, finance and information technologies these initiatives have often fallen short in countries like India, China, and Indonesia. The socio-cultural environment significantly influences the well-

being and empowerment of agribusiness women are affected both positive and negative outcomes. Research on women's roles in the agriculture, particularly in developing countries, remains limited. There is a notable gap in studies on decision-making skills, the distribution of accessible information, and the factors on technology adoption among agribusiness women. While Industry 5.0 advancements among agribusiness women are explored in Europe and the USA, they are scarcely addressed on other parts of the globe. Issues such as food security, alternative farming, gender inequality, female empowerment in rural areas, and agricultural diversification in countries like Bangladesh, Uganda, Malawi, and India, require deeper investigation to understand the intersection of social structures, cultural norms, technology adoption and economic outcomes. This study's findings emphasize the need for future research to focus on creating employment opportunities for women, enhancing their empowerment, and achieving sustainability in rural areas. Addressing these issues will require a concerted effort from governments, national organizations, and NGOs to provide the necessary resources, expertise, and support for gender-sensitive agricultural programs. Such efforts are crucial for enhancing women's roles in agriculture, ensuring equitable access to resources, and fostering economic growth and sustainability.

Abbreviations

Nil.

Acknowledgement

Authors are thankful for the support and facilities provided by the Vellore Institute of technology, to carry out this research work.

Authors Contribution

All authors have been personally and actively involved in substantial work leading to this paper. First author contributed on writing, literature review, analysis and original drafting. Second and the corresponding author contributed on reviewing, editing, conceptualization and validation.

Conflict of Interests

The authors declared no potential conflicts of interest concerning the research, authorship, and or publication of this article.

Ethics Approval

Not applicable.

Funding

The authors received no financial support for the research, authorship, and or publication of this article.

References

- Balza LH, Camilo, Guerra A, Luis Omar Herrera-Prada, Manzano O. Unraveling the network of extractive industries. *Resources policy*. 2023 Aug 1;85:103823-3. <https://doi.org/10.1016/j.resourpol.2023.103823>
- Ahmed A, Coleman F, Hoddinott J, Menon P, Parvin A, Pereira A, et al. Comparing delivery channels to promote nutrition-sensitive agriculture: A cluster-randomized controlled trial in Bangladesh. *Food policy*. 2023 Jul 1;118:102484-4. <https://doi.org/10.1016/j.foodpol.2023.102484>
- Ayanlade A, Oluwatimilehin IA, Ayanlade OS, Adeyeye O, Abatemi-Usman S. Gendered vulnerabilities to climate change and farmers' adaptation responses in Kwara and Nassarawa States, Nigeria. *Humanities and Social Sciences Communications*. 2023 Dec 6, 10(1):1-15. <https://doi.org/10.1057/s41599-023-02380-9>
- Menusch Khadjavi, Kacana Sipangule, Thiele R. Exposure to large-scale farms increases smallholders' competitive behavior and closes the gender gap. *World development*. 2024 Apr 1;176:106519-9. <https://doi.org/10.1016/j.worlddev.2023.106519>
- Ingutia R, Sumelius J. Do farmer groups improve the situation of women in agriculture in rural Kenya?. *International Food and Agribusiness Management Review*. 2022 Jan 1;25(1):135-56.
- Goel S. Effect of Deagrarianization at the Household Level on the Scale and Nature of Women's Work in Rural India. *The Indian Journal of Labour Economics*. 2022 Dec;65(4):1053-82.
- Das S, Delavallade C, Fashogbon A, Olatunji Ogunleye W, Papineni S. Occupational sex segregation in agriculture: Evidence on gender norms and socio-emotional skills in Nigeria. *Agricultural Economics*. 2023 Mar;54(2):179-219.
- Milojevic A, Vujicic S, Nikitović Z, Marković MR. Women's Entrepreneurship in Organic Production in Serbia. *JWEE*. 2021;3-4:184-98.
- Farooq R. Mapping the field of knowledge management: a bibliometric analysis using R. 1178-1206. *Journal of Information and Knowledge Management Systems*. 2023 Nov 20; 53(6) 1178-206.
- Aria M, Cuccurullo C. bibliometrix : An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*. 2017 11(4):959-75. <https://doi.org/10.1016/j.joi.2017.08.007>
- Paul J, Lim WM, O'Cass A, Hao AW, Bresciani S. Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). *International Journal of Consumer Studies*. 2021 Jul;45(4):01-6.
- Zhao D, Strotmann A. The knowledge base and research front of information science 2006-2010: An

- author cocitation and bibliographic coupling analysis. *Journal of the Association for Information Science and Technology*. 2014 Jan 7;65(5):995-1006.
13. Alesina A, Giuliano P, Nunn N. On the origins of gender roles: Women and the plough. *The quarterly journal of economics*. 2013 May 1;128(2):469-530.
 14. Quisumbing AR, Pandolfelli L. Promising approaches to address the needs of poor female farmers: Resources, constraints, and interventions. *World development*. 2010 Apr 1;38(4):581-92.
 15. Ali DA, Deininger K, Goldstein M. Environmental and gender impacts of land tenure regularization in Africa: Pilot evidence from Rwanda. *Journal of Development Economics*. 2014 Sep 1;110:262-75.
 16. Palacios-Lopez A, Christiaensen L, Kilic T. How much of the labor in African agriculture is provided by women?. *Food policy*. 2017 Feb 1;67:52-63.
 17. Carney J. Converting the wetlands, engendering the environment: The intersection of gender with agrarian change in the Gambia. *Economic Geography*. 1993 Oct 1;69(4):329-48.
 18. Mehrotra S, Parida JK. Why is the labour force participation of women declining in India?. *World Development*. 2017 Oct 1;98:360-80.
 19. Croppenstedt A, Goldstein M, Rosas N. Gender and agriculture: Inefficiencies, segregation, and low productivity traps. *The World Bank Research Observer*. 2013 Feb 1;28(1):79-109.
 20. Ma W, Grafton RQ, Renwick A. Smartphone use and income growth in rural China: Empirical results and policy implications. *Electronic Commerce Research*. 2020 Dec;20(4):713-36.
 21. Jacoby HG. The economics of polygyny in sub-Saharan Africa: Female productivity and the demand for wives in Côte d'Ivoire. *Journal of Political Economy*. 1995 Oct 1;103(5):938-71.
 22. Kotsadam A, Tolonen A. African mining, gender, and local employment. *World Development*. 2016 Jul 1;83:325-39.
 23. Swaminathan M. Contemporary features of rural workers in India with a focus on gender and caste. *The Indian Journal of Labour Economics*. 2020 Mar;63(1):67-79.
 24. Tuteja U. Female employment in agriculture: A district-wise analysis of Haryana. *The Indian Journal of Labour Economics*. 2000;43(2):339-47.
 25. Gill KK. Diversification of agriculture and women employment in Punjab. *Indian Journal of Labour Economics*. 2001;44(2):259-67.
 26. Burnette J. The wages and employment of female day-labourers in English agriculture, 1740-1850. *The Economic History Review*. 2004 Nov;57(4):664-90. <https://doi.org/10.1111/j.1468-0289.2004.00292.x>
 27. Witinok-Huber R, Radil SM. Introducing the Local Agricultural Potential Index: An approach to understand local agricultural extension impact for farmer adaptive capacity and gender equity. *World Development Perspectives*. 2021 Sep 1;23:100345.
 28. Rao N. Assets, agency and legitimacy: Towards a relational understanding of gender equality policy and practice. *World development*. 2017 Jul 1;95:43-54.
 29. Saha S, Goswami R, Paul SK. Recursive male out-migration and the consequences at source: A systematic review with special reference to the left-behind women. *Space and Culture, India*. 2018 Mar 25;5(3):30-53.
 30. Gouse M, Sengupta D, Zambrano P, Zepeda JF. Genetically modified maize: less drudgery for her, more maize for him? Evidence from smallholder maize farmers in South Africa. *World Development*. 2016 Jul 1;83:27-38.
 31. Mariara J, McKay A, Newell A, Rienzo C. Gender gaps in the path to adulthood for young females and males in six African countries from the 1990s to the 2010s. *IZA Journal of Development and Migration*. 2018 Dec;8:1-9.
 32. Arora J, Sharma SS. Dampening of female workforce participation with reference to agricultural sector of India. *International Journal of Economic Research*. 2017;14(16):99-108.
 33. Chakraborty A, Sutradhar R. Unpaid Work by Women: A State-level Analysis of Evidence from Time-use Survey. *Indian Journal of Human Development*. 2023 Dec;17(3):461-76. <https://doi.org/10.1177/09737030231218147>
 34. Marchesoni. C, G. de Ros. Type of farming and female entrepreneurship in agriculture: the case of Trentino (Italy). 2009 Jan 1;18(2):105-17.
 35. Sarker MR. Labor market and unpaid works implications of COVID-19 for Bangladeshi women. *Gender, Work & Organization*. 2021 Jul; 28:597-604. <https://doi.org/10.1111/gwao.12587>
 36. Herz B. Women in development: Kenya's experience. *Finance and Development*. 1989;26(2):43-5.