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Global research networks in zero budget natural farming: A bibliometric perspective

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Abstract

Zero Budget Natural Farming (ZBNF) is gaining global attention as a sustainable, low-cost agricultural approach that aligns with agroecological principles. This review aims to map the global research trends, institutional collaborations, and thematic developments surrounding ZBNF through a bibliometric lens. A total of 447 publications were retrieved from the Scopus database using carefully selected keywords. After applying inclusion and exclusion criteria, 120 relevant articles were analysed using R Studio and VOS viewer to visualize patterns in scientific production, author collaboration, and keyword co-occurrence. Results indicate a sharp increase in research output from 2019 onward, with peak activity in 2024. Countries such as India, Italy, and China lead in scholarly contributions, while institutions like the University of Reading and Tamil Nadu Agricultural University show growing research engagement. Thematic clusters revolve around sustainable agriculture, soil health, farmer empowerment, and policy relevance. Despite growing interest, gaps remain in geographic representation, gender dynamics, and long-term ecological outcomes. This study underscores the importance of fostering international and interdisciplinary collaboration to strengthen the evidence base and policy integration of ZBNF. By offering a comprehensive bibliometric overview, the review contributes to the global discourse on sustainable agriculture and highlights pathways for future research

Keywords: Zero budget natural farming, bibliometric analysis, natural farming, agroecology, global research trends

Introduction

Zero Budget Natural Farming (ZBNF) is an innovative, cost-effective, and ecologically sustainable farming model conceptualized by Subhash Palekar in the 1990s (Choudhary *et al.*, 2023) ^[4]. It relies on low-cost, locally sourced inputs like Jeevamrutha, Beejamrutha, mulching, and Waaphasa to maintain soil fertility and protect crops without chemical interventions (Deb & Bhowmick, 2024; Khan *et al.*, 2022) ^[6, 10]. ZBNF has gained prominence in Indian states like Andhra Pradesh and Karnataka through grassroots movements and government-led initiatives (Khadse & Rosset, 2019; Pathak *et al.*, 2024) ^[11, 15]. The approach emphasizes farming in harmony with nature, enabling smallholders to cut production costs, reduce debt, and ensure food security (Mondal *et al.*, 2023) ^[13]. Empirical studies from West Bengal have shown ZBNF to outperform conventional organic farming in terms of net returns and sustainability (Koner & Laha, 2021) ^[12]. However, certain criticisms exist, including concerns about yield stability and adaptation limitations across diverse agro-climatic zones

(Nagarjun *et al.*, 2025; Rosset & Martinez-Torres, 2012) ^[14, 16].

The concept is aligned with broader agroecological principles and global sustainability goals (Fukuoka, 2009; Hanley, 1990) ^[8, 9], gaining increasing attention in scholarly discourse. According to a bibliometric overview, more than 200 research papers related to ZBNF and related sustainable models have been published globally since 2018 (Archambault *et al.*, 2009; Bertoglio *et al.*, 2021) ^[1, 2]. The research spans key thematic areas such as ecological resilience, soil microbiota, farmer empowerment, economic viability, and climate mitigation (Khadse & Rosset, 2019; Choudhary *et al.*, 2023; Floyd & Zubevich, 2024) ^[11, 4, 7]. India has emerged as the central hub for research in this domain, with significant contributions from institutions such as RySS, ICRISAT, and state agricultural universities (Pathak *et al.*, 2024) ^[15]. Global actors from the United States, Italy, and China are also participating in emerging collaborations (Cortes *et al.*, 2021) ^[5]. However, network mapping of research collaboration in ZBNF is relatively

underexplored, particularly in relation to international co-authorship and institutional partnerships (Brembs, 2024)^[3]. Bibliometric tools such as VOS viewer, R Studio, and Gephi can offer insights into author collaborations, keyword co-occurrence, citation bursts, and institutional networks (Floyd & Zubevich, 2024; Archambault *et al.*, 2009)^[7, 11]. While Scopus and Web of Science have complementary coverage, using both ensures a robust analysis of research trends (Brembs, 2024; Smith, 2023)^[3, 17].

This review aims to address current knowledge gaps by examining:

- Growth trends in global ZBNF literature
- Authorship and institutional collaboration networks
- To Visualize the Author keywords related to ZBNF

Future directions and underrepresented regions or themes. By leveraging a bibliometric lens, this study contributes to a comprehensive understanding of the research ecosystem around Zero Budget Natural Farming and guides future policy and scientific discourse.

Methodology

To understand the evolving research landscape of natural farming, a bibliometric analysis was systematically conducted. Articles were collected from the Scopus database using carefully selected keywords that reflect various components and themes related to natural farming. These keywords are listed in Table 1, along with the number of articles retrieved for each term. The collected literature was then analysed using established bibliometric tools to uncover patterns such as trending research themes, citation metrics, and collaborative networks among countries. For visual representation of these networks and topic clusters, software such as R Studio and VOS viewer was employed. To ensure the review process was transparent and methodical, the PRISMA (Preferred Reporting Items for

Systematic Reviews and Meta-Analyses) framework was followed. This approach guided the screening and selection of relevant literature.

Further, inclusion and exclusion criteria were developed to refine the search results and ensure that only relevant, high-quality publications were considered. These criteria are detailed in Table 2 and were applied during the initial screening stage to filter out unrelated or non-scholarly works.

By integrating both bibliometric and systematic review methods, this study aims to offer a comprehensive and reliable overview of natural farming research and its global adoption trends.

Table 1: Number of keywords used for this study

Data bases	Search strings	Numbers of Publications
Scopus	"Natural farming" OR "ecofriendly farming*" OR "zero budget farming*" OR "Traditional farm*" OR "Eco friendly*" AND "Adoption" or "Impact" or "Perception"	447

Data Collection and Screening Process

An initial search in the Scopus database yielded a total of 447 records related to natural farming. After applying the predefined inclusion and exclusion criteria, 327 records were excluded during the screening stage. The remaining 120 articles were identified through automated database filters as relevant to the study's focus.

Following a detailed evaluation process guided by the PRISMA flow diagram (Fig. 1), these 120 high-quality and relevant publications were selected for final review and analysis. To conduct the bibliometric analysis and visualize key insights, R Studio and VOS viewer were used throughout the review process

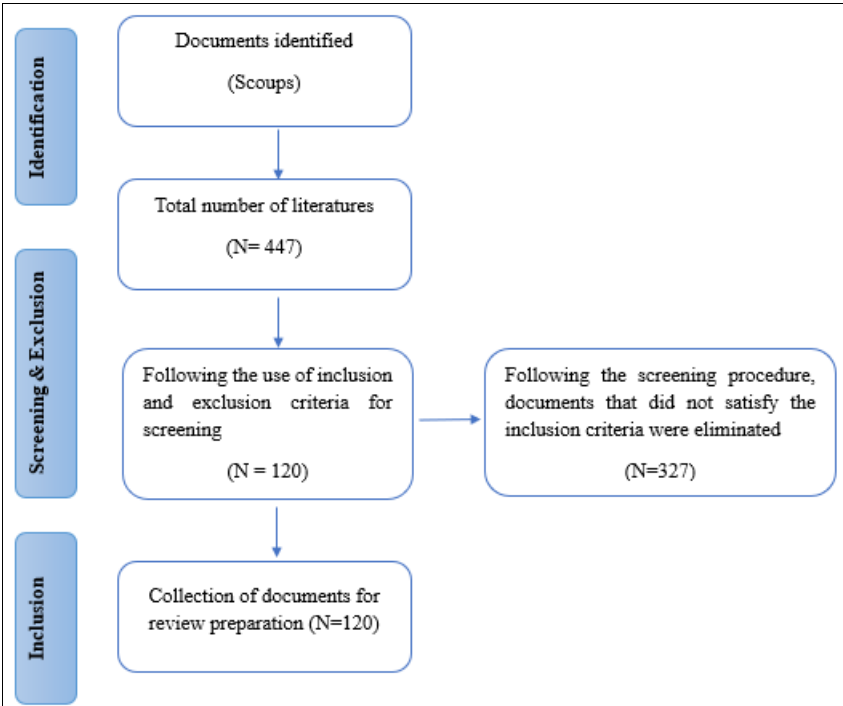


Fig 1: PRISMA flow diagram illustrating the step-by-step screening and selection process of studies included in the systematic review on the impact of natural farming

Results and Discussion

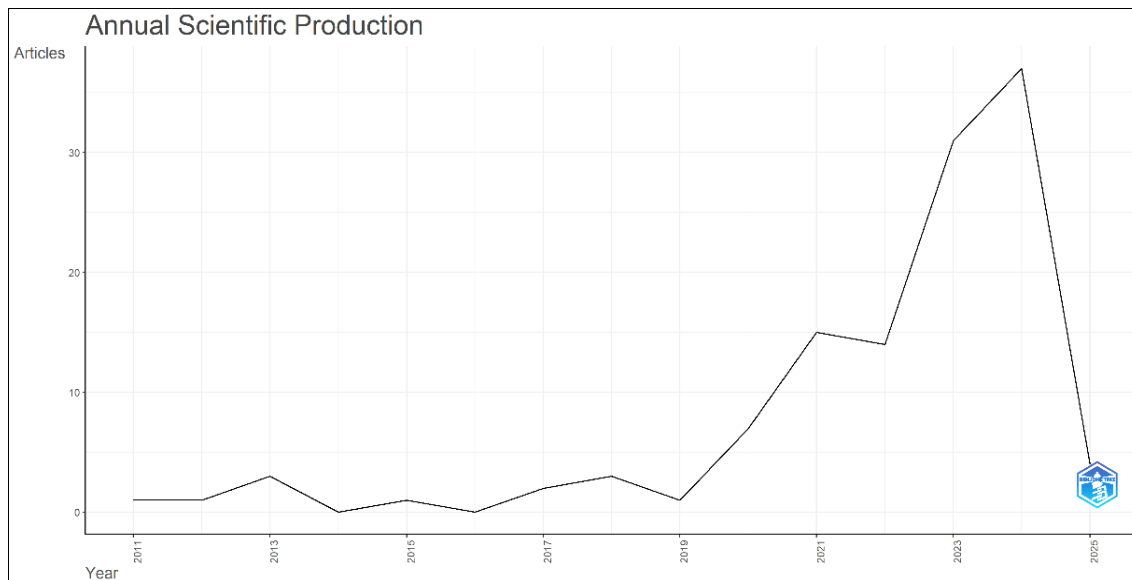


Fig 2: Annual scientific production

Figure 1 illustrates the annual scientific production related to the research field under study. From 2010 to 2018, there was a relatively low and fluctuating number of publications, typically ranging between 0 and 3 articles per year. This suggests that during this period, the topic had limited scholarly attention or was in its early stages of exploration. However, a noticeable upward trend began in 2019, with a substantial increase in publication output. The number of articles rose significantly in 2021 and peaked in 2024 with over 35 publications, indicating a growing academic interest

and increased research activities in this area. This surge could be attributed to rising awareness, funding initiatives, or policy relevance of the research theme (e.g., natural farming or sustainable agriculture).

Interestingly, there is a sharp decline in 2025, which may be due to incomplete data for the current year, as the analysis might have been conducted mid-year. This dip should be interpreted cautiously and not as a conclusive decline in research activity.

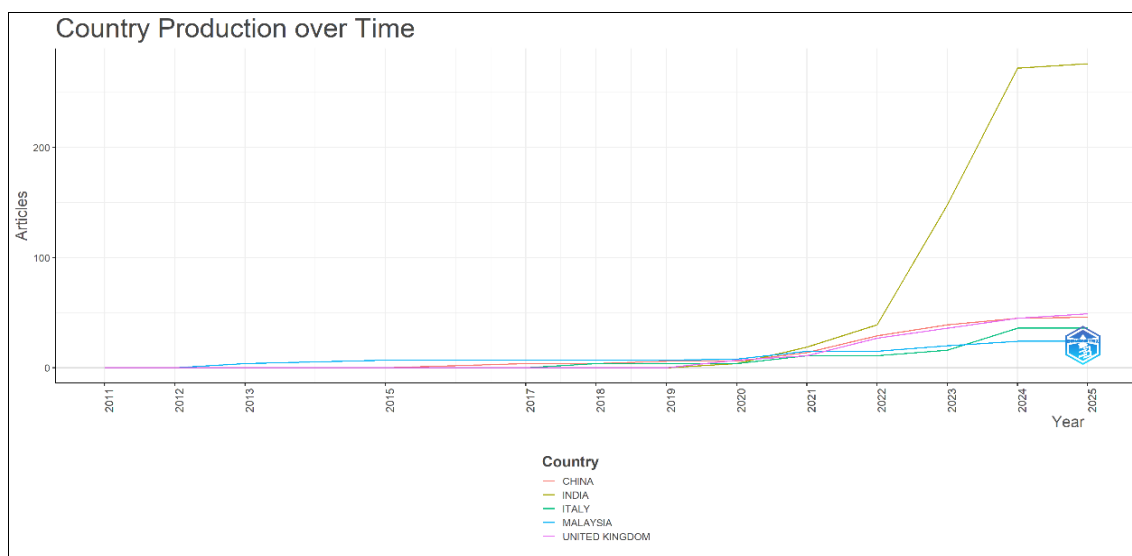


Fig 3: Country production overtime

Figure 3 illustrates the trend of scientific production by country over the years. Among the top contributing countries, Italy shows a dramatic rise in publications from 2022 onwards, leading all other countries by a wide margin. This suggests a strong recent focus and investment in the research area within Italy. China and India follow with steady growth, showing

increased involvement in recent years. Malaysia and the United Kingdom also show consistent, though comparatively moderate, contributions to the field.

Overall, the graph highlights how global interest in the research area has intensified, especially after 2021, with Italy emerging as the most active country in terms of scholarly output.

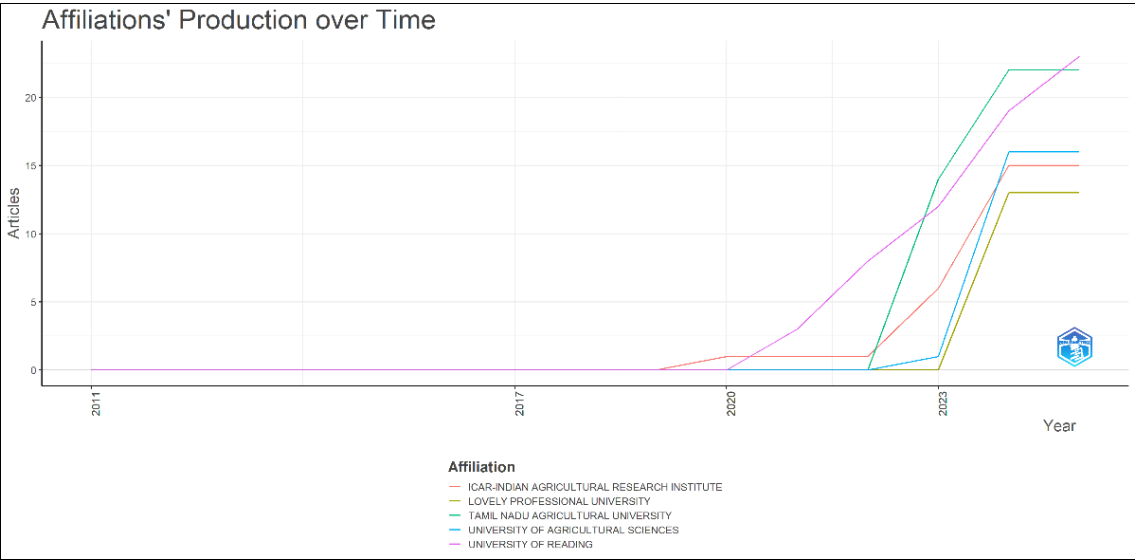


Fig 4: Affiliation production overtime

Figure 4 displays the growth of research contributions from various institutions over the years. The University of Reading leads in terms of total publications, showing a steady rise from 2020 onwards. Tamil Nadu Agricultural University (TNAU) also shows a rapid increase, especially after 2022, becoming one of the major contributors. ICAR-Indian Agricultural Research Institute, Lovely Professional University, and University of Agricultural

Sciences have all shown consistent growth, with notable surges starting around 2022. This trend highlights how academic institutions are increasingly engaging in research on the topic, with both Indian and international universities actively contributing. Overall, the data reflects rising institutional involvement and collaboration in this emerging field of study.

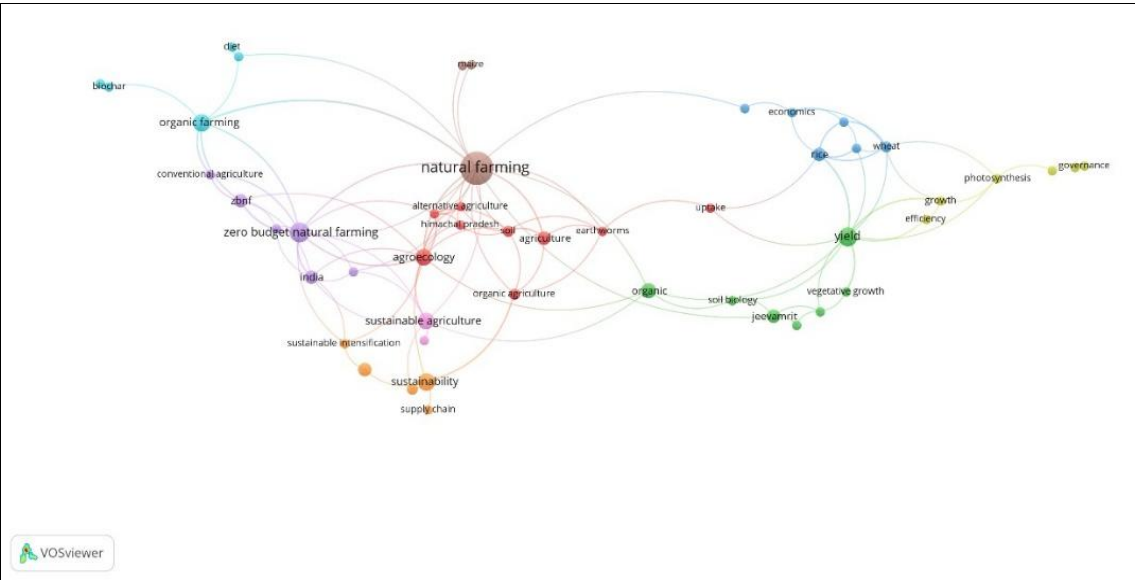


Fig 5: Author keywords

The author keyword visualization presented in Figure 5 offers valuable insights into the evolving research landscape of natural farming. The keyword "natural farming" is prominently positioned at the centre, highlighting its dominant role and frequent occurrence in the literature. This central node connects to various clusters of related keywords, reflecting the diversity and interdisciplinary nature of the topic. One of the major clusters is associated with zero budget natural farming (ZBNF), agroecology, sustainable agriculture, and organic agriculture. These keywords

suggest that researchers have been exploring natural farming in connection with low-cost, eco-friendly, and alternative agricultural systems. The presence of terms like India, Himachal Pradesh, and alternative agriculture indicates that the concept is particularly relevant in the Indian context and often studied in relation to regional case studies. Another significant cluster revolves around yield, vegetative growth, soil biology, and jeevamrit, pointing toward the agronomic and biological aspects of natural farming. These keywords imply that scholars are examining the effectiveness of natural inputs and their impact on crop

productivity, soil health, and plant development, especially in contrast to conventional farming practices.

In addition, keywords such as organic farming, diet, biochar, and conventional agriculture form a separate cluster, indicating comparative studies and sustainability-focused approaches. Researchers appear to be investigating how natural farming aligns with or diverges from organic and conventional systems, and how it contributes to nutritional outcomes.

Finally, the network also includes terms like economics, governance, efficiency, and policy, reflecting an emerging interest in the socio-economic and institutional dimensions of natural farming. This suggests that beyond its environmental and agricultural benefits, natural farming is being discussed in terms of its economic viability, adoption at scale, and potential for policy integration.

Discussion

The findings of this bibliometric study offer a compelling narrative about the evolving scholarly engagement with Zero Budget Natural Farming (ZBNF) and its associated themes. The temporal analysis of annual scientific production reveals a notable surge in research output post-2019, with a peak in 2024. This trend likely reflects the growing recognition of ZBNF as a sustainable agricultural model amidst global concerns over chemical-intensive farming, climate change, and smallholder distress. The increase in publications also indicates an expanding academic curiosity driven by policy reforms and grassroots successes, particularly in India.

The country-wise distribution of research shows Italy emerging as a key contributor in recent years, followed by China and India. This is significant as it suggests that ZBNF, although rooted in the Indian context, is gaining traction globally as a subject of academic inquiry. The rising involvement of European and Asian countries highlights the universal appeal of agroecological practices that emphasize low-cost, nature-based farming methods. It also suggests a shift in research priorities towards more inclusive and sustainable agricultural paradigms.

Institutional analysis uncovers a growing commitment from both Indian and international academic bodies. The University of Reading, TNAU, and ICAR-IARI have played crucial roles in pushing the ZBNF research agenda. Notably, TNAU's increasing output post-2022 reflects its strategic focus on natural farming, possibly in response to state-level policy directions in Tamil Nadu. Such trends emphasize the institutionalization of natural farming as a legitimate and important area of study, not only within India but also in academic circles abroad.

Keyword co-occurrence mapping offers further insight into the thematic evolution of the field. The prominence of terms like “natural farming,” “ZBNF,” and “agroecology” underscores the centrality of sustainability and ecological alignment in current research. Clusters around “yield,” “soil biology,” and “Jeevamrit” highlight the agronomic focus of many studies, particularly regarding biological soil health and input efficacy. Meanwhile, the appearance of terms like “policy,” “economics,” and “governance” indicates an emerging shift towards interdisciplinary inquiry—connecting agronomic efficiency with institutional feasibility and socio-economic impact.

Importantly, the visualization also reveals research gaps. Despite the surge in publications, certain regions, particularly in Africa and Latin America, remain underrepresented. Likewise, while the agronomic and economic benefits of ZBNF have been extensively explored, there is limited work on long-term ecological outcomes, gender dynamics, and scalability across diverse agro-ecological zones. This presents opportunities for future research to adopt a more holistic and inclusive lens.

Conclusion

This bibliometric review highlights the growing academic attention toward Zero Budget Natural Farming (ZBNF) as a viable alternative to conventional agriculture. The rising trend in scientific publications, especially after 2019, along with increasing contributions from countries like India, Italy, and China, signals a shift toward ecologically sustainable and economically viable farming models. Institutional engagement from both Indian and global universities further affirms the academic legitimacy of ZBNF. The keyword analysis reveals diverse research interests from soil health and input efficiency to policy and socio-economic dimensions reflecting the multidimensional nature of the subject. Looking ahead, future research should prioritize interdisciplinary and transnational collaborations to better understand the scalability of ZBNF across diverse agro-climatic zones. Underexplored regions such as Africa and Latin America offer fertile ground for comparative studies. Moreover, there is a need to investigate long-term ecological impacts, gender inclusivity, market linkages, and policy integration of ZBNF. Strengthening empirical evidence on these fronts will be crucial for its mainstreaming into global sustainable agricultural policies and practices.

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