GMR

The Original

MAPPING THE GLOBAL RESEARCH LANDSCAPE OF NATURAL FARMING: TRENDS, COLLABORATIONS, CHALLENGES AND FUTURE DIRECTIONS

Amina S S[1], Ramasubramanian M[2*], Prahadeeswaran M[3], Padma S R[4], Kavino M[5], Punitham M[6], Mohamed Aseemudheen[7]

[1]PG Scholar, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore 641003, Tamil Nadu, India. Email id: aaminahsalim786@gmail.com
[2*]Senior Scientist and Head, ICAR-Krishi Vigyan Kendra, Virudhunagar,626107, Tamil Nadu, India. Email id: ramasubramanian.m@tnau.ac.in
[3]Associate Professor (Agricultural Economics), Dept. of Agricultural Economics, TNAU, Coimbatore, 641003, Tamil Nadu, India
Email id: prahadeeswaranmecon@tnau.ac.in
[4]Assistant Professor (Agricultural Extension), ICAR-KVK, Pongalur, Tiruppur, 641667, Tamil Nadu, India. Email id: padmasr@tnau.ac.in
[5]Associate Professor (Hort.) and Head, Horticultural Research Station, TNAU, Ooty, 643001, Tamil Nadu, India. Email id: kavino.m@tnau.ac.in
[6]Ph. D Scholar, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore 641003, Tamil Nadu, India. Email id: punithammaha2000@gmail.com
[7]Ph. D Scholar, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore 641003, Tamil Nadu, India, Email id: aseem1264@gmail.com

ABSTRACT
Natural farming has recently attracted more and more interest as an agroecological practice that aims at minimising reliance on external inputs through enhancing ecological functions in agricultural systems. This paper provides an overview of the global research field of natural farming and analyses research trends, cooperation, thematic structure, defining characteristics, institutional support, and main challenges related to it. A systematic review and bibliometric analysis of research papers published in Scopus was carried out based on the PRISMA framework. Systematic screening resulted in 89 research papers being selected for analysis. Bibliometric analysis was carried out with Bibliometrix in RStudio and VOSviewer in order to evaluate publication dynamics, author productivity, source trends, international cooperation, keyword co-occurrence, and theme development. It is shown that there was a significant increase in scientific productivity starting from 2020, with peak activity observed in 2025. India was the leading contributor and an active participant in international cooperation; however, worldwide participation in research was geographically uneven. Author productivity generally obeyed Lotka's Law, with almost 80 per cent of authors publishing only one article. Thematic analysis showed that agriculture and soil health are well-developed research themes, while natural farming, sustainability, agroecology, and farming systems are the central areas for further development. In the literature, few external inputs, use of local resources, cycling of biological nutrients and ecological management are also mentioned as important features of natural farming. While policy and institutional support is increasing, challenges around productivity, transition, labour, knowledge, economic viability and scaling hamper wider adoption. Future research needs to be focused on long-term, comparative, and interdisciplinary studies in different agro-climatic and socio-economic settings, and should strengthen international cooperation and build more knowledge in relation to institutions, markets, and farmers.

KEYWORDS: Natural farming; Zero Budget Natural Farming; bibliometric analysis; sustainable agriculture; soil health; research trends.

INTRODUCTION
Contemporary agriculture is greatly associated with the use of chemicals such as fertilisers, pesticides, and other external resources. Although these methods have contributed to improved productivity, they have resulted in issues about soil degradation, loss of biodiversity, and financial strain on farmers. To address these problems, natural farming has emerged as an approach that is environmentally friendly. The academic sources define natural farming in different ways. Zero Budget Natural Farming (ZBNF) involves farming without synthetic fertilisers and pesticides, relying instead on homemade inputs prepared from indigenous cow dung and urine, along with mulching (Duddigan et al., 2023). A broader perspective describes ZBNF as an approach that promotes harmony with nature by minimising external inputs and eliminating synthetic chemicals (Pathak et al., 2024). It is also viewed as a sustainable farming approach that can improve soil health and crop productivity while reducing production costs (Kumar et al., 2024). Despite these differences, the definitions share a common principle: restoring the relationship between agriculture and natural ecological processes.
The roots of natural farming are closely associated with Masanobu Fukuoka, who advocated minimal intervention, reduced disturbance and maintenance of natural soil fertility (Kaundal et al., 2024). Over time, these principles evolved across regions: ZBNF gained prominence in India, Fukuoka-inspired approaches remained influential in East Asia, while related agroecological movements developed in Brazil, Cuba and Mexico (Machnoor et al., 2025). In India, natural farming has increasingly moved from a farming philosophy towards institutional and policy support, reflected in initiatives such as ZBNF in Andhra Pradesh and broader ecological farming efforts across the country (Mishra et al., 2025).

The growing interest in natural farming is closely linked to the environmental and economic concerns associated with conventional agriculture. The Green Revolution transformed agricultural production and strengthened food security; however, intensive chemical use has also been associated with soil degradation, biodiversity decline and chemical residues in food (Anil Kumar et al., 2025). Natural farming has emerged as an alternative approach that seeks to balance agricultural productivity with ecological sustainability (Daifa et al., 2024). In practice, it promotes the integration of crops, trees and livestock, makes use of natural biodiversity, minimises soil disturbance and reduces dependence on chemical fertilisers, pesticides and external inputs (De, 2022). Its potential benefits extend beyond crop production to improved soil health, water conservation, biodiversity and farmers' livelihoods (Shravanilakshmi et al., 2026). By linking food security, farmer wellbeing, climate resilience and environmental protection, natural farming has gained relevance across diverse climatic and socio-economic settings (Nivedha et al., 2024; N. Mandal et al., 2025). The increased adoption of natural farming has led to more scientific inquiry, leading to the growth of research in this field at the global level. However, the overall architecture and development of natural farming research remain poorly understood. Existing reviews largely focus on production costs, soil health, crop yield and sustainability (Joy et al., 2026), while concerns remain about the limited scientific evidence supporting the performance of natural farming under diverse conditions (Patel et al., 2024). Important questions regarding long-term productivity, soil nutrient dynamics and performance across different agro-climatic regions are yet to be fully addressed (Joy et al., 2026). Evidence on the transition from conventional to natural farming is also limited, particularly regarding changes in yield, nitrogen availability and pest management (Mane et al., 2026). Despite the increasing adoption of Zero Budget Natural Farming (ZBNF), scientific evidence on its benefits and limitations remains limited, emphasising the need for more systematic research (Nagarjun et al., 2025).

METHODOLOGY

Structure of the review

This study uses a bibliometric approach that combines quantitative performance analysis with science mapping to provide a systematic overview of the global research landscape on natural farming. Bibliometric analysis is useful to track the evolution of a research field by identifying publication and journal trends, patterns of scholarly collaboration, key contributors, intellectual structure and emerging research directions (Donthu et al., 2021). Furthermore, quantitative bibliometric indicators add objectivity and methodological rigour through the use of the collective body of scholarly work, rather than mainly relying on the subjective judgement of individual researchers, thus decreasing the possibility of researcher bias (Zupic & Čater, et al., 2015). Unlike traditional narrative reviews, bibliometric analysis provides a systematic and reproducible way of identifying, analysing and mapping scientific literature. Such reviews can be organised around a domain, theory or method, with domain-based reviews widely used to understand knowledge development within a particular research area (Paul & Criado, et al.,2020). Bibliometric studies provide a wider perspective on the development of a field through the analysis of publication growth, citation patterns, research collaborations and thematic changes. The science mapping also shows the relationship between authors, institutions, countries and research themes, which gives a clearer understanding of the existing knowledge base (Aria & Cuccurullo, 2017). This approach provides a systematic review of the existing literature within the framework of natural farming, while identifying gaps and emerging themes that may guide future research.

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009), as shown in Figure 1, proceeding through the systematic stages of identification, screening and inclusion to ensure consistency, minimise bias and strengthen the reliability of the findings.

Search strategy

Using the methodological framework that had been adopted, the initial search in the Scopus database with the keywords "Natural Farming" or "Zero Budget Natural Farming" or ZBNF or "Subhash Palekar Natural Farming" or SPNF or "Bharatiya Prakritik Krishi Paddhati" or "BPKP" yielded a total of 545 records. After applying a subject area filter to include only those within the fields of Agricultural & Biological Sciences, Social Sciences and Multidisciplinary, 163 records were discarded, so that 382 records remained for further evaluation. Of these, 112 were excluded because they were not research articles, leaving 270 articles for the next stage. The subsequent screening of these articles was done in order to retain articles that were written in English, which led to 3 articles being excluded from the dataset, leaving 267 articles in total. Subsequently, there was another stage where the refining of the keywords used was performed in order to get rid of irrelevant articles, leading to a further exclusion of 115 articles, leaving 152 articles in the dataset. The third filtering step was based on the source type of the article; only journal articles were considered, leading to 1 article being excluded.

During the eligibility assessment phase, records were evaluated based on their publication status to retain only final articles rather than those still in press, which led to the exclusion of 4 records and resulted in a total of 147 articles. Following this step, the open access filter was employed, resulting in the removal of 58 non-open access documents, leaving behind a total of 89 papers used in the bibliometric and thematic analysis. The PRISMA flow diagram (Figure 1) illustrates the systematic selection process carried out to identify a set of papers that is both relevant and of high quality. Table 1 presents the inclusion and exclusion criteria used in the systematic review of literature.

The bibliometric study was done in RStudio using the Bibliometrix package, which is used for managing the data and performing statistical analysis of bibliometric data (Aria & Cuccurullo, 2017). VOSviewer software was used for analysing annual scientific output, source productivity over time, keyword co-occurrence analysis, most relevant affiliations, most cited papers and thematic maps. In VOSviewer software, the coloured circles show the various research elements while different sizes of the circles denote the importance and hierarchy of research elements (van Eck & Waltman, 2010).

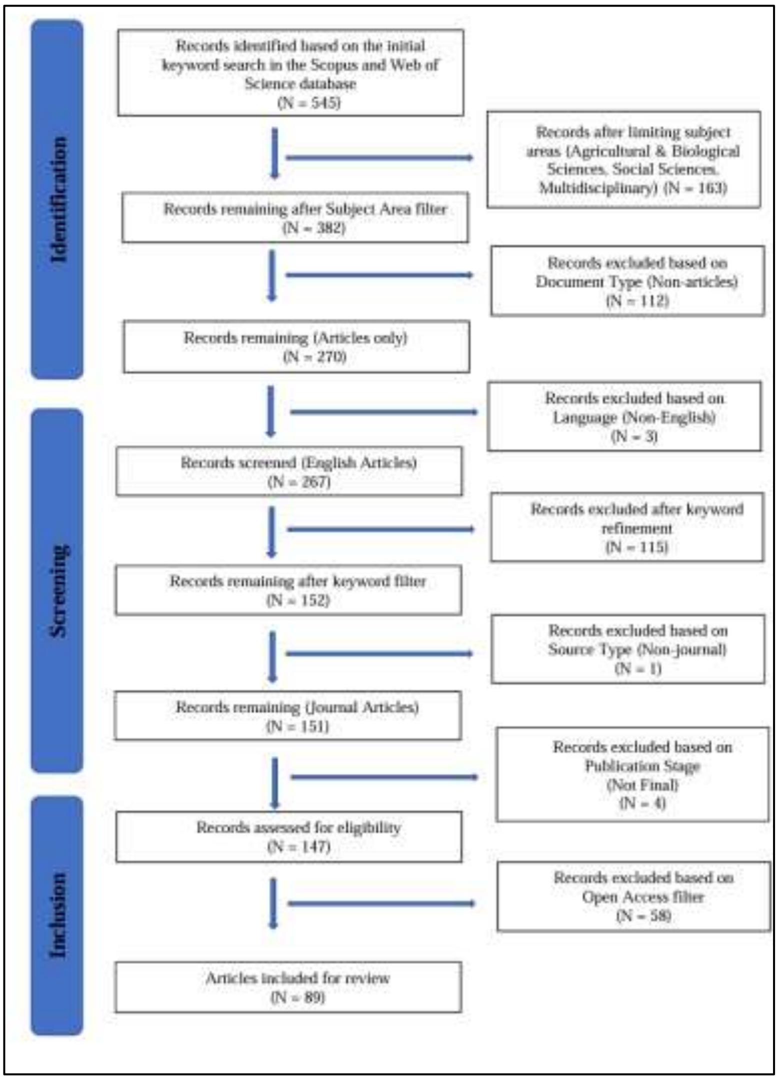

Figure 1. PRISMA flowchart.

Table 1. Inclusion and exclusion criteria for the systematic literature review

Criteria	Inclusion	Exclusion
Subject area	Agricultural & Biological Sciences, Social Sciences, Multidisciplinary	Other than the included subject areas
Literature type	Research articles	Review articles, book chapters, conference papers, editorials
Language	English	Non-English
Keyword relevance	Records aligned with the study's keyword scope after refinement	Records excluded following keyword refinement
Source type	Journal	Conference proceedings, book series, books, trade journals, reports
Publication stage	Final	Article in press
Access type	Open access	Restricted access

FINDINGS AND DISCUSSIONS
Findings of Bibliometric Analysis
Annual Scientific Production

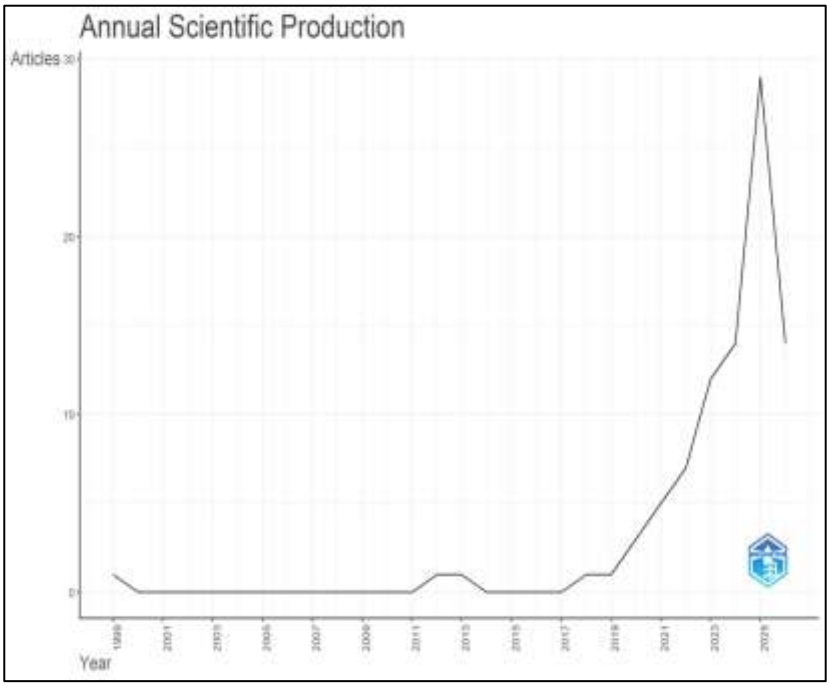

Figure 2. Year-wise publications

The scientific output per annum on natural farming demonstrates an obvious tendency towards long-term dormancy periods with bursts of activity happening quite rapidly after certain time intervals. The first piece of work on the subject was published in 1999. However, the following twenty years were rather inactive with regard to research and studies until several works appeared independently between 2012-2013 and 2018-2019. Since 2020, however, a steady increase in the number of published works has started. Approximately 5 articles were produced in 2021, 7 were published in 2022, 12 appeared in 2023 and 14 in 2024. The number of publications drastically increased in 2025, amounting to 29 articles published within the year, which is the largest number of works ever. The apparently smaller number of 14 papers in 2026 is certainly not to be considered a true decrease in the number of papers because the year has yet to end and the statistics provided only partially reflect the situation. All in all, natural farming has gone from being an overlooked topic of scientific studies to becoming a thriving field of research.

Country Collaboration Map of Natural Farming Research

Figure 3 illustrates the geographical distribution and patterns of international cooperation in natural farming research. The dominant position of India as both a major contributor to and central node in the network under discussion can be seen through the darker colouration of the corresponding circle and also through the connections made by it with other nations. These results indicate that natural farming research is particularly developed in India, with Indian scientists playing an important connecting role between the field and the international community. Cooperation links are found between India and a number of countries, including the USA and the UK, as well as some Asian and European nations.

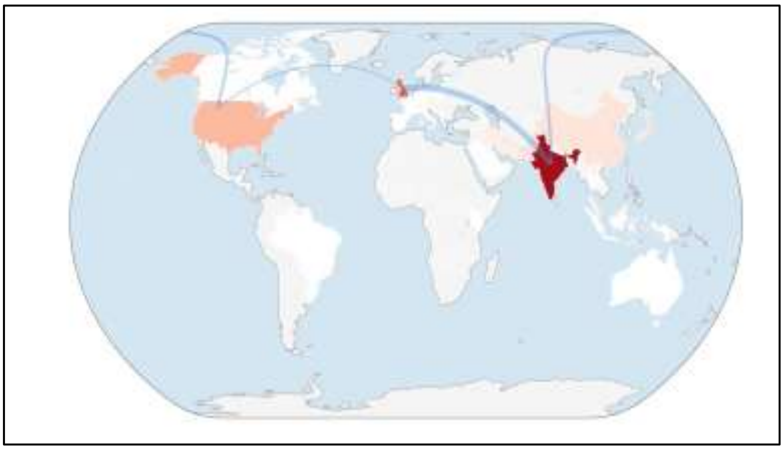

Fig. 3. Global Distribution and International Collaboration Network in Natural Farming Research

Having said that, the network as a whole continues to remain fairly concentrated geographically, with regions such as Africa, South America, and Oceania being underrepresented in their numbers. This implies that while there have been attempts at establishing international collaboration among researchers involved in natural farming, the research collaboration network continues to be somewhat unevenly distributed geographically.

Author Productivity Distribution

Author productivity in natural farming literature according to Lotka's law has been presented in Figure 4 below. Over 80 per cent of authors published only one piece of literature, and this percentage rapidly declined as the number of publications by each author rose. Fewer authors had written three or more papers, implying that the field is characterised mainly by authors who have published their works once in their lifetime. The beta coefficient of 2.69 obtained is indicative of a more rapid decline in productivity as opposed to the classical Lotka coefficient of 2, while the R^2 value of 0.9541 is an indication of a good fit of the estimated model to the actual data. Furthermore, the Kolmogorov–Smirnov test produced p-values above 0.05 for both the classical model ($p = 0.627$) and the fitted model ($p = 0.964$), indicating that the observed pattern does not deviate significantly from what Lotka's Law would predict. Taken together, these results suggest that authorship in natural farming research broadly follows the pattern described by Lotka's Law.

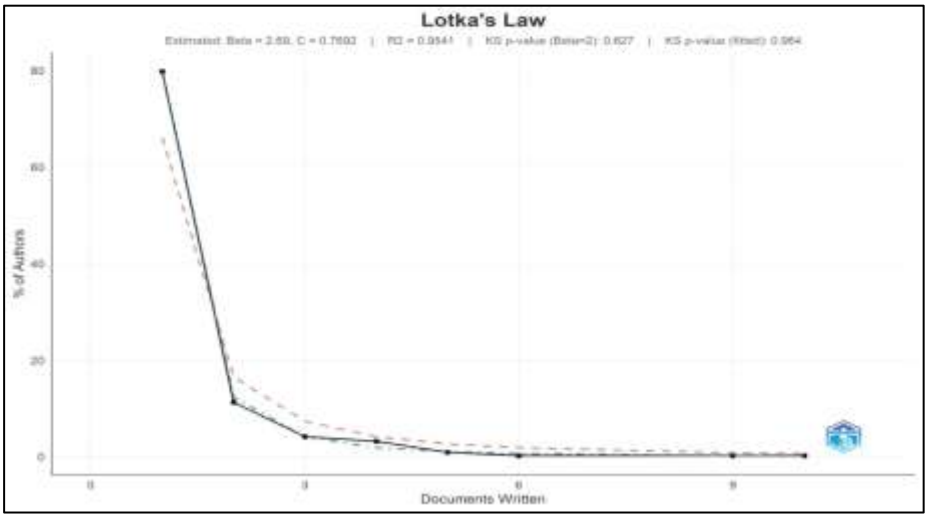

Fig. 4. Distribution of Author Productivity in Natural Farming Research Based on Lotka's Law

Sources' Production Over Time

Figure 5 illustrates the cumulative publication outputs for each of the top contributors to natural farming research from year to year. As can be seen in the figure, there are trends toward an increasing number of publications on this topic among the major contributors in more recent times; thus, demonstrating greater academic interest in the area. Sustainability (Switzerland) was the first of the major contributors, publishing its first paper prior to all others, and had published five papers by 2022. It remained steady at five until it ceased to contribute further. In contrast, Frontiers in Sustainable Food Systems rapidly increased contributions to become the top producer, as it published six papers by 2026. Likewise, Plant Science Today produced five papers. By comparison, the Indian Journal of Agricultural Sciences produced four papers through 2026. Thus overall, natural farming research appears to have increasingly been covered across multiple journals representing sustainability, plant sciences and agriculture, and much of the increase in publications occurred post-2020.

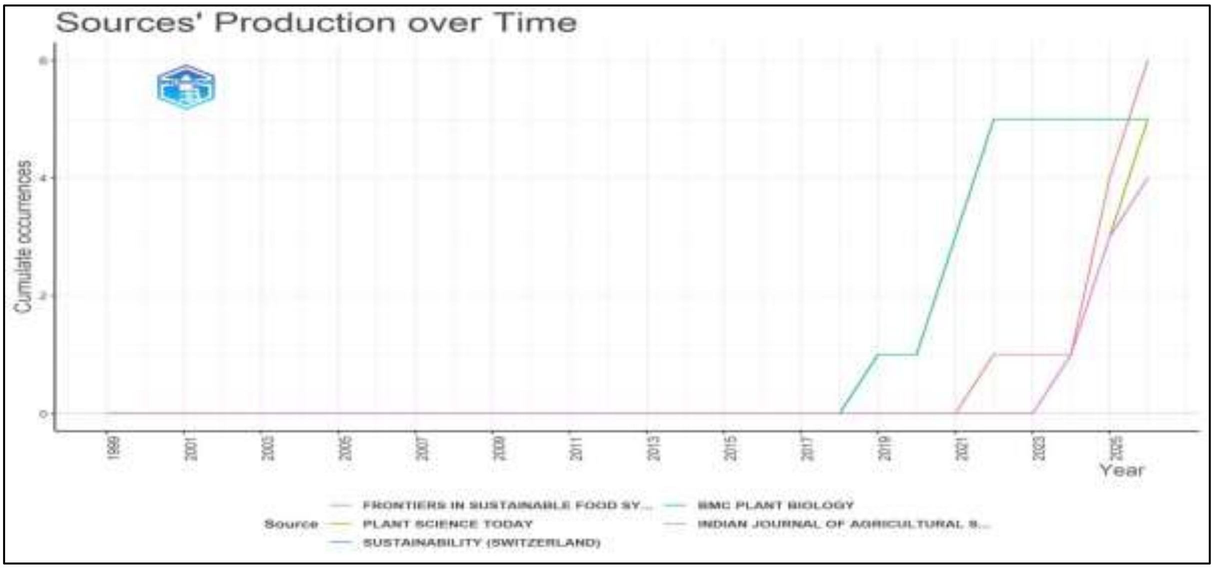

Fig. 5. Sources' Production over Time

Co-occurrence Network

Figure 6 displays the keyword co-occurrence network; this illustrates how some thematic areas relate to one another through natural farming research. The "natural farming" theme has the highest centrality/degree measure in the co-

occurrence network and the highest number of connected nodes. Thus, it represents the greatest frequency of occurrences of the term among other themes and has a high degree of connection to other themes. The overall structure of the co-occurrence network can be broken down into three main thematic clusters. The red cluster includes terms that are related to the concept of "sustainable agriculture", "alternative agriculture", "agroecology", "soil health", "intercropping", and "agricultural production". These terms represent the literature's focus on the sustainability orientation of natural farming. The green cluster includes terms related to "soil", "agriculture", "soil microbiology", "microbiology", "nutrient uptake", "crop production", and "yield." This indicates research focused on soil processes (i.e., biogeochemical cycling), nutrient dynamics, and crop performance. The blue cluster has a high degree of connectivity to India, zero budget natural farming (ZBNF), Andhra Pradesh, and crop yield. These terms also have a high degree of connectivity to each other. They illustrate the significant amount of research being conducted in India on natural farming; specifically, studies related to ZBNF.
The convergence and interrelationship between the various clusters suggest that the study of natural farming includes aspects of sustainability, soil and crop management, farming system, and locational methods, thus highlighting the multidisciplinary nature of the study.

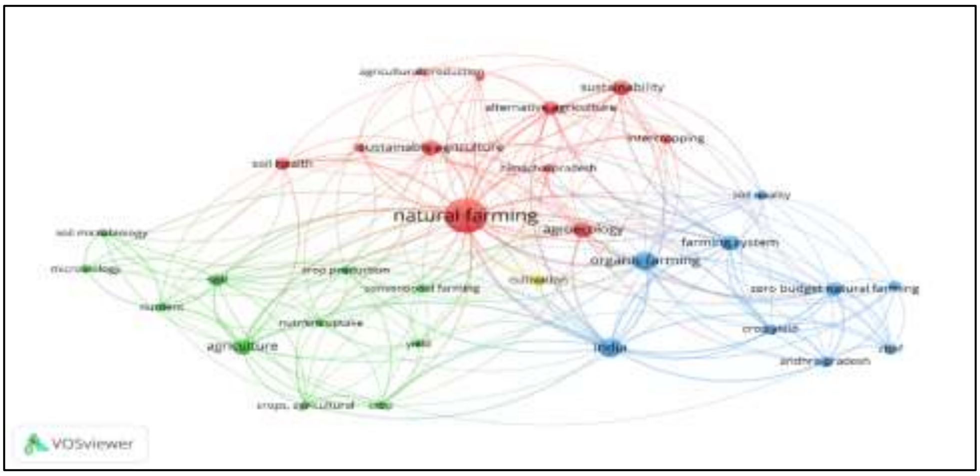

Fig. 6. Keyword Co-occurrence Network

Thematic Analysis
Thematic structure of natural farming is presented in Figure 7 based on two parameters: centrality and density. Central themes of the discipline include agriculture and soil, which are characterised by high values of both centrality and density, meaning that the topics are well-developed and are well-integrated with the discipline. Basic themes, India, agroecology, and farming systems have high centrality but low density, which means that there is a need for development of themes. Another cluster of themes includes natural farming, sustainability, and alternative agriculture and belongs to the same quadrant with similar dynamics.
This includes two different clusters within the niche-theme quadrant. First is the relatively well-developed one consisting of organic farming and soil fertility, which shows weak connections to the whole area. The second cluster, agricultural production, greenhouse gas and organic carbon, occupies the same quadrant, showing that there are even more sub-clusters, which are well developed but are peripheral to the main core of the area. Meanwhile, sustainable agriculture, cultivation and conventional farming fall into the emergent or declining quadrant, featuring low scores on both centrality and density. This statement could be an expression of topics that are new or emerging and have not yet become popular or topics that are already on the decline; but what the thematic map fails to determine without temporal analysis is whether this is the case. All in all, this map shows that soil studies are the most developed topic in this area, while natural farming and sustainability remain areas of great promise

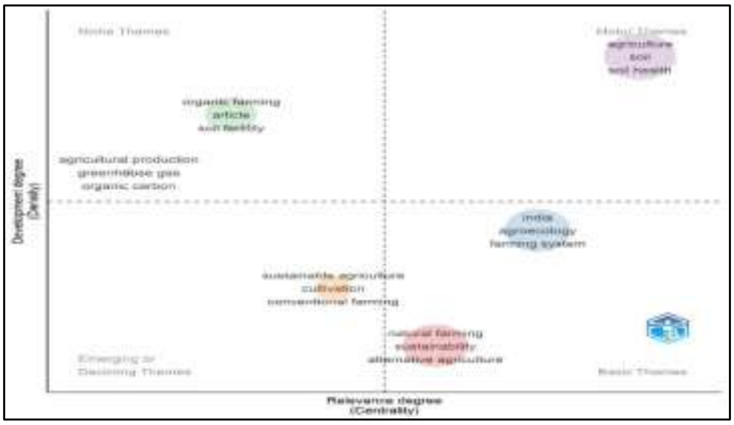

Fig. 7. Thematic map

Features of Natural Farming

Natural farming is often understood simply as farming without chemicals, but its approach goes beyond the exclusion of synthetic inputs. Natural farming emphasises self-reliance by limiting purchased inputs and making effective use of resources available within the farm, including livestock-based preparations, crop residues, biomass and other locally sourced materials (Choudhary et al., 2023). Synthetic fertilisers, pesticides and herbicides are avoided, while biological and fermented preparations are used to support crop nutrition and protection (Duddigan et al., 2023). This makes natural farming different from conventional agriculture, which relies heavily on synthetic agrochemicals and from organic farming, where externally sourced composts, manures and biological inputs may still be used (Korat et al., 2023; Panday et al., 2024). Another important feature is the recycling of resources within the farm. Crop residues and biomass are returned to the production system, while livestock and soil biological processes contribute to nutrient cycling and help reduce the need for external inputs (Deb & Bhowmick, 2024; Voisin et al., 2024). Rather than depending mainly on direct nutrient application, natural farming seeks to encourage soil microorganisms, residue decomposition and plant–soil interactions to support nutrient availability (Basak et al., 2025). Crop diversification, mixed and intercropping systems, agroforestry and livestock integration further strengthen these ecological interactions and help create a more integrated farm ecosystem (Warghane et al., 2025).

As far as the practical aspect goes, natural farming is based on Jeevamrit, Beejamrit, Acchadana (mulching), and Whapasa. While Jeevamrit and Ghanjeevamrit help increase microbial activity in the soil and recycle nutrients, Beejamrit is often used for seed treatment. Acchadana helps retain water in the soil and prevent erosion of the soil, while Whapasa helps create a favourable balance between air and moisture in the soil (Saharan et al., 2023). Together, these practices represent the main features of natural farming, which include the use of minimal outside input, more use of local input, biological recycling of nutrients, resource recycling, diversified cropping, and coordination of various farm elements

Institutional and Government Support for Natural Farming

The support provided by governments and institutions has been pivotal in ensuring that natural farming practices are adopted in a wider manner through their endorsement, funding, research, extension services, and marketing. Considering the ability of natural farming to contribute to healthy soils, biodiversity conservation, climate resilience, and food security, governments have established programs meant to encourage the adoption of natural farming practices.

There has been an increasingly growing policy backing for natural farming practices in India over the past decade. Early attempts with the use of Bharatiya Prakritik Krishi Paddhati (BPKP) through the Paramparagat Krishi Vikas Yojana (PKVY) scheme, aimed at supporting chemical-free farming, were through a cluster approach involving both farmer training and financing. This has continued even after the launch of the National Mission on Natural Farming (NMNF) in 2024 (Government of India, Ministry of Agriculture and Farmers Welfare, 2024).

Extension agencies play an important role in making policies practical. Various agricultural universities, the Indian Council of Agricultural Research (ICAR), and Krishi Vigyan Kendras (KVKs) assist natural farming via adaptive research, demonstration, capacity building of farmers, and dissemination of site-specific technologies. International bodies such as FAO also play their role via agroecology knowledge transfer and capacity building programs (Food and Agriculture Organisation, 2018).

Support from institutions plays an additional role in ensuring increased market access, mainly through FPOs, cooperatives, certification agencies, and marketing institutions. Such institutions help in aggregation, certification, branding, and establishment of market linkages. In turn, this enhances market access and price realisation for farmers (Nikam et al., 2019). Despite this, the high cost of certification, fragmented value chains, lack of awareness among consumers, and poor market infrastructure pose serious challenges in marketing natural farming products. Ultimately, the development of natural agriculture depends on the integrated workings of government policies, research and extension system, farmer organisation, and market arrangements. It is important that there should be enhanced cooperation between the policymakers, researchers, extension workers, and farmers' organisations.

Challenges in Natural Farming

Natural farming has received growing attention as a sustainable farming method that involves reducing dependence on external sources and maintaining ecological balance and good soil health. Nevertheless, despite all its benefits, there are many obstacles that are associated with the process of implementing natural farming. Scientific research highlights some problems such as productivity issues, problems of adaptation to natural farming, need for labour, input preparation, pest and disease control, lack of technical knowledge, poor access to the market, weak institutional capacity, and the question of economic feasibility of natural farming. Since these obstacles differ according to the type of farming and local environment, there is a need to better understand the factors that determine successful adoption of natural farming.

Yield and Productivity Challenges

The influence of natural farming on crop yields is still unclear since the productivity depends on crops, soil quality, agro-climatic conditions, and the extent of prior farming activities. Depending primarily on biological means for providing nutrients would not necessarily ensure the provision of enough nutrients to support yields, particularly in cases of high-input farming, while natural farming shows greater results when there is lower dependence on inputs (Smith et al., 2020). Field observations have revealed that natural farming is capable of producing yields equivalent to or even higher than what can be obtained through conventional or organic farming systems. This varies largely depending on the particular crop, location, soil and the time taken by the system to establish itself (Duddigan et al., 2022; Duddigan et al., 2023).

Other research studies have also shown yield equivalency and increased profitability among farms using natural farming practices (Berger et al., 2025). The majority of the evidence is, however, limited to particular geographical locations and farms, limiting the generalisation of the evidence to different agricultural landscapes.

Transition-Period Challenges

The shift from conventional to natural farming involves a major learning process, where the farmer will have to cut down dependency on artificial inputs alongside adopting different methods of production and also adapting to new changes in the soil. With the benefits of natural farming usually taking time through gradual soil improvements, the initial adoption stage is usually characterised by doubts about production (Duddigan et al., 2023). The farmers will need to develop new skills, such as making natural inputs and pest control in the soil (Bharucha et al., 2020). Short-term reductions in productivity and profit could discourage farmers from persisting with natural farming, especially in environments in which there is not enough financial and institutional support (Thapa et al., 2026). Therefore, it is critical that effective training, extension work, networks, and appropriate institutional support are provided in order for natural farming to be adopted.

Labour and Time Requirements

Natural Farming requires more effort and time, especially in the production and use of on-farm inputs and weeding when chemical inputs are not used conventionally. These extra demands may cause difficulties among farmers who lack family labour, animals, machines or resource availability (Bharucha et al., 2020). Labour and resource availability can affect the farmers' ability and readiness to implement Natural Farming (Balla & Goswami, 2022). How great this challenge will be depending on the size of farms and the number of available resources and support, among others.

Knowledge, Skills, Training and Extension Support

Natural Farming is knowledge-intensive and requires farmers to develop skills in bio-input preparation, soil management, pest management and other ecological farming practices. Structured training and extension interventions can improve farmers' understanding and ability to implement these practices effectively (Gamit et al., 2024). Large-scale programmes have therefore relied heavily on farmer training, community resource persons and continuous extension support to facilitate adoption (Bharucha et al., 2020). Limited access to such support may constrain adoption, particularly in areas where Natural Farming extension systems are still developing.

Economic Constraints

Reduced expenditure on purchased inputs is frequently identified as an important economic advantage of Natural Farming, with potential improvements in profitability arising primarily through lower production costs (Berger et al., 2025). Manual weed management requires considerable time and labour, making Natural Farming more labour-intensive than conventional farming systems (Dhivya et al., 2024). Lower input costs and reduced reliance on credit have also drawn farmers towards natural farming (Khadse et al., 2018; Khadse & Rosset 2019). Even so, the economic outcomes are far from uniform, as labour requirements, resource availability, access to livestock, farm characteristics and local conditions all shape how much individual farmers actually benefit (Balla & Goswami et al., 2022). The economic viability of natural farming should therefore be treated as context-specific rather than something that can be assumed across the board.

Policy and Scaling-Up Challenges

Scalability of natural farming would require more than just the advocacy for practices at the farming stage. The success of adoption of the approach would greatly depend on the continued support of institutions and extension. Large-scale initiatives have usually relied on farmer trainings, community resource persons, shared equipment, among other similar strategies to make adoption possible (Bharucha et al., 2020). While the farmer groups and the bottom-up movements have been vital for the spread of natural farming to this day, institutional support has become increasingly important as adoption goes beyond the initial adopters (Khadse & Rosset, 2019; Khadse et al., 2018).

CONCLUSION

Natural farming has been gaining momentum and becoming one of the fast-growing fields of study within the sphere of agriculture, with India being the leading producer of studies and at the same time the leader in the role of international collaboration. Nevertheless, the uneven geographical distribution and fragmentation of authorship suggest that there is a need for wider involvement in natural farming from other countries in the future. The thematic analysis suggests that agriculture, soil, and soil health are the existing thematic fields, while natural farming and sustainability have great possibilities for further development. In essence, natural farming involves minimising reliance on external sources, efficient utilisation of locally available resources, biological cycling of nutrients, crop diversity, and ecological management as opposed to chemical control of farms. Policy measures, extension services, organisations of farmers, and marketing have all helped increase natural farming. However, challenges with regard to yield consistency, transition barriers, labour constraints, lack of technical information, economic feasibility, costs of certification, and market linkages hinder the adoption of natural farming.

In the coming days, research needs to shift from one-point and short-term analysis to multi-point and long-term analysis. These kinds of research need to be conducted on topics such as crop productivity, soil condition, biodiversity, etc. in various agro-climatic zones. There exists a need to pay more heed to socio-economic impact, gender aspects, the decision-making process of farmers, the market system, and institutional aspects which affect successful adoption. A combination of various fields such as agroecology, soil science, ecology, economics, sociology, and behavioural science can be used to realise this objective. The development of technologies such as artificial intelligence, geographic information systems, and remote sensing presents possibilities for better monitoring, assessing, and managing according to location. At the same time, more collaboration among scientists internationally, provision of affordable inputs for agriculture, conducive policies, good market connections, innovations by farmers, and better knowledge transfer are crucial in ensuring implementation of findings from the scientific research. This intersection is set to lay the groundwork for scientific knowledge that would lead to a better understanding of the conditions that make natural farming sustainable.

REFERENCES

1. Duddigan, S., Shaw, L. J., Sizmur, T., Gogu, D., Hussain, Z., Jirra, K., ... & Collins, C. D. (2023). Natural farming improves crop yield in SE India when compared to conventional or organic systems by enhancing soil quality. Agronomy for Sustainable Development, 43, Article 31. https://doi.org/10.1007/s13593-023-00884-x
2. Pathak, S., Johar, V., Kaur, A., Elizabath, R., & Muhammad, K. T. (2024). A comprehensive review on harvesting abundance: Exploring the tools and techniques of zero budget natural farming. International Journal of Plant & Soil Science, 36(4), 293–301. https://doi.org/10.9734/IJPSS/2024/v36i44482
3. Kumar, A., Brar, G. S., Kaushal, S., & Shubham. (2024). Sustainable development attributes of zero budget natural farming (ZBNF) to agricultural practices. Asian Journal of Soil Science and Plant Nutrition, 10(2), 205–214. https://doi.org/10.9734/AJSSPN/2024/v10i2277
4. Kaundal, M., Ojha, S., Singh, V., & Bharti, B. (2024). Natural farming potential to mitigate climate change for sustainable agriculture: A comprehensive review. International Journal of Advanced Biochemistry Research, 8(7), 714–717. https://doi.org/10.33545/26174693.2024.v8.i7i.1579
5. Machnoor, A. V., Rosin, K. G., Gurjar, D. S., & Ajayakumar. (2025). Restoring the soil and sustaining the future: A global review of natural farming practices and impacts. Asian Journal of Soil Science and Plant Nutrition, 11(4), 1–18. https://doi.org/10.9734/AJSSPN/2025/v11i4576
6. Mishra, A. K., Maurya, P. K., & Sharma, S. (2025). Comprehensive analysis of natural farming practices across India: A systematic review. Journal of Modern Agriculture and Biotechnology, 4(2), Article 2. https://doi.org/10.53964/jmab.2025002
7. Anil Kumar, S., Manjunatha Reddy, T. B., Shashidhar, K. R., & Mushrif, S. K. (2025). Advances and insights into natural farming for sustainable horticultural production. International Journal of Research in Agronomy, 8(8S), 337–341. https://doi.org/10.33545/2618060X.2025.v8.i8Se.3571
8. Daifa, O. M. S. B., Panchal, N., Jangir, S., Singh, S., & Win, C. Y. (2024). Cultivating abundance and harmony: Exploring the ecological, economic, and cultural implications of natural farming: A literature review. International Journal of Management, Public Policy and Research, 3(2), 30–35. https://doi.org/10.55829/ijmpr.v3i2.217
9. De, L. C. (2022). Natural farming – A sustainable ecological approach. Research Biotica, 4(1), 5–20. https://doi.org/10.54083/ResBio/4.1.2022/05-20
10. Shravanilakshmi, V., Mahesh, R., & Shruthi, R. (2026). Natural farming: A sustainable approach for enhancing soil health and productivity in mulberry based sericulture. International Journal of Plant & Soil Science, 38(4), 93–107. https://doi.org/10.9734/IJPSS/2026/v38i46034
11. Nivedha, S., Marichamy, M. S., & Kanthaswamy, V. (2024). Natural farming: Embracing regenerative agriculture for sustainable crop production. Journal of Experimental Agriculture International, 46(8), 855–865. https://doi.org/10.9734/JEAI/2024/v46i82771.
12. Mandal, N. K., Parida, P., Patnaik, S., & Pati, J. (2025). Rooted in sustainability: A comprehensive review of natural farming practices worldwide. Journal of Informatics Education and Research, 5(1). DOI: 10.52783/jier.v5i1.2104
13. Joy, J. M. M., Jacob, D., Ravinder, J., & Mondal, T. (2026). Performance of cropping systems under natural farming in India. International Journal of Research in Agronomy, 9(5S), 389–393. https://doi.org/10.33545/2618060X.2026.v9.i5Se.5597
14. Patel, N., Meena, S., & Chhabhaiya, N. B. (2024). Natural farming: A study of farmers' perceptions and practices. International Journal for Multidisciplinary Research, 6(6). https://doi.org/10.36948/IJFMR.2024.V06I06.31681
15. Mane, P. P., Chorey, A. B., Paslawar, A. N., Dodewar, P. G., Bayskar, A. S., & Jadhav, A. K. (2026). Natural farming in India: Evidence, challenges, and pathways for sustainable agriculture. Journal of Scientific Research and Reports, 32(2), 182–197. https://doi.org/10.9734/JSRR/2026/v32i23961
16. Nagarjun, P., Sanjay, M. T., Rao, G. G. E., Kumari, A., Anushree, Krishna, D. K., Chakravarty, S., Umesha, C., & Kushal. (2025). An overview of zero budget natural farming: Problems and prospects in implementation. International Journal of Plant & Soil Science, 37(3), 127–133. https://doi.org/10.9734/IJPSS/2025/v37i35353
17. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070
18. Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. Organizational Research Methods, 18(3), 429–472. https://doi.org/10.1177/1094428114562629
19. Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? International Business Review, 29(4), 101717. https://doi.org/10.1016/j.ibusrev.2020.101717
20. Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007
21. Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Medicine, 6(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

22. van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3
23. Choudhary, S. K., Kumar, R., Seema, & Kumar, A. (2023). General Overview of Zero Budget Natural Farming (ZBNF). Agricultural Reviews, 44(3), 328–335. https://doi.org/10.18805/ag.R-2186
24. Korat, H., Mathukia, R., & Talaviya, H. (2023). Comparative evaluation of low-cost natural farming, organic farming and conventional farming in major crops of South Saurashtra region at Junagadh, Gujarat, India. Environment Conservation Journal, 24(3), 126–135. https://doi.org/10.36953/ECJ.14912463
25. Panday, D., Bhusal, N., Das, S., & Ghalehgolabbehbahani, A. (2024). Rooted in nature: The rise, challenges, and potential of organic farming and fertilizers in agroecosystems. Sustainability, 16(4), Article 1530. https://doi.org/10.3390/su16041530
26. Deb, A., & Bhowmick, S. (2024). Zero budget natural farming: A sustainable agricultural practice. International Journal of Agriculture and Nutrition, 6(2), 89–94. https://doi.org/10.33545/26646064.2024.v6.i2b.186
27. Voisin, R., Horwitz, P., Godrich, S., Sambell, R., Cullerton, K., & Devine, A. (2023). What goes in and what comes out: a scoping review of regenerative agricultural practices. Agroecology and Sustainable Food Systems, 48, 124 - 158. https://doi.org/10.1080/21683565.2023.2270441
28. Basak, S., Mandal, S., Gangopadhyay, C., & Chatterjee, S. (2025). Enhancing natural farming practices: A pathway to sustainability and chemical pesticide-free superior food quality. NL Journal of Agriculture and Biotechnology, 2(4), 3–12. https://doi.org/10.71168/NAB.02.04.120
29. Warghane, A., Bhatt, V., Chopade, B. A., Thakkar, J., Sharma, R., Mondal, A. S., Sabhadiya, P., Singh, A., & Bhardwaj, G. (2025). Jivamrit as a sustainable approach: A review of natural farming and future agriculture. Recent Advances in Food, Nutrition & Agriculture, 16(3), 241–249. https://doi.org/10.2174/012772574X332918240911033507
30. Saharan, B. S., Tyagi, S., Kumar, R., Vijay, Om, H., Mandal, B. S., & Duhan, J. S. (2023). Application of Jeevamrit improves soil properties in zero budget natural farming fields. Agriculture, 13(1), Article 196. https://doi.org/10.3390/agriculture13010196
31. Government of India. (2024). National Mission on Natural Farming (NMNF): Guidelines and implementation framework. Ministry of Agriculture and Farmers Welfare.
32. Food and Agriculture Organization. (2018). The 10 elements of agroecology: Guiding the transition to sustainable food and agricultural systems. FAO.
33. Nikam, V., Singh, P., Ashok, A., & Kumar, S. (2019). Farmer producer organisations: Innovative institutions for upliftment of small farmers. The Indian Journal of Agricultural Sciences, 89(9), 1383–1392. https://doi.org/10.56093/ijas.v89i9.93451
34. Smith, J., Yeluripati, J., Smith, P., & Nayak, D. R. (2020). Potential yield challenges to scale-up of zero budget natural farming. Nature Sustainability, 3(3), 247–252. https://doi.org/10.1038/s41893-019-0469-x
35. Duddigan, S., Collins, C. D., Hussain, Z., Osbahr, H., Shaw, L. J., Sinclair, F., Sizmur, T., Thallam, V., & Winowiecki, L. A. (2022). Impact of zero budget natural farming on crop yields in Andhra Pradesh, SE India. Sustainability, 14(3), 1689. https://doi.org/10.3390/su14031689
36. Berger, I., Kamble, A., Morton, O., Raj, V., Nair, S. R., Edwards, D. P., Wauchope, H. S., Joshi, V., Basu, P., Smith, B., & Dicks, L. V. (2025). India's agroecology programme, 'Zero Budget Natural Farming', delivers biodiversity and economic benefits without lowering yields. Nature Ecology & Evolution, 9, 2057–2068. https://doi.org/10.1038/s41559-025-02849-7
37. Bharucha, Z. P., Mitjans, S. B., & Pretty, J. (2020). Towards redesign at scale through zero budget natural farming in Andhra Pradesh, India. International Journal of Agricultural Sustainability, 18(1), 1–20. https://doi.org/10.1080/14735903.2019.1694465
38. Thapa, A., Muthuprakash, S., Damani, O., & Isaac, M. E. (2026). Social-ecological outcomes of agroecological transitions: A case study from natural farming systems in central India. PLOS Sustainability and Transformation, 5(1), e0000212. https://doi.org/10.1371/journal.pstr.0000212
39. Balla, J., & Goswami, K. (2022). Understanding the constraints and reasons to adopt natural farming – a study on rice growing farmers of Andhra Pradesh, India. International Journal of Agricultural Sustainability, 20(6), 1209–1224. https://doi.org/10.1080/14735903.2022.2070340
40. Gamit, R. A., & Vinaya Kumar, H. M. (2024). Perception of farmers about natural farming. Gujarat Journal of Extension Education, 38(2), 195-200.
41. Dhivya, C., Murugan, P. P., Senthilkumar, M., & Arunkumar, R. (2024). Opportunities and Challenges on Natural Farming. Asian Journal of Soil Science and Plant Nutrition, 10(4), 301-309 https://doi.org/10.9734/ajsspn/2024/v10i4405
42. Khadse, A., Rosset, P. M., Morales, H., & Ferguson, B. G. (2018). Taking agroecology to scale: The Zero Budget Natural Farming peasant movement in Karnataka, India. The Journal of Peasant Studies, 45(1), 192–219. https://doi.org/10.1080/03066150.2016.1276450
43. Khadse, A., & Rosset, P. M. (2019). Zero budget natural farming in India–from inception to institutionalization. Agroecology and Sustainable Food Systems, 43(7–8), 848–871. https://doi.org/10.1080/21683565.2018.1550797