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The Impact of Agroecological Practices on Biodiversity and Agricultural Productivity

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Abstract

By means of this document, it was possible to analyze the main characteristics of the volume of scientific production referring to the study of the variables Agroecological Practices, Biodiversity, and Agricultural Productivity. A bibliometric analysis was proposed to analyze details such as Year of Publication, Country of Origin of the publication, Area of Knowledge in which the published research is carried out and the Type of Publication most frequently used by the authors of each document published in high-impact journals indexed in the Scopus database during the period between 2017 and 2022. Among the main findings, it was possible to determine that, for the execution of the different research methodologies, the report of 19 scientific documents related to the study of the impact of agroecological practices on biodiversity and agricultural productivity was achieved. The maximum number of publications made in a year was 6 papers submitted in 2020. The country of origin of the institutions that reported the highest number of records in Scopus was France with 6 documents. The area of knowledge with the greatest influence at the time of executing the research projects that resulted in scientific publications was Environmental Sciences and Agriculture and Biological Sciences with 11 documents. Finally, the type of publication most frequently used to publicize findings from the analysis of the aforementioned variables was the Article, which represented 69% of the total scientific production.

Keywords: *Agroecological Practices, Biodiversity, Agricultural Productivity.*

1. Introduction

The recent introduction of agroecological practices as a social movement, pursues multifunctional roles for agriculture, promotes social justice, nurtures identity and culture, and strengthens the economic viability of rural areas. In the world, emphasizing the country of Ecuador where it faces various consequences as a result of climate change, population growth, population increase and the limitation of the natural resources that we have at our disposal, this leads us to implement agricultural production systems at a global level based on sustainability and resilience. Agroecology is a scientific discipline that studies how the different components of the agroecosystem interact with each other,

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these practices seek to promote more sustainable agricultural systems that optimize and stabilize production levels.

The impact of the implementation of agroecology on biodiversity and agricultural productivity is a relevant issue that concerns the field of agriculture and environmental sciences. In this sense, the relationship occurs in ecosystems, agriculture and population, where the health of society is closely related to the well-being of others.

In the first instance, the implementation of this agroecological science prioritizes the use of processes and the optimization of natural resources, with the function of being able to significantly reduce the use of synthetic inputs used for agriculture such as chemical fertilizers and pesticides. By employing these ecological production techniques in the production models of agricultural crops and polycultures, it seeks to ensure that this system carries out integrated pest management, where agroecology provides an environment with greater biodiversity and is more environmentally friendly. This alternative not only improves the production levels used in the traditional way, but also seeks to improve the health of the soil, achieving the creation of new habitats to increase the range of beneficial organisms, such as pollinators, predators and prominent soil microorganisms. This alternative practice directly counteracts the negative impacts of pests and diseases, while seeking to maximize the resilience of agricultural production systems.

Likewise, the sustainability of agricultural production systems is closely linked to the preservation of biodiversity. Agroecology practices aim to improve soil fertility, proper use of water resources, non-contamination of ecosystems which, in turn, seek to cooperate to increase and improve agricultural crop yields. The reduction of environmental impact and sustainability over time, integrated with agroecology, allows farmers new options that help secure natural resources and improve crops, preserving a greener natural world for future generations.

In this context, it is vitally important that investigating the myriad ways in which agroecological practices implement positively impact biodiversity and agricultural production in Ecuador. This integration of new production models aims to address a wide variety of ecosystems, from large-scale modes of production to large commercial operations, in climatic and demographic environments that help improve agricultural yields in this country. In this scenario, agroecological practices in Ecuador increase the potential benefits of local agriculture and allow them to directly address the current challenges of food security, environmental and economic sustainability, and allow them to conserve unlimited environmental resources in an ever-changing world. For this reason, this article seeks to describe the main characteristics of the compendium of publications indexed in the Scopus database related to the variables Agroecological Practices, Biodiversity, Agricultural Productivity, as well. Such as the description of the position of certain authors affiliated with institutions, during the period between 2017 and 2022.

2. General Objective

To analyze, from a bibliometric approach, the characteristics in the volume of scientific production related to Agroecological Practices, Biodiversity, Agricultural Productivity, registered in Scopus during the period 2017-2022.

3. Methodology

This article is carried out through a research with a mixed orientation that combines the quantitative and qualitative method.

On the one hand, a quantitative analysis of the information selected in Scopus is carried out under a bibliometric approach of the scientific production corresponding to the study of Agroecological Practices, Biodiversity, Agricultural Productivity. On the other hand, examples of some research works published in the area of study mentioned above are analyzed from a qualitative perspective, based on a bibliographic approach that allows describing the position of different authors on the proposed topic.

It is important to note that the entire search was carried out through Scopus, managing to establish the parameters referenced in Figure 1.

3.1 Methodological design

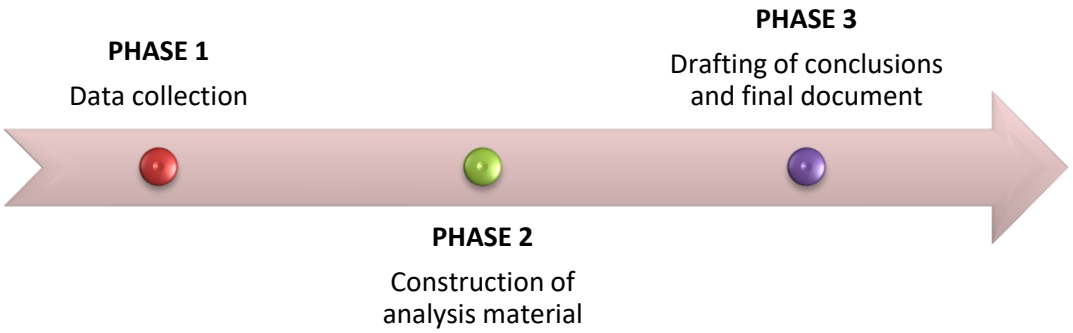

Figure 1. Methodological design

Source: Own elaboration

3.1.1 Phase 1: Data collection

Data collection was carried out from the Search tool on the Scopus website, where 19 publications were obtained from the following filters:

TITLE-ABS-KEY (agroecological AND practices, AND biodiversity, AND agricultural AND productivity) AND PUBYEAR > 2016 AND PUBYEAR < 2023

- Published documents whose study variables are related to the study of Agroecological Practices, Biodiversity, Agricultural Productivity
- Works published in journals indexed in Scopus during the period 2017-2022.
- Without distinction by country of origin
- No distinction in areas of knowledge.
- No distinction of type of publication.

3.1.2 Phase 2: Construction of analytical material

The information collected in Scopus during the previous phase is organized and then classified by graphs, figures and tables as follows:

- Co-occurrence of Words.
- Year of publication.
- Country of origin of the publication.
- Area of knowledge.
- Type of Publication.

3.1.3 Phase 3: Drafting of conclusions and outcome document

In this phase, the results of the previous results are analysed, resulting in the determination of conclusions and, consequently, the obtaining of the final document.

4. Results

4.1 Co-occurrence of words

Figure 2 shows the co-occurrence of keywords found in the publications identified in the Scopus database.

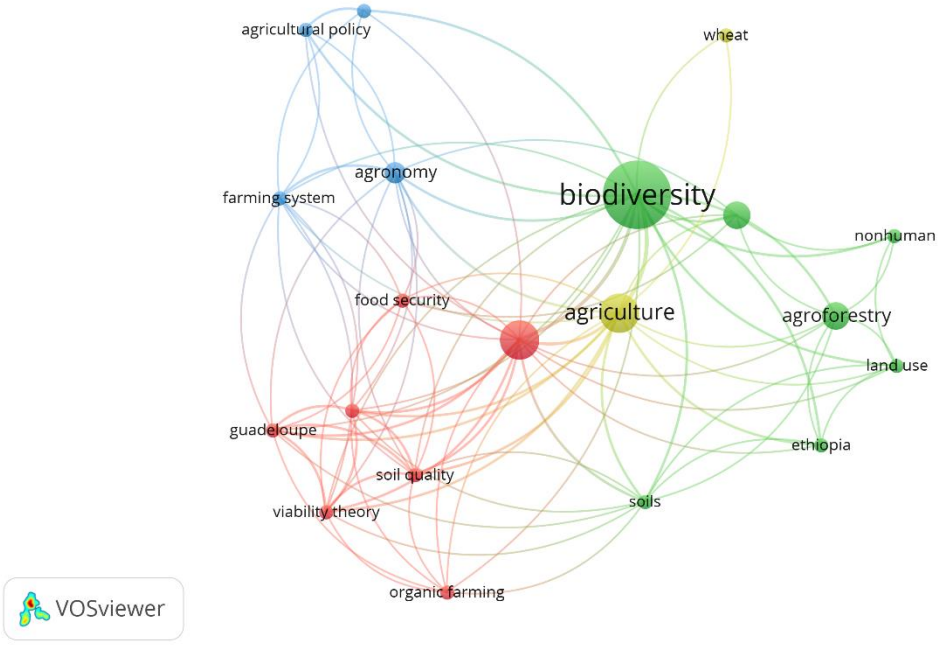

Figure 2. Co-occurrence of words

Source: Authors' own elaboration (2023); based on data exported from Scopus.

Biodiversity was the most frequently used keyword within the studies identified through the execution of Phase 1 of the Methodological Design proposed for the development of this article. Agriculture is among the most frequently used variables, associated with variables such as Food Security, Agricultural Policy, Agricultural System, Agronomy, and Organic Agriculture. From the above, it is striking, these practices encourage beneficial interactions between various organisms, which leads to a healthier and more diverse ecosystem. This enhanced biodiversity can include pollinators, natural predators of pests, and soil microorganisms. Increased biodiversity helps maintain ecological balance, reduce the need for chemical inputs, and support the overall health of the ecosystem. Agroecological practices prioritize organic matter, cover crops, and reducing soil disturbance. These strategies improve soil fertility and structure, reduce erosion, and improve water retention. Healthy soils support healthier plant growth, which ultimately leads to higher agricultural productivity. While agroecological practices may not always produce the same high yields in the short term as some intensive conventional methods, they often maintain consistent and sustainable yields in the long term. This is especially valuable in the context of ensuring food security and addressing the challenges of population growth and climate change.

4.2 Distribution of scientific production by year of publication

Figure 3 shows how scientific production is distributed according to the year of publication.

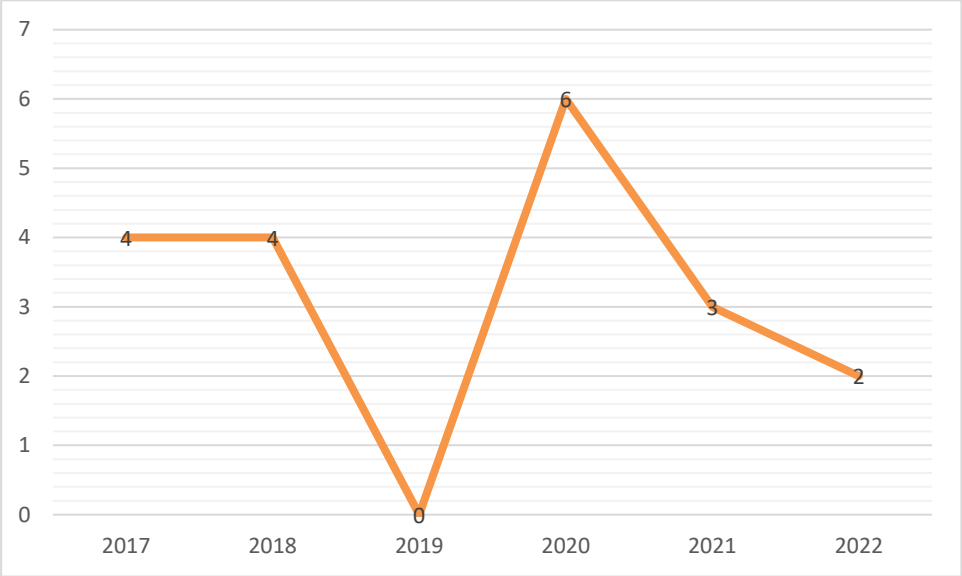

Figure 3. Distribution of scientific production by year of publication.

Source: Authors' own elaboration (2023); based on data exported from Scopus

Among the main characteristics evidenced through the distribution of scientific production by year of publication, it is notorious a level of number of publications registered in Scopus in the years 2020, reaching a total of 6 documents published in journals indexed on this platform. This can be explained by articles such as the one entitled "Responses of active soil microorganisms to a biostimulant input from the soil compared to the effects of plant legacy." In this study, our aim was to decipher the mode of action of an algae and amino acid-based biostimulant intended to be applied to soil crop residues to increase their microbial mineralization and increased nutrient release. By setting up a two-phase experiment (plant cultivation in soil and incubation in soil), our objectives were to (1) determine the effects of the soil biostimulant over time on active soil bacteria and fungi and the consequences on organic carbon mineralization. in bare soils, and (2) to assess the biostimulant effects on soil microorganisms in relation to the effects of plant legacy in planted soils. We showed that the soil biostimulant had a delayed effect on active soil microorganisms and activated both plant growth-promoting bacteria and saprophytic microorganisms in the medium term of 49 days. However, changes in the abundance of active microbial decomposers were not associated with an increased rate of soil-derived organic carbon mineralization and/or leaf litter. The present study evaluated the beneficial effect of biostimulants on active soil microbial communities as similar or even greater than the effects inherited from A. thaliana or T. aestivum plants. Specifically, we show that the biostimulant increased the richness of active fungi to a greater extent than what was observed in soils in which the two plants previously grew.(Hellequin, 2020)

4.3 Distribution of scientific production by country of origin.

Figure 4 shows how the scientific production is distributed according to the nationality of the authors.

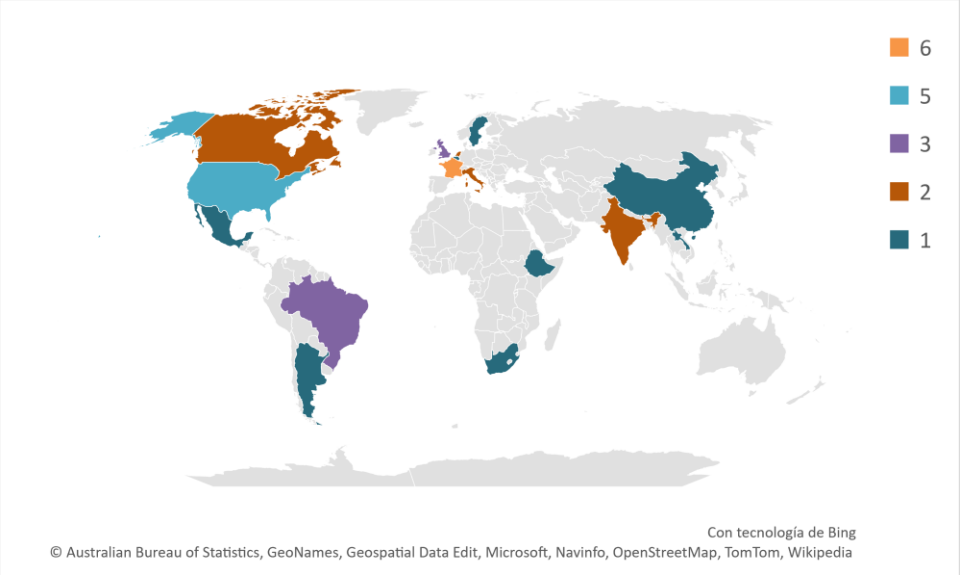

Figure 4. Distribution of scientific production by country of origin.

Source: Authors' own elaboration (2023); based on data provided by Scopus.

Within the distribution of scientific production by country of origin, registrations from institutions were taken into account, establishing France as the country of that community, with the highest number of publications indexed in Scopus during the period 2017-2022, with a total of 6 publications in total. In second place, the United States with 5 scientific papers, and Brazil occupying third place presenting to the scientific community, with a total of 3 papers among which is the article entitled "Viability of agroecological systems under climate uncertainty." In this paper, we propose a model based on feasibility theory to study the sustainability of an agricultural system subject to climate uncertainty. Our goal is to determine which agricultural practices and sequences of activities restore soil quality to a desired level and at the same time ensure an acceptable level of productivity in the presence of the risk of major climatic disasters. The model applies to Guadeloupe, an island in the French West Indies. We found that the results are highly sensitive to the direct effect of hurricanes on soil quality, which, in turn, strongly affects the impact of the other parameters and that the export-oriented sector is more vulnerable and less resilient to climate uncertainties than the sector aimed at the local market.(Oubraham, 2020)

4.4 Distribution of scientific production by area of knowledge

Figure 5 shows the distribution of the elaboration of scientific publications based on the area of knowledge through which the different research methodologies are implemented.

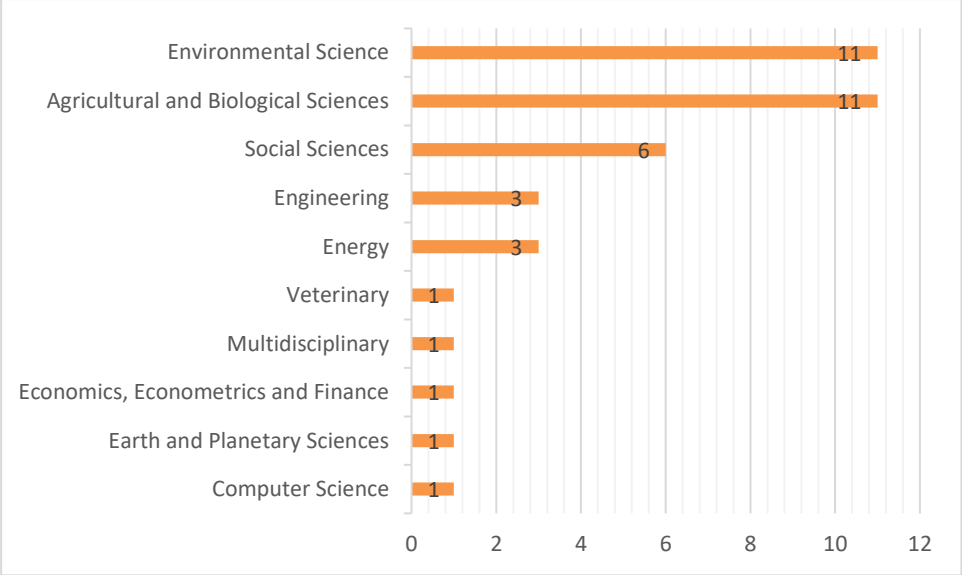

Figure 5. Distribution of scientific production by area of knowledge.

Source: Authors' own elaboration (2023); based on data provided by Scopus.

Environmental Sciences was the area of knowledge with the highest number of publications registered in Scopus with a total of 11 documents that have based their study methodologies Agroecological Practices, Biodiversity, Agricultural Productivity. In second place, Biological Sciences and Agriculture with 11 articles and Social Sciences in third place with 6. The above can be explained thanks to the contribution and study of different branches, the article with the greatest impact was registered by Environmental Sciences entitled "Implementation of good agricultural practices for rural environmental management" The objective of this study is to evaluate the environmental situation of a representative rural establishment of Tandil for the application of Good Agricultural Practices (GAP). The methodology has been divided into two stages: a) analysis of the control points proposed by the GAP, primary sources (direct observation in fieldwork, checklist of the GAP Manual (2013), semi-structured interviews directed) and secondary sources were used. sources (documentary records of the activities carried out in the farm, Global Gap Manual of Good Agricultural Practices (2013); and b) SWOT Matrix was created for the understanding of the environmental situation of the rural farm evaluated in a qualitative-quantitative and synthetic way. . Of the total aspects evaluated, 60% of the control points analysed present an ideal or adapted environmental situation for the incorporation of BPA and 40% of them an uncomfortable situation. Therefore, it is possible to conclude that most of the processes and actions carried out in the rural establishment are favorable for the implementation of GAP. However, it should be noted that there are impacts, such as those on biodiversity, that must be overcome in order to improve the environmental situation of unfavourable control points. The conclusions show that different measures were identified to reduce the impacts. However, by incorporating techniques that increase sustainability in terms of soil conservation, the demand for energy inputs, agrochemicals and the number of liters used per year increases. It is expected to provide a preliminary overview for the implementation of the GAP, not only analyzing strengths and opportunities, but also taking corrective measures regarding threats and weaknesses.(Somoza A, 2018)

4.5 Type of publication

In the following graph, you will see the distribution of the bibliographic finding according to the type of publication made by each of the authors found in Scopus.

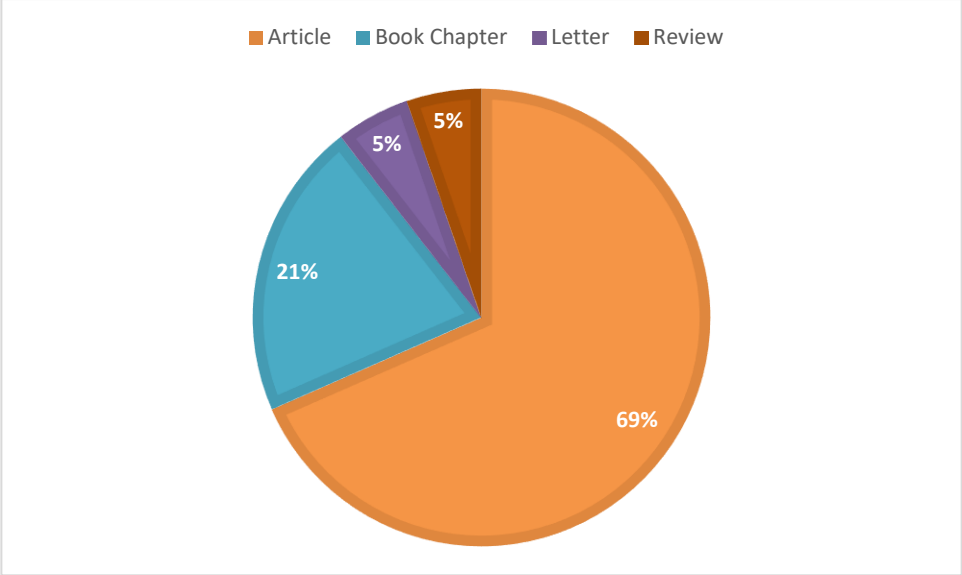

Figure 6. Type of publication.

Fountain: Authors' own elaboration (2023); based on data provided by Scopus.

The type of publication most frequently used by the researchers referenced in the body of this document was the one entitled Journal Articles with 69% of the total production identified for analysis, followed by Book Chapter with 21%. Letters are part of this classification, representing 5% of the research papers published during the period 2017-2022, in journals indexed in Scopus. In the latter category, the one entitled "Effects of Acacia tortilis (Forssk) hayne dispersa on soil properties in different land uses in the Central Rift Valley of Ethiopia" stands out. The aim of the study was to determine the effects of A. tortilis on variations in soil fertility along a gradient from the base of the tree to the open area in different types of land use. earth. Soil samples were taken from the topsoils (0–15 cm) in four concentric transects at distances from the base of the tree (0.5, 2, and 4 m), compared with soil samples from adjacent open areas (15 m away from the tree canopy cover). and then analyzed following standard procedures. The results of the study indicated that, with the exception of Na, the amount of soil nutrients under A. tortilis varied significantly ($P < 0.05$) in land-use types. Overall, comparisons between low- and out-canopy tree species indicated a highly significant difference in major soil fertility parameters. The effect of tree species on soil fertility parameters was significantly greater with distance from the base of the tree to the outside of the canopy. But soil texture was not affected, indicating that it is more related to parental material and land-use practices than to the influence of trees.(Tiruneh Asaye, 2017)

5. Conclusions

Through the bibliometric analysis carried out in this research work, it was possible to establish that France was the country with the highest number of published records regarding the variables Agroecological Practices, Biodiversity, Agricultural Productivity. With a total of 6 publications in the Scopus database. In the same way, it was possible to establish that the application of theories framed in the area of Environmental Sciences, were used more frequently in the implementation of industrialized agricultural and food systems, since they are also an important factor that contributes to the decrease in the number of agricultural holdings, and the high use of antibiotics has caused serious human health problems. In this sense, agroecology can provide information on important pathways and guide the design, development and promotion of the transition to sustainable agriculture and food systems. The minimized impact on natural resources carried out by the implementation of agroecological practices tends to reduce the

implementation of chemical derivatives such as fertilizers and pesticides, as the use of these products can be harmful on a large scale in the environment. By being able to reduce the use of these products, agroecology would allow the management and mitigation of the pollution present in water resources and soil. These agroecological systems can identify and monitor those environmental stressors and the current climatic changes presented in the current decade. The diversity of agricultural crops, the large scale of intercropping, and other production practices allow this system to achieve adaptability to weather patterns, pests, and diseases. This resilience will allow agricultural production to be able to carry out good production and ensure sustainability and food security in the face of unprecedented environmental challenges.

To conclude, these agroecological practices offer a very promising outlook to address the present double challenges, the loss and pollution of biodiversity and the focus on increasing agricultural productivity. By focusing this sustainable agriculture system based on caring for the environment and long-term food security, at the same time being able to minimize negative impacts on environmental ecosystems. However, the successful adoption of agroecological practices often depends on local conditions, knowledge, and supportive policies.

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