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# Agroecological Transition in the Cotton Zone: Analysis of Technical-Economic and Environmental Performances in Northern Benin - A Literature Review

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## Abstract

This article is a systematic review of the knowledge of technical-economic and environmental performance in agroecological transition. The data collected in the Scopus and dimension database concerned exclusively published articles and journals, using the relevant terms. Thus, 227 documents exported from Scopus and dimension were submitted to a bibliometric analysis with the Citespace software, then the inclusion and exclusion criteria were carried out according to the ROSES standards. The results reveal that the annual production of studies related to the technical-economic and environmental performance in agro-ecological transition is increasing with an annual growth rate of about 1.3%. There is a common understanding of agroecological transition. The agroecological transition addresses the problems of the food system from field to plate, covering all activities and actors involved in the cultivation based on natural resources. Among the agroecological practices analyzed, the application of compost seems the most promising to be scaled up to improve economic and environmental performance.

**Keywords**: Agroecological transition, bibliometric analysis

## Introduction

Agricultural systems in the tropics, where many countries are still facing large increases in human population, are faced with increasing food demand, uneven food availability, and structural economic conditions that are not conducive to rural employment (Coast et al., 2022). Producing more and more, by all means, is the cultivation policy advocated by intensive farming systems. Unfortunately, these cultivation methods have ended up showing shortcomings with either increasingly resistant pests or soils that die over time. To overcome this, ecological cropping systems through agroecology offer sustainable, healthy, and economically viable methods of production by minimizing external inputs with interesting yields (Ploeg, 2019). This is a real opportunity that presents itself but raises many questions that must be answered upfront so as not to jump headfirst into a mud puddle. As is the case with agriculture in Northern countries, these challenges in tropical countries come with the need to reduce rural poverty, maintain a balance between rural and urban areas, and preserve natural resources (HLPE, 2019). Thus, to promote a transition to more sustainable agriculture, alternative solutions have emphasized the positive role of (bio)diversification and ecological processes and services (Kremen et al., 2012). These processes are called agroecological transition. They are systemic transformations that involve the greening of agriculture and food (Magrini et al., 2019). Proponents of agroecology also claim that it has the potential to make agri-food systems more socially just in addition to its ecological goals (Anderson et al., 2019; Boillat and Bottazzi, 2020; Coolsaet, 2016).

Nevertheless, the potential of agroecology to empower small farmers and other disadvantaged actors to achieve a socially just transition remains a contested issue. Agroecological transition initiatives are often constrained by the characteristics and politics of the movements behind them (Meek, 2016). Research results and observations from experiments and real-world cultivation are available in the form of scientific articles, journals, books, and others, and show what the application of ecological cultivation methods can bring to the renovation of farming systems. Agroecology is continuously gaining recognition in the scientific world regarding food production (Kerr, 2021). The ecological transition, therefore, builds on this learning effort to guide the gradual shift from chemical to ecological farming. In this momentum of knowledge, relevant questions emerge about the management of the agroecological transition itself. This article is a systematic review of the knowledge of technical-economic and environmental performance in

agroecological transition. The bibliographic synthesis and the systematic review will allow answering the following questions:

What are the publication trends in the field of agroecological transition? How is the concept of agroecological transition evolving? What are the technical, economic, and environmental performances in agroecological transition? and What are the current challenges and opportunities of agricultural practices toward agroecological transition?

## Methodology

### Strategy and search term

A search strategy that includes search terms from a data source to collect the most relevant references was performed. The first step was to define a search string considering keywords and terms related to the PICO (Population, Interventions, Comparator, and Outcome) elements (Petrokofsky et al., 2015). The data source was the Scopus database (http://www.scopus.com/search/) and Dimension. These Scopus data were chosen because it includes a wide range of high-impact international academic journals (Caviggioli & Ughetto, 2019) and records mainly scientific articles, journals, and books, but also other documents such as conference reports, etc.

The keywords and terms used for searches in the main bibliographic databases were derived from the PIOS items detailed in Table 1 IOP elements.

| **Elements** | *Description* | **Syntax** |
|---|---|---|
| Population | Agro-ecological transition | **"Agroecological transition" OR "agroecological" OR "agro-ecological"** |
| Intervention | Cropping system, Farming, Activity | **"Cropping system" OR "farm" OR "activity"** |
| Outcome or results | Technical performance or Economic performance or Environmental performance | **"Technical performance" OR "economic performance" OR "environmental performance"** |

Each element was compared by the Boolean operator OR (Garcia-Yi et al., 2014; Petrokofsky et al., 2015) and their combinations by the Boolean operator AND. The terms were used to establish the search string (Search by titles, summary keywords) shown below:

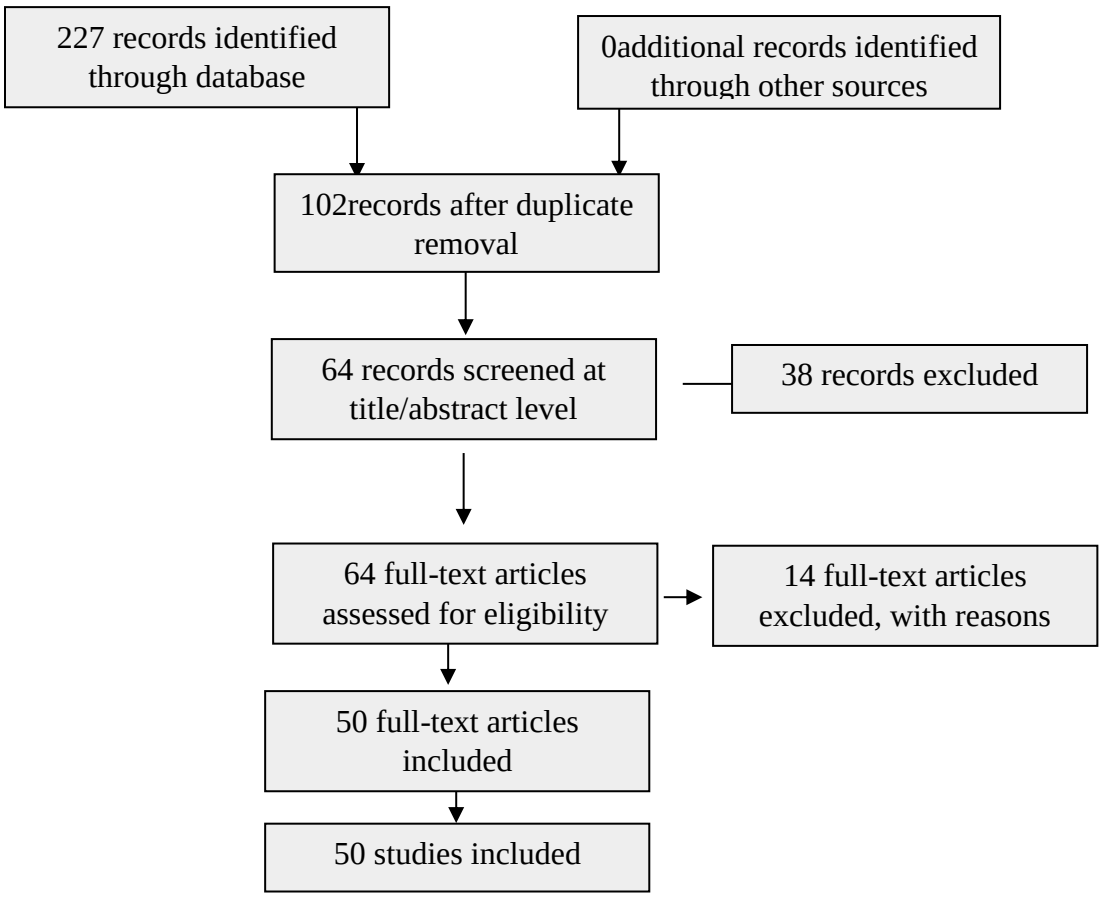
( TITLE-ABS-KEY ( "Agroecological transition" OR agroecological OR "agro-ecological" ) AND TITLE-ABS-KEY ( "Cropping system" OR farm OR activity ) AND TITLE-ABS-KEY ( "Technical performance" OR "economic performance" OR "environmental performance" ) )

**Analysis method for bibliometric analysis**

227 documents exported in RIS format from Scopus were subjected to bibliometric analysis with Citespace software. The analyses performed studied the evolution of the number of publications, and an analysis of the bursts of references (Chen, 2017; Xiao et al., 2017). The configuration parameters of the analyses in citespaces are left by default.

**Study inclusion criteria**

The inclusion criteria outlined in the IOP list (Table 1) specify the types of populations, interventions, outcomes, and geolocation. Figure 1 summarizes the evaluation steps according to the criteria for the documents to be included in the study. A set of 102 documents after deletion is subjected to an initial inclusion/exclusion step. This step consists in checking the relevance of the documents based on the title and abstract only (Petrokofsky et al., 2015). In case of doubt, the study is retained for further evaluation (Garcia-Yi et al., 2014). Then, the second step consisted of an evaluation of the relevance of the documents at the full-text level.



## Results and discussion

### Publication trend on the theme

The evolution of the number of publications on the theme can be divided into two main phases: a first phase from 2007 to 2012 characterized by low publications. The second phase from 2013 to 2022 characterized by the exponential growth of publications (Figure 2). This trend could be explained by the fact that the agroecological transition is a recent concept in the world.

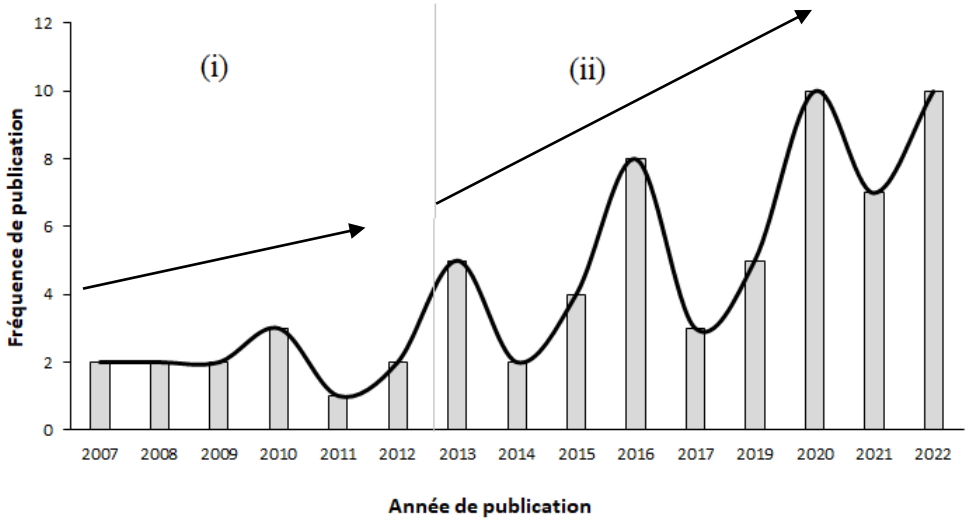



**Figure 1.** Evolution of the number of publications

## 2. Keyword analysis

### 2.1. Cluster analysis of keywords

Figure 3 shows the most cited articles in the area of agroecological transition performance. The size of the polygons represents the frequency of citation, and the lines between the polygons represent the cooperative relationship between them.

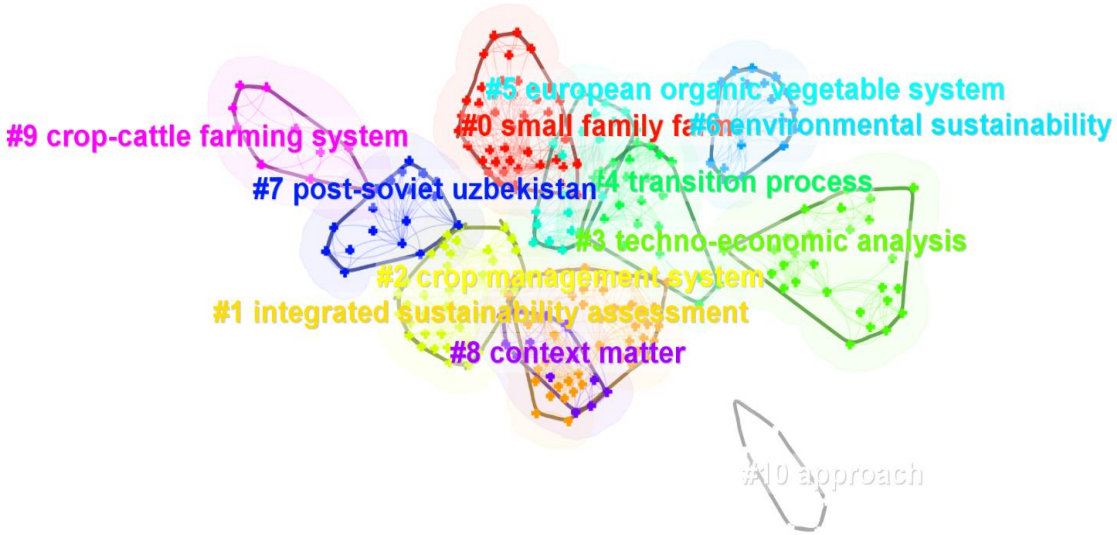



**Figure 2.** Cluster analysis of keywords

10 clusters were formed and the citation and silhouette information for each cluster (Table 2).

**Table 1.** Summary of the 10 largest reference groups

| Cluster-ID | Size | Silhouette | Label (SIF) | Label (LLR) | Label (MI) | Average year |
|---|---|---|---|---|---|---|
| 0 | 43 | 0.907 | Small family farm | small family farm (16.88, 1.0E-4) | Case Study (0.54) | 2013 |
| 1 | 42 | 0.844 | Economic indicator | integrated sustainability assessment (17.13, 1.0E-4) | farm level (0,3) | 2012 |
| 2 | 39 | 0.799 | Methodological framework | Crop management system (9.61, 0.005) | Cuba (0.2) | 2009 |
| 3 | 27 | 0.935 | Technical and economic analysis | Technical-economic analysis (14.23, 0.001) | Food sustainability (0.22) | 2018 |
| 4 | 21 | 0.833 | Agro-ecological performance | transition process (15.37, 1.0E-4) | Economic evaluation (0.17) | 2012 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 20 | 0.877 | European organic vegetable system | European organic vegetable system (13, 0.001) | Multi-criteria evaluation (0.28) | 2018 |
| 6 | 19 | 0.968 | The role of input self-sufficiency in the economic and environmental sustainability of specialized dairy farms | Environmental sustainability (7.98, 0.005) | Environmental sustainability (0.03) | 2015 |
| 7 | 19 | 0.869 | An agronomic, economic, and behavioral analysis of nitrogen application to cotton and wheat in post-Soviet Uzbekistan | Post-Soviet Uzbekistan (7.47, 0.01) | Post-Soviet Uzbekistan (0.04) | 2012 |
| 8 | 14 | 0.92 | Sustainability of the agricultural system | Background (12.72, 0.001) | Opportunity cost (0.3) | 2018 |
| 9 | 10 | 0.958 | intersection | Cattle raising system (10.11, 0.005) | Productive sheet (0,17) | 2010 |

**Keyword burst analysis**

Figure 3 shows a sudden detection analysis of cited keywords to explore the literature with significant contributions in the area of agroecological transition performance. We selected 07 keywords with the highest sudden appearance in the results of the article collection. Keywords with high values in the intensity value column are often important research papers in this field (Chen, 2017).

As shown in Figure 3, the oldest burst began in 2007, and the most recent in 2019. The most recent keyword bursts are related to "sustainability", "culture" and "biodiversity".

**Table 2.** Graphical analysis of time zone for keywords

| Keyword | Year | Strength | Start | End | 2007 - 2022 |
|---|---|---|---|---|---|
| zea may | 2007 | 1.73 | **2007** | 2008 |  |
| mixed farming | 2007 | 1.29 | **2010** | 2014 |  |
| food security | 2007 | 1.15 | **2012** | 2013 |  |
| organic farming | 2007 | 1.27 | **2015** | 2019 |  |
| sustainability | 2007 | 1.74 | **2016** | 2020 |  |
| Farm | 2007 | 1.28 | **2016** | 2022 |  |
| biodiversity | 2007 | 2.11 | **2019** | 2020 |  |

## Concept of the agro-ecological transition

Agroecology has been broadly defined as "the ecology of sustainable food systems. (Francis et al., 2003). Thus, agroecology is the application of ecological concepts and principles to the design and management of sustainable agroecosystems (Gliessman et al., 1998). In this definition, the key concept is the ecosystem: a functional system of complementary relationships between living organisms and their environment. Agroecological management uses practices such as no-tillage, plant cover, application of organic amendments, etc., to balance agricultural productivity and environmental concerns. (Wezel et al., 2014) to balance agricultural productivity and ecological functionality and improve resilience to external bio-physical disturbances (e.g., erosion, drought, plagues, etc.) (Altieri, 2002).

Therefore, the agroecological transition according to the FAO has been promoted as a potential solution to the ecological, social, and economic problems generated by dominant agricultural models (Audouin et al., 2019). It thus provides access to healthy agricultural products following a major ecological scandal caused by a persistent pesticide that contaminated water and agricultural soils (Andrieu et al., 2022).

## Technical-economic and environmental performance in agro-ecological transition

### Technical and economic performance

Economic performance varies according to the agroecological transition. Production activities also differ. The use of plant protection products allows farmers to maximize their economic performance and yields (Trabelsi et al., 2016)

However, farm economic performance and input self-sufficiency respond differently to farm growth. Although the study does not consider the underlying mechanisms, the results are consistent with the hypothesis that

functionally diversified cropping systems offer farmers a wider range of potential growth factors and opportunities to exploit economies of scope in production that can improve their economic performance (Bommarco et al., 2013; Chavas and Kim, 2007; De Roest et al., 2018; Van der Ploeg et al., 2019).

Similarly, the satisfactory demand for legumes by the farm had a positive influence on socioeconomic performance at the territorial level, including an increase in the average gross margin (from 71 €/ha; to 4% more) (Catarino et al., 2021).

The French case study, based on self-sufficient farming systems belonging to a sustainable agriculture network, highlights that cost reduction management led to a win-win strategy including good economic and environmental performance (Bonaudo et al., 2014). Farms reduced their dependence on external inputs and suffered only a limited loss of production (Bonaudo et al., 2014). This is the case of a good procedure to attribute in most cases the greatest sustainability to permanent grasslands, thanks to good soil, nutrient, and pesticide management. The succession of rice continues, despite satisfactory economic results (Castoldi and Bechini, 2010).

**Environmental performance**

The environmental performance of agroecology is maintained and improved with the complete elimination of synthetic chemical plant protection products in mineral-ecological cropping systems (MECS) (Zimmermann et al., 2021). Therefore, the development of mineral-ecological cropping systems aims to improve the overall ecosystem services of agricultural landscapes by "(i) improving the provision of regulatory ecosystem services compared to conventional cropping systems and (ii) improving the provision of provisioning ecosystem services compared to organic cropping systems. (Zimmermann et al., 2021).

Furthermore, studies show that by decreasing dependence on external inputs, production systems are promising alternatives for an agroecological transition. Thus ecologically sustainable, resilient, and economically viable (Catarino et al., 2021). Therefore, the use of organic fertilizers such as composting is environmentally sustainable in terms of energy consumption and carbon emissions and produces a good quality fertilizer (Persiani et al., 2021).

Modern agricultural systems should combine healthy agricultural production with environmental benefits and high efficiency, to make them more sustainable. (Persiani et al., 2021).

**Current challenges and opportunities of agroecological transition practices**

Of the agroecological practices analyzed, compost application appears to hold the most promise for improving economic and environmental performance, and further research is needed to determine the results of a combination of compost and ground covers (De Leijster et al., 2020). A trade-off study of technical, economic, and environmental performance is also needed to show the dynamics of agroecological transition.

**Conclusion**

Based on the bibliometric analysis method, the scientific progress made on the performance of the agroecological transition is weak. Despite the low level of publications on the topic, there is common knowledge of the agroecological transition. The agroecological transition addresses the problems of the food system from field to plate, covering all activities and actors involved in the cultivation based on natural resources. Among the agroecological practices analyzed, the application of compost seems the most promising to be scaled up to improve economic and environmental performance. The trade-off studies of technical, economic, and environmental performance have shown the dynamics of agroecological transition.

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