Land Improvements in Agriculture: A bibliometric Analysis Unveiling Trends and Future Research Perspectives

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Abstract

Land improvement in agriculture refers to the set of interventions and practices applied to agricultural land in order to optimise it for more efficient and sustainable production. This paper investigates developments and trends in the field of agricultural land improvement through a comprehensive bibliometric analysis. From the inception of publications in 1979 to 2023, we observed a significant increase in interest, evidenced by a peak in 2022. Year-by-year analysis revealed thematic shifts, such as increased focus on erosion, deforestation and agricultural land use in 2014 and 2015, compared to increased interest in biodiversity, greenhouse gas emissions and agricultural technologies in later years.

Keywords: *Land improvements, agriculture, bibliometric analysis, land practices, infrastructure*

JEL classification: Q1, Q13, N5

DOI: 10.24818/RMCI.2023.12.859

1. Introduction

Land use changes and agricultural changes have been numerous in Europe during the time. It is important to note that these changes were driven by a variety of factors. In recent times, the growth of agricultural production has increased dramatically over the last few hundred years and will likely accelerate in the early part of the next century, at least in most of Europe's farming regions. In other regions of the Globe, such as Asia or Africa these increases are urgently needed. The expansion of agricultural aims and land use will primarily depend on the quality of agricultural produce and production practices.

These agricultural objectives will be stimulated by government policies and directly by market value added. Agriculture not only serves as a means of food production but also contributes significantly to nature protection, to the preservation of biodiversity and to the European landscape, which is a public asset that is

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currently undervalued by the market and which may require a different approach (Taghizadeh-Mehrjardi et al., 2020). This study confidently explores the opportunities and challenges of agriculture and land use in Europe through a simulation study using climatic data, pedological data, and the physiological, phenological, optical and geographical characteristics of crops as inputs. The findings of the preparatory study will be confronted with the expanded objectives of agriculture and its place in society through additional research (Zhang et al., 2023).

For ages, agricultural development was the only answer to provide enough food for Europe's growing population. During the Medieval period, more than 80% of the total population was employed in the agricultural sector, utilising the most efficient methods possible given the limited external resources available to increase productivity and the lack of labour to substitute for machinery (Rabbinge, R. & van Diepen, C.A, 2000).

To achieve the goals and targets of eradicating poverty and malnutrition at the continental level, the interventions required included doubling crop productivity through a focus on inputs, irrigation and mechanization. However, irrigation is not a solution to all security problems. Therefore, it is necessary to complement irrigation with improvements in water use efficiency, nutrition and human health. To sustainably tackle the complex challenge of food insecurity, a comprehensive and systemic approach is needed. (Moeis et al., 2020).

Expanding the amount of irrigated land means expanding the volume of water abstracted for agriculture, which already accounts for the majority of freshwater withdrawals. It also necessitates substantial investments in infrastructure and energy, particularly in nations with economic water scarcity. Yet at the same time as producing more food to feed a growing population, the region is experiencing energy instability (Mabhaudhi et al. 2018).

The efficient use of land as a resource, and the protection and enhancement of its fertility, have always been considered urgent concerns. The concept of assessing soil fertility in terms of productivity has existed since the time of ancient China and Egypt. With the development of the agricultural sector, land was valued on the basis of the ecological requirements of each crop. But it was not until the eighteenth and nineteenth centuries in Western Europe that methods for assessing soil quality and ecological properties began to develop. Soil fertility is considered an important quality (Sterie & Dumitru, 2020). It is the main and most common means of production for the national economy. Soil fertility is the capacity of the soil to provide plants with the factors of life that are available to a certain degree. Every soil has a specific capacity as a natural aggregate and its quality as well as productivity is determined by its fertility. As fertility is a key indicator of a soil's productive capacity, there are numerous techniques for estimating how much more productive one soil is than another (Valiyev, A. & Mirzayev, 2023).

Land reform has been a key element of agricultural transformation during the long-term transition in countries such as Bulgaria, Romania or Poland, which has the objective of establishing suitable conditions for the establishment of a market economy by introducing process of decentralisation and re-establishing the right of

ownership for all owners and their heirs (Mihailova, 2020). Since the decisive year 1989, the farming industry has changed a lot, the most relevant of which was the introduction of the land reform and the restoration of land in its original borders, and it has also faced some serious problems, such as the disintegration of the old production structures, privatisation, as well as the lack of a purposeful government policy or support for agriculture (Stoeva et al, 2023).

Rather than allocating additional factors, changes in the structure of production are considered as methods of improving performance. Farmers can assess economic efficiency using a range of indicators: gross and net profit, marginal profit, gross margin, unit and variable costs, material costs per unit, rate of internal rate of return and rate of economic return (Jean et Ion 2018).

As (Popescu et al. 2017) says to ensure total economic competitiveness, it is necessary to take a more in-depth perspective in the process of evaluating the potential of land use. Understanding farming productivity increases the development of the agricultural structure of land in order to exploit the most suitable crops with the highest productivity.

Implementing positive change in the agricultural sector is a crucial need to streamline production and promote environmental sustainability and hence land improvements (Cunha et al., 2023).These improvements are geared towards diversifying and modernizing agricultural practices, adopting innovative technologies and effective strategies with the aim of maximizing crop yields and conserving natural resources (Chen et al., 2023).There are several key elements that help to optimize land improvements (Figure 1).

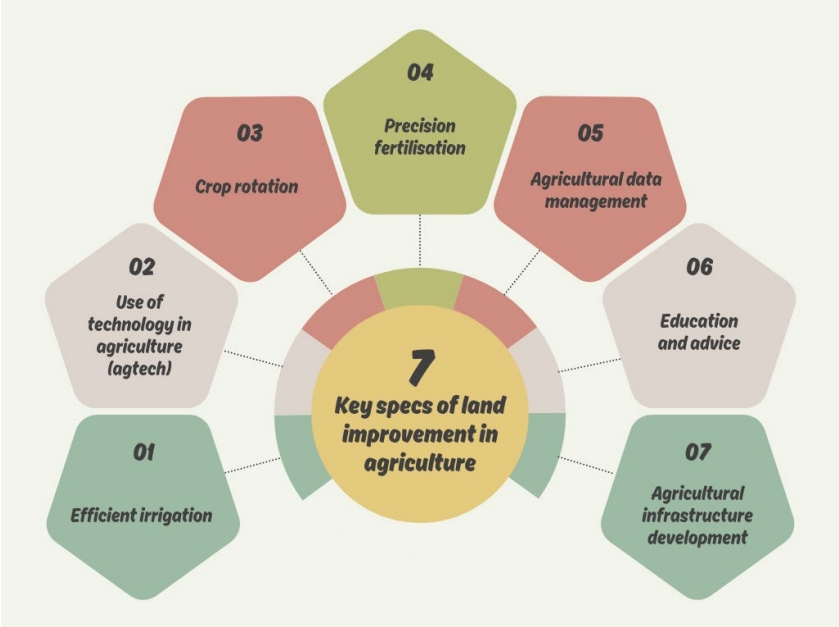

Figure 1. Key aspects of land improvements
Source: Own processing

2. Material and method

As early as 1969, Alan Pritchard introduced the term "bibliometrics", described as a statistical and mathematical method applied to books and other publications. Today, bibliometric research has become commonly used in the literature, providing an opportunity to illustrate a specific or general area of interest (Pritchard, 2003). This approach involves the quantitative study of published works and bibliographic records, in which historical data are explored, organized, and analyzed on a large scale to identify unseen patterns.

This approach helps researchers gain a deeper understanding of the topics they are investigating. Bibliometric analysis is recognized as an alternative method for investigating different fields of study.

This technique provides a systematic and transparent process focused on the overall examination of a particular academic or research area. Specifically, it facilitates the quantitative assessment of institutional performance and the identification of constructs as well as modes of collaboration (Broadus, 1987).

3. Results and discussions

Scientific publications on our subject started in 1979 in the Web of Science database when 2 scientific papers were published. From 1990 onwards, the number of publications increases, reaching a peak of publications in 2022 when 957 publications were made, slightly decreasing to 830 publications in 2023 (Figure 2).

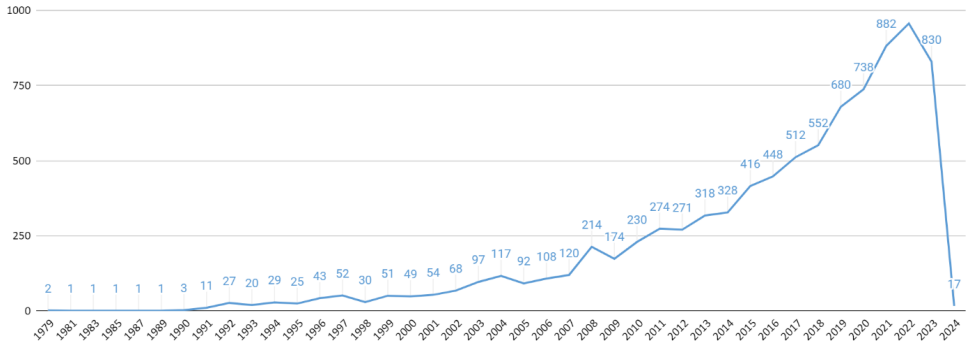

Figure 2. Number of papers published on the topic „Land improvements in agriculture"
Source: processing based on WoS data

On the topic „Land improvements in agriculture", 8754 papers have been produced, found in the WoS database, included in several categories such as: environmental science (2,503 papers), Agronomy (1,196 papers), environmental studies (806 papers), multidisciplinary agriculture (778 papers), soil science (757 papers) etc. (Figure 3).

Figure 3. Tree diagram of Web of Science publications on the „Land improvements in agriculture"
Source: WoS

Figure 4 shows the key words used at least 3 times in a publication on "Land improvement in agriculture". Thus, the words are grouped in 8 clusters. The first cluster contains the words; accuracy, area, agricultural land, climate, cover, cropland, cropland, cultivated land, desert, desertification, land cover, grassland, fertility, drought, degradation, deep learning, pattern, region, risk, satellite, suitability, trends.

The second cluster includes: energy, emissions, biomass, bioenergy, agricultural land use, farms, food production, innovation, costs, climate change, evolution, performance, policy, pollution, resilience, protection, water, water quality, soil organic matter.

The third cluster includes: adoption, agricultural intensification, crop production, growth, health, labor, land resources, land tenure, impact, patterns, poverty, poverty rights, reform, rural, market, livestock, security, soil erosion, transition, The fourth cluster includes: adaptation, agriculture, food, food security, land improvement, irrigation, resources, rice, recovery, soils, water productivity, wheat, winter wheat, yield.

Cluster number 5 includes: carbon, conservation agriculture, biochar, land use change, matter, nitrogen, quality, no-tillage, sediment, soil, soil carbon, soil properties.

Cluster number 6 includes: biodiversity, biodiversity, cover change, development, expansion, dynamics, population, urbanization, patterns, agricultural policies, development, expansion, dynamics, population, urbanization, patterns.

Cluster number 7 comprises: areas, agroforestry, crop production, land conservation, land fragmentation, land fragmentation, rural areas.

Cluster number 8 comprises: carbon emission, cattle, communities, forest, habitat, habitat, nutrients, urban (Figure 4.)

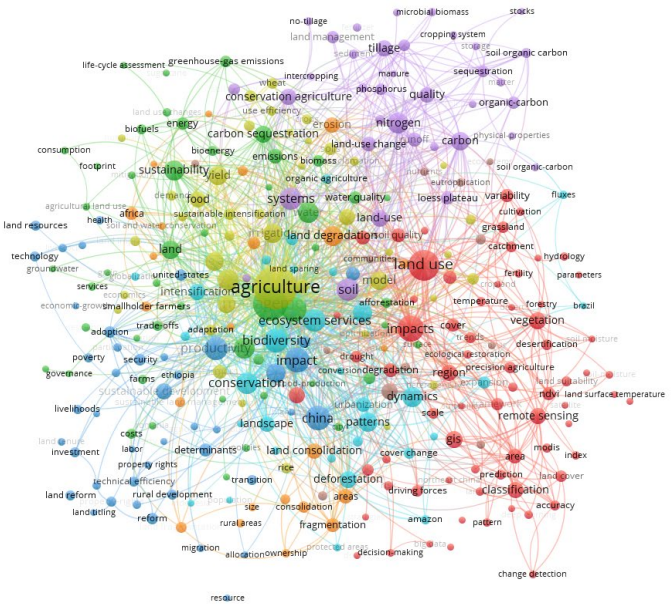

Figure 4. Link between „Land improvements in agriculture" and other related terms
Source: own processing based on WoS results using VOSviewer

Regarding the key words used by year, there was an increased interest in 2014 and 2015 for sub-items such as: erosion, fertilizers, trends, deforestation, agricultural land use, wheat, afforestation, variability, cultivation, biomass, erosion, intensification, rural area.

In 2016 and 2017, researchers focused on agriculture, land use, biodiversity, emission, tillage, conservation, climate-change, trade-offs, rural development, energy, land resources, technology.

In 2018 and 2019, scientific papers focused on the following topics: impact, organic carbon,. land, food, land conservation, model, migration, investment, costs, prediction, index, sequestration, organic carbon, no tillage, microbial biomass, stocks, storage, farms, poverty, governance.

In 2020, the focus was on live hoods, reform, areas, urbanization, precision agriculture, adoption, size, consolidation, technical efficiency, river-basin, risk, carbon emission (Figure 5).

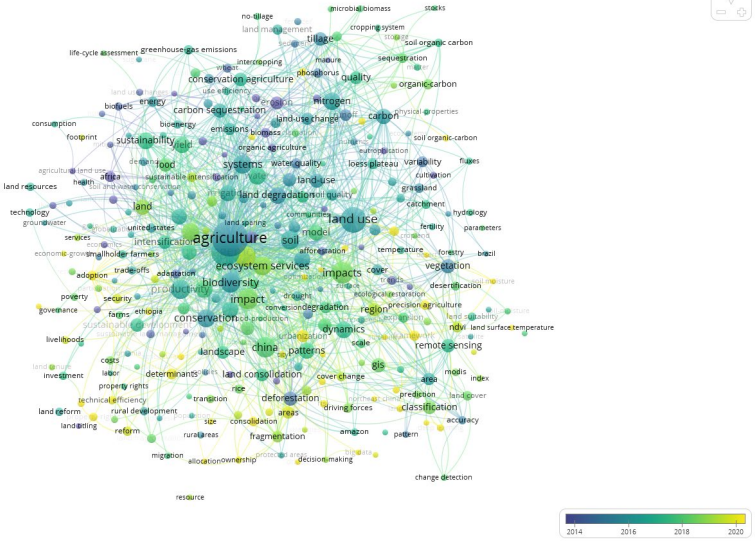

Figure 5. Link between „Land improvements in agriculture" and other related terms by year

Source: own processing based on WoS results using VOS viewer

As for the interest shown by countries in our field of study, this is evident according to the size of the node, and the diversity of colors reflects the research directions addressed by these countries. Among the countries showing particular interest are China, the United States, the Netherlands and Germany. The map highlights 9 distinct colors, corresponding to the 9 research directions. Collaborations in Romania, in particular with Malaysia, Indonesia, the Netherlands and Norway, are also highlighted, as shown in Figure 6.

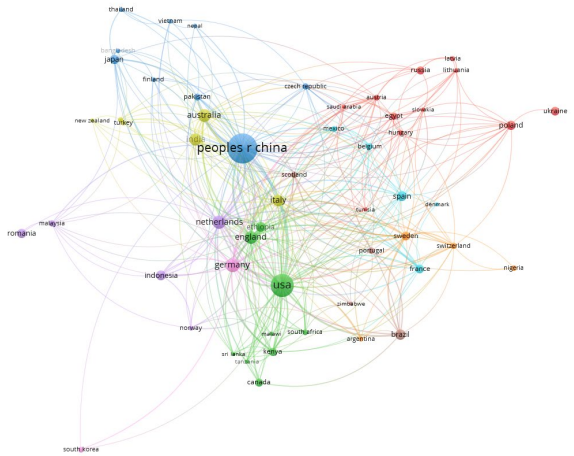

Figure 6. Graphical representation of co-author countries

Source: own processing based on WoS results using VOS viewer

4. Conclusions

Since 1979, we see a significant increase in the number of publications, reaching a peak in 2022 with 957 papers and a slight decrease in 2023 to 830 papers. This trend indicates a continued and growing interest in the field. Keyword analysis reveals 8 distinct clusters, covering a wide range of topics. These include issues related to agricultural land use, climate change, innovations in food production, health impacts, and technologies such as artificial intelligence and deep learning. Based on the clustering of keywords, we can identify major research directions such as resource efficiency, climate change adaptation, food security, health impacts and sustainable agricultural policies. Depending on the year, we see a variation in the themes addressed. The years 2014 and 2015 showed interest in topics such as erosion, land degradation and agricultural land use. In subsequent years, the focus has shifted to issues such as biodiversity, greenhouse gas emissions, agricultural technologies and sustainable rural development. Romania appears to be involved in significant collaborations, notably with Malaysia, Indonesia, the Netherlands and Norway, indicating an effort to develop common knowledge and practices in the area of agricultural land improvement.

References

1. Broadus, R. N. (1987). Toward a definition of bibliometrics. Scientometrics, 12, 373-379.
2. Chen, L., Rejesus, R. M., Aglasan, S., Hagen, S., & Salas, W. (2023). The impact of no-till on agricultural land values in the United States Midwest. American Journal of Agricultural Economics, 105(3), 760-783.
3. Cunha, M. C., Serpa, D., Marques, J., Keizer, J. J., & Abrantes, N. (2023). On sustainable improvements of agricultural practices in the Bairrada region (Portugal). Environment, Development and Sustainability, 25(3), 2735-2757.
4. Jean, Andrei & Andreea, I.R.. (2018). A trade-off between economics and environment requirements on energy crops vs. food crops in Romanian agriculture. Custos e Agronegocio. 14. 61-82.
5. Mabhaudhi, T.; Mpandeli, S.; Nhamo, L.; Chimonyo, V.G.P.; Nhemachena, C.; Senzanje, A.; Naidoo, D.; Modi, A.T. Prospects for Improving Irrigated Agriculture in Southern Africa: Linking Water, Energy and Food. Water 2018, 10, 1881. https://doi.org/10.3390/w10121881.
6. Moeis, F. R., Dartanto, T., Moeis, J. P., & Ikhsan, M. (2020). A longitudinal study of agriculture households in Indonesia: The effect of land and labor mobility on welfare and poverty dynamics. World Development Perspectives, 20, 100261.
7. Popescu, Gh., Istudor, N., Nica, E., Andrei, V., Ion, R., (2017). The influence of land-use change paradigm on Romania's agro-food trade competitiveness—An overview. Land Use Policy. 61. 293-301. 10.1016/j.landusepol.2016.10.032.
8. Pritchard, A. (2003). Bibliografía estadística o bibliometría. Infobib, 2, 33-36.
9. Rabbinge, R.; van Diepen, C.A, Changes in agriculture and land use in Europe, European Journal of Agronomy, Volume 13, Issues 2-3, 2000, Pages 85-99, ISSN 1161-0301, https://doi.org/10.1016/S1161-0301(00)00067-8.

10. Sterie, C., & Dumitru, E. A. (2020). Research on the evolution of the number of agricultural holdings in the period 2002–2016. Scientific Papers. Series Management, Economic Engineering in Agriculture and Rural Development, 20(3), 579-582.
11. Stoeva, T.; Dirimanova, V.; Georgiev, M. (2023). The trends, role and importance of extension services for the development of land relations in Bulgaria. Bulgarian Journal of Agricultural Science. 29. 97-100.
12. Taghizadeh-Mehrjardi, R., Nabiollahi, K., Rasoli, L., Kerry, R., & Scholten, T. (2020). Land suitability assessment and agricultural production sustainability using machine learning models. Agronomy, 10(4), 573.
13. Valiyev, A. ; Mirzayev, N. (2023). Ways to improve land assessment methods in Azerbaijan. Acta Scientiarum Polonorum Administratio Locorum. 22. 421-431. 10.31648/aspal.8979.
14. Zhang, H., Chen, Z., Wang, J., Wang, H., & Zhang, Y. (2023). Spatial-Temporal Pattern of Agricultural Total Factor Productivity Change (Tfpch) in China and Its Implications for Agricultural Sustainable Development. Agriculture, 13(3), 718.