Worldwide research trends on land tenure

Esther Salmerón-Manzano [a], Francisco Manzano-Agugliaro [b],[*]

[a] *Faculty of Law, Universidad Internacional de La Rioja (UNIR), Av. de la Paz, 137, 26006 Logroño, Spain*
[b] *Department of Engineering, University of Almeria, ceiA3, 04120 Almeria, Spain*

A B S T R A C T

Land tenure issues can contribute to food insecurity, limited livelihood opportunities and consequently poverty. Lack of land tenure can cause migratory movements that can affect not only individuals and families but also communities or even entire nations. This study aims to underline the scientific and social relevance of land tenure studies by identifying research focus and trends. To this end, we analyzed all scientific publications related to land tenure from 1950 to 2020. The three most active countries in this field are the United States, the United Kingdom and Australia. The three most active countries in this field are the United States, the United Kingdom, and Australia, with the three main institutions being Wageningen University & Research, the University of Wisconsin-Madison, and the Norwegian University of Life Sciences. Three different research periods have been identified in this domain. In the period from 1950 to 1999, the main research clusters identified were related to socioeconomics and demography issues. In the second period, from 2000 to 2009, the main research clusters identified were related to specific geographical areas and land rights issues, with an emphasis on countries in Africa or South America. In the third period, from 2010 to 2020, the main research clusters identified were related to environmental aspects. It has been found that land tenure studies have always been linked to what subsequently became the sustainable development goals, especially those related to the elimination of poverty and hunger in the first period, economic growth and reducing inequalities in the second period, and climate change in the third period. From a geographical point of view, the first two periods were characterized by terms related to continents such as Africa, Asia, or Latin America, with Africa being the most frequently used term in the first two periods. In the third period, studies on specific countries stood out, especially those related to China and Mexico.

1. Introduction

Land tenure plays a critical role in determining access to productive land, with those holding limited land rights often in a disadvantageous position compared to those with more extensive rights (Masitera, 2021). The land used productively by humans was approximately 47 million square kilometers in 1990 (Houghton, 1994). Based on World Data Bank, in 2016, the global agricultural area was about 48.6 million square kilometers (The World Data Bank, 2021). This area is distributed over more than 200 countries, which in terms of surface area vary widely from country to country. If the total land surface of our planet is calculated to be about 149 million square kilometers, the conclusion can be drawn that one third of the planet's surface is considered to be arable land or land under permanent crops (Bahar et al., 2020). According to some studies there are still some 27 million square kilometres with crop production potential, suggesting that there is still room for further

expansion of agricultural land (Harrison et al., 2002). However, there is also a perception, at least in some sectors, that there is little or no more land to be cultivated (Murty et al., 2002; Perea-Moreno et al., 2017). Fig. 1 shows the amount of arable land available per person in each country, ranging from 0.05 ha per person to 2 ha. On average, there is 0.19 ha of arable land per person globally. However, there is significant variation in the average areas of arable land per person between countries. Only three countries have a ratio greater than 1 hectare per person: Australia (1.90), Kazakhstan (1.65), and Canada (1.21) (World Data Bank, 2021), which is 6–10 times higher than the global average.

Fig. 1 shows the amount of arable land per person for each country. The arable land ranges from 0.05 ha to 2 ha per person. On average, there is 0.19 ha of arable land per person for the entire population. It should be noted that the average area of arable land varies greatly between countries. For instance, there are only three countries in the world with a ratio greater than 1 hectare per person: Australia (1.90),

Kazakhstan (1.65), and Canada (1.21) (World Data Bank, 2021). This is 6–10 times higher than the average. The world map reveals two types of countries with a low ratio of arable land per person. The first group comprises highly populated countries like India or China. The second group includes countries with smaller populations but extreme climatic conditions, such as those on the east coast of Africa or in the Middle East.

The distribution of arable land per person does not show a significant gap between the world's richest and least developed countries. This raises questions about whether access to land tenure could be a crucial factor in their development (Altieri and Nicholls, 2020). The challenges surrounding this issue are being studied globally, and ongoing research on arable land tenure is shedding light on its complexities.

Nowadays, scientific journals are the primary platform for publishing research findings (Salmerón-Manzano and Manzano-Agugliaro, 2020, 2019). Bibliometrics is a research technique that analyzes the size, growth, and distribution of scientific publications in a specific field and studies the structure of the groups that produce them (Cascajares et al., 2021). Although bibliometrics originated in the early 20th century, it experienced a significant boost in the 1960 s with the creation of the Science Citation Index (SCI) by Garfield in 1955 at the Institute for Scientific Information (ISI) in Philadelphia. Garfield and Sher developed the Journal Impact Factor in the 1960 s as a methodological tool to select titles to be included in the SCI. The success of the SCI and the subsequent creation of the Social Science Citation Index (SSCI) and Arts and Humanities Citation Index (AHCI) marked a turning point in the field of Bibliometrics.

Bibliometric studies have proven successful in evaluating almost all fields of science (Garrido-Cárdenas et al., 2020). The social sciences have received the highest number of bibliometric-related studies, with 38% of the total manuscripts in this field (Cascajares et al., 2021). Environmental sciences are also a very remarkable field with 8% of the total number of bibliometric publications. Related to land there have been about 40 bibliographic studies according to the Scopus database, most of them related to land use, such as sustainable use (Aznar-Sánchez et al., 2019a, 2019b) or land degradation (Escadafal et al., 2015; Xie et al., 2020) but none related to land tenure and its consequences.

Research on land tenure began in 1921 with the publication of "Melanesian Land Tenure" (Anonymous, 1921), and it has since developed significantly. The rural sector is the foundation of food production for people worldwide, either directly or through animal feed production. Land tenure is a key factor in organizing rural economies and societies worldwide, defining economic and contractual relationships, forms of cooperation, and social relations. Food security is a global concern, and sustainability in the management of land resources is crucial to achieve

it. This requires improving resource efficiency for food production while preserving the environment. This is impossible without landowners, making it essential to explore the challenges and opportunities of land tenure.

This manuscript provides a comprehensive analysis of the existing literature on arable land tenure, with the following objectives: 1) to identify the main periods of research and the scientific categories they fall into; 2) to examine the distribution of publications by countries, institutions, and authors; 3) to analyze and identify the main research focus or clusters of this area of study; and 4) to identify the research trends of this field by periods, using bibliometric analysis.

The study analyzed scientific publications on land tenure to identify the global evolution trend by years, the distribution by subject category, the distribution of publications by country, the main institutions or affiliations, and their main interests, and the main authors. Then, the key words used in these publications were used to determine the scientific clusters and the research trends in each period. The study and analysis of scientific activity in land tenure can provide a global perspective to both researchers and policymakers.

The manuscript is organized as follows: First, the conceptual framework of the research is presented. Second, the methodology used is described in detail. Third, the results of all land tenure related work are compiled and ordered to reach the first two objectives. Finally, the results are analyzed to obtain the clusters for each period and their trends over time, in order to attain the other two objectives. The findings of this study can be useful for researchers, policymakers, and other stakeholders working in the field of land tenure.

2. Conceptual framework

The conceptual framework of land tenure involves three main aspects: people, rights, and uses, as depicted in Fig. 2. Land tenure refers to the relationship between individuals or groups and land, and the legally permissible uses of this natural resource. The right to land can be considered a form of property (Vandevelde, 1980), with individual property rights beginning in the classical world when the family unit broke down (Lozano, 1994). Property is an absolute right, giving the owner the power to dispose of the object as they see fit (Merrill, 1998), and land has been considered a form of wealth since ancient times (Lozano, 1994).

Formal property rights are those that are recognized by the state and protected by legal means (Joireman, 2008). In the case of land tenure, these rights can be considered the right to own land (De Schutter, 2010). The distinction between "real estate" or "immovable property" (land and
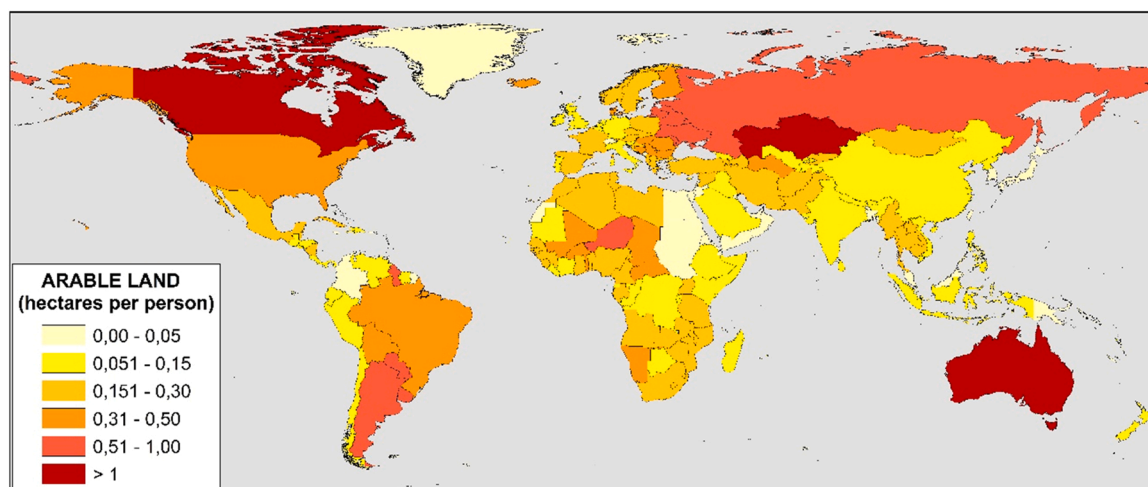

Fig. 1. Worldwide map of the area of arable land (ha) per person.
Data retrieved from Faostat database in the year 2022.

Fig. 2. Land tenure conceptual framework and the Sustainable Development Goals (SDG) 2030 Agenda.

its fixed elements, such as buildings and trees) and "personal property" or "movable property" (assets not linked to the land, like livestock) is often made (Jacobus et al., 2010).

In some cases, property rights are informal, meaning they are not illegal but are not recognized by the law (Shin, 2009). This is often the case for traditional property of rural indigenous communities in certain countries (Assies, 2009). A distinction is often made between "formally recognized rights" and "traditional rights" (Wily, 2011). In some countries, customary rights are officially recognized by law, blurring this distinction (Fontana, 2014). The ownership pattern of land in most parts of the world is based on the agrarian structure, with medium-sized or large owners owning most of the land (Rondhi et al., 2018). In China and some other countries, land use rights are assigned to households belonging to a village on an equal basis.

Land rights and labor are crucial assets for rural households to produce food for consumption and generate income through cash crops (Maxwell et al., 1998). As such, land rights are a powerful resource for sustainable livelihoods and a key factor in rural development interventions (Chambers and Conway, 1992).

However, discrimination against women's land rights has been identified as a human rights problem by the United Nations Commission on the Status of Women (1998). Therefore, it is essential for support programs to adopt a rights-based perspective that not only avoids reinforcing discrimination against vulnerable groups but also contributes to reducing discrimination (Stamatopoulou, 1995).

Land tenure determines who has access to resources, for how long, and under what conditions. It is a crucial factor for rural households in balancing their capacities and assets to meet their daily food production and security needs. However, land tenures are not only sources of economic production but also shape social relations, cultural values, and power dynamics (Jarosz, 2000). The resulting social networks within specific social and cultural groups are significant assets for the sustainability of rural households' livelihoods (Bebbington, 1999).

Investing in the technical and institutional infrastructure necessary for effective and equitable management of land use rights can lead to rapid development, higher levels of food security, health, and well-being (Toulmin, 2009). Countries that have secured property rights for men and women have achieved greater development, and authorities that recognize the need for land reform and support the protection of the

deeply embedded resource rights of disadvantaged groups foster more sustainable development. Conversely, denying equitable access to land and other assets can lead to unforeseen costs, including extreme poverty, dependency, social unrest, rural migration, and land abandonment (Anderson, 2008). On the other hand, more equitable access to land and other assets can stimulate broader and faster economic growth.

Land use rights can be categorized into four main types:

- Private land use rights are assigned to a specific stakeholder, which can be an individual, a married couple, a group of people, or a legal entity such as a commercial or non-profit organization.
- Community land use rights are collective rights held by the community, where each member has the right to use the community property independently (Cheyns and Riisgaard, 2014). For example, community members may have the right to move their livestock to a common pasture (Li et al., 2007).
- State property rights are assigned to public sector authorities. For instance, in some countries, forest land may be authorized by the state, either by a central government or a decentralized government (De Oliveira, 2002). China and Vietnam are examples of countries where state property rights are prevalent, with no private ownership of land. Land tenure in China is based solely on two types of land use rights: the granted land use right and the allocated land use right.
- Free access land use rights mean that no specific permissions are assigned to anyone, and no one can be excluded. Free access can include grasslands, forests, and other resources.

Comparing the magnitudes of legal, actual, and perceived security of agricultural land tenure and investigating the causes of prevailing land tenure insecurity is crucial (Ma et al., 2015). Uncertainty regarding land tenure can lead to inappropriate land use (Reydon et al., 2015), which, in the long run, causes environmental deterioration (Zhang et al., 2007). Therefore, environmental endowments are strongly linked to land tenure, as land use practices may either encourage sustainable practices or promote negative environmental impacts due to mismanagement. For example, excessive use of nitrogen fertilizers can pollute aquifers (Padilla et al., 2018), and certain land tenure policies in some areas of the world are leading to deforestation (Robinson et al., 2011).

Land titling has been an active way of claiming land ownership (Plant and Hvalkof, 2001). Forest lands, for instance, have traditionally been used for slash-and-burn cultivation by indigenous people who hold traditional rights to these resources (Ducourtieux et al., 2005). Policies that allow outsiders to acquire land by clearing the trees that cover it have encouraged large-scale deforestation, leading to incidents such as fires, as seen in parts of Asia (Ducourtieux et al., 2005) and South America (Pedroso-Junior et al., 2009).

Clear and secure land tenure rights are crucial for promoting sustainable land use practices and protecting natural resources (Allred et al., 2021). Inadequate land tenure systems can lead to environmental degradation, as landholders may not have the motivation to pursue long-term resource protection measures, especially if they hold shorter-term contracts or lack clear rights to the land (Betts et al., 2021). For example, tenant landholders may not invest in soil protection measures or replant trees if they do not hold the land long enough to obtain the returns on their investments. Similarly, inadequate land tenure systems for public lands can also lead to unsustainable land use practices, such as intensive cattle ranching, which can damage ecosystems and biodiversity.

On the other hand, well-targeted land tenure policies can promote sustainable land use practices. For instance, secure land tenure conditions or longer lease durations could encourage landholders to invest in sustainable land use practices, such as agroecological zoning, that are tailored to soil type, slope, and climatic conditions (Abera et al., 2020; Totin et al., 2021). These measures would also facilitate the adoption of sustainable land use practices, helping to achieve the sustainable development goals of the 2030 agenda, as illustrated in Fig. 2 of the

conceptual framework for land tenure.

To better understand the evolution of land tenure literature over time, it is necessary to interpret it in terms of its relevance for achieving sustainable development goals. Therefore, the next step in the analysis is to examine the periods of evolution of the land tenure literature in this context.

3. Materials and methods

The data analyzed in this study were obtained by searching the Scopus database, which is a well-established source for bibliometric studies (Garrido-Cardenas et al., 2023; Salmerón-Manzano et al., 2021). The search query used in this study was "(TITLE-ABS-KEY ("Land tenure"))", which covers not only arable land but also forestland and grasslands.

Fig. 3 provides a schematic chart of the procedure used. The documents obtained from the search were ordered in Excel to achieve the first and second objectives. To achieve the third and fourth objectives, the Vosviewer software (Vosviewer, 2021) was used to identify different scientific clusters from the keywords in the articles (Salmerón-Manzano and Manzano-Agugliaro, 2019). Vosviewer was also used to detect relationships between authors and their affiliation countries.

The problem of community detection arises from a common characteristic inherent to all complex systems, which is the presence of patterns of nodes that are more densely connected to each other than to the rest of the nodes in the network (Guerrero et al., 2017). These densely connected nodes are called communities, and they are expected to share certain properties that allow the detection of new characteristics or functional relations of the network (Guerrero et al., 2018). The search for these patterns or community structures is known as the problem of community detection. To do so, finding the optimal community structure that best represents the network's characteristics has become a scientific challenge. For this purpose, a multitude of algorithms and objective functions have been proposed to solve the problem, with evolutionary algorithms and the Modularity Index standing out as the main solutions accepted by the scientific community (Guerrero et al., 2019).

The software tool Vosviewer uses an algorithm for modularity-based community detection in large networks. Modularity functions were introduced by Newman and Girvan, and Newman himself proposed using them to detect communities by optimizing a modularity function (Waltman and Van Eck, 2013). There are many variants of the modularity-based approach to community detection, dealing with targeted or weighted networks or providing a resolution parameter (Newman, 2004) that allows customization of the level of granularity at which communities are detected and mitigation of the so-called resolution limit problem (Leicht and Newman, 2008).

For the global evolution trend by years, keywords are associated with the date of publication. Based on a probability density function for a particular keyword, the maximum of the function indicates the date where a particular keyword is most accumulated.

4. Results

In this results section, we provide the context for the scientific production analyzed in this study. We have organized this section into five subsections. Firstly, we identify the periods of scientific production. Secondly, we define the scientific categories in which this research is indexed. Thirdly and fourthly, we show the distribution by countries and affiliations, respectively. Finally, we examine the authors and their degree of specialization in this scientific field.

4.1. Global evolution trend

Over 5800 papers on land tenure have been published from 1950 to the end of 2020, indicating a sustained interest in this topic among the scientific community. Fig. 4 illustrates the temporal evolution of these works. We have identified three time periods. The first period, until 1999, saw less than 100 publications per year, with the first few years having fewer than 10 publications per year. From 1975 until the end of the period, growth was slow, with about 3 or 4 publications per year. The second period (2000–2009) is characterized by less than 180 publications per year, and the growth rate doubled compared to the first period, with around 8 publications per year. In the third period (2010–2020), the growth rate doubled again, with an average of about 16 publications per year. This period peaked at 350 publications per year.

4.2. Global Subject category

The first question to be addressed is the scientific perspective from which the issue of land tenure is being studied. This is determined by examining the scientific categories in which the studies are indexed. Note that a single publication can be indexed under multiple categories. Fig. 5 presents the distribution of publications by scientific category according to the Scopus database. The results reveal that one third of the
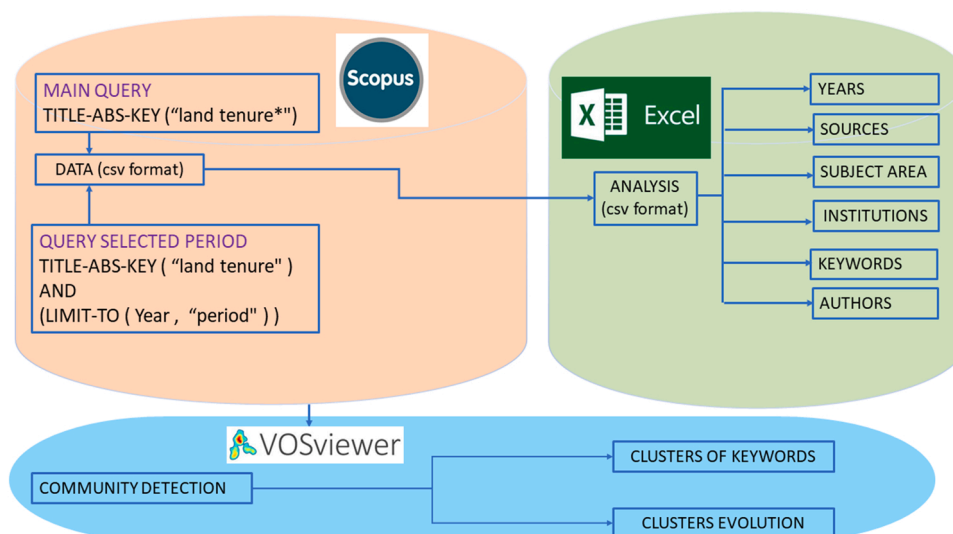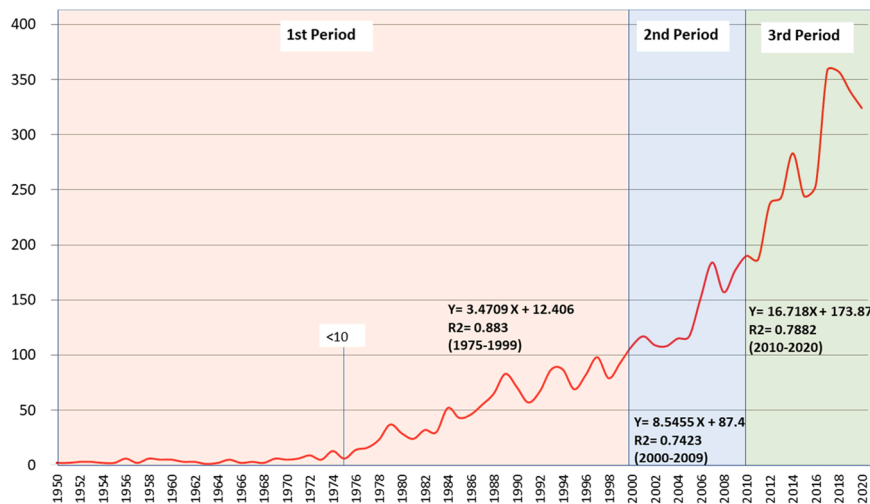

Fig. 3. Methodology chart.

Fig. 4. Worldwide temporal evolution of land tenure publications.
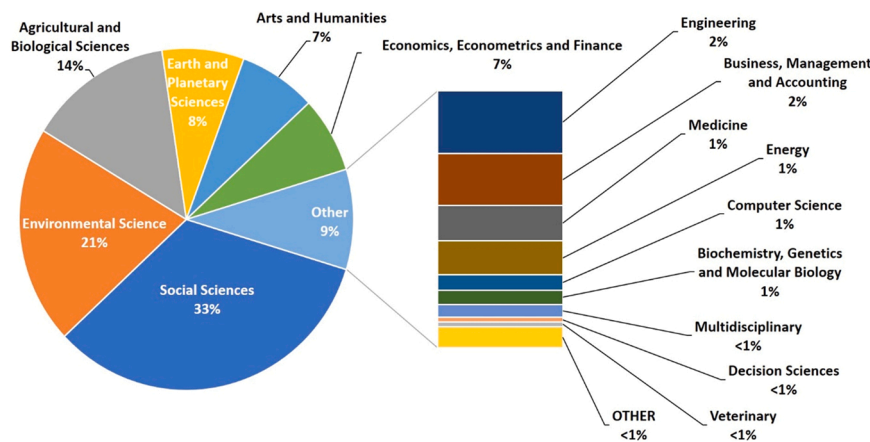Data retrieved from Scopus database in the year 2022.

Fig. 5. Land tenure publications by scientific categories indexed in Scopus.
Data retrieved from Scopus database in the year 2022.

publications fall under the category of Social Sciences (33%). Environmental Science is the second most common category, accounting for 21% of the publications. Notably, this category surpasses Agricultural and Biological Science (14%), which may be attributed to the abundance of research on deforestation to clear land for agriculture (Lawrence et al., 2020). In many countries, deforestation operations are expensive, and this is what gives added value to the land (Hecht, 1993). And, from the opposite point of view the fight against deforestation (Ostrom and Nagendra, 2006). This aspect is one of the concerns from the environmental point of view.

The fourth most prominent category is Earth and Planetary Sciences (8%), which features a significant amount of activity related to Remote Sensing and Photogrammetry. For example, researchers may use these methods to examine the relationship between land tenure and forest cover change (Paneque-Gálvez et al., 2013).

The categories of Arts and Humanities (7%) and Economics, Econometrics and Finance (7%) deserve special attention. The sociological issues pertaining to land reform, resettlement, and re-peasantization are occasionally classified under Arts and Humanities as a miscellaneous category.(Peluso and Lund, 2011), and studies published in journals such as the Journal of Peasant Studies or Journal of Agrarian Change. The latter category is self-explanatory, as it examines the implications of land tenure and property rights for development policy (Feder and Feeny, 1991).

The remaining categories have relatively minor impact since, as previously mentioned, a paper may be indexed under multiple categories, implying that some issues related to land tenure may be only tangentially related. Table 1 displays the top 10 keywords for each category, revealing similarities between different categories, particularly between Environmental Science and Agricultural and Biological Science, which share six common keywords among their top 10.

4.3. Distribution of Publications by Countries

As noted earlier, one of the objectives of this study was to identify the countries that have been researching land tenure. Fig. 6 shows the distribution of publications on this topic by country. The United States accounts for 24% of the total number of publications, followed by the United Kingdom with 10%, and Australia with 7%. Interestingly, researchers from several countries have examined land tenure in countries other than their own (see Table 2). On the other hand, some countries with large populations, such as China, India, Brazil, and South Africa, have a lower ratio of publications on this topic. Finally, a third group of countries that are likely to face land tenure challenges includes those in the eastern coast of Africa, such as Kenya, and to a lesser extent, Nigeria and Ethiopia, which may have deficits in this resource.

Table 2 presents the top four keywords in publications from countries that have published more than 100 documents on land tenure. The

Table 1

Main keywords by scientific categories indexed in Scopus.

Rank	Social Sciences	Environmental Science	Agricultural and Biological Science	Earth and Planetary Sciences	Arts and Humanities	Economics, Econometrics and Finance
1	Land Rights	Land Use	Land Use	Land Use	Land Rights	Property Rights
2	Africa	Deforestation	Deforestation	Developing Country	Land Reform	Africa
3	Land Reform	Agriculture	Forest Management	Africa	Africa	Land Rights
4	Property Rights	Africa	Forestry	Agriculture	Agriculture	China
5	Land Use	Land Management	Africa	Land Rights	Property Rights	Deforestation
6	Landownership	Land Rights	Agriculture	Land Management	Landownership	Land Reform
7	Land Management	Sustainable Development	Land Management	Deforestation	Rural Economy	Forestry
8	Developing Country	Forestry	Land Use Planning	Sustainable Development	Nineteenth Century	Tenure System
9	Sub-Saharan Africa	Property Rights	Biodiversity	Land Reform	Historical Geography	Land Use
10	China/ Deforestation	Sustainability	Conservation	Land Use Change	Eurasia/Gender	Ethiopia/ Landownership
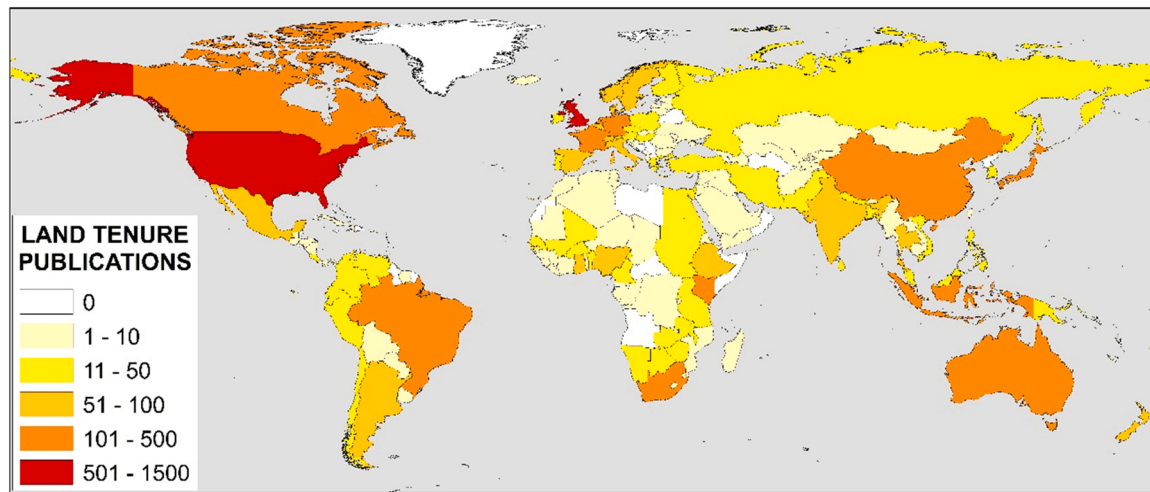
Fig. 6. Worldwide research on land tenure.
Data retrieved from Scopus database in the year 2022.

Table 2

Main keywords by country of publication.

Rank	Country	N	1	2	3	4	Top-cited
1	United States	1398	Deforestation	Property Rights	United States	Land Use	Brown (1990)
2	United Kingdom	583	Africa	Land Reform	Property Rights	Sub-Saharan Africa	Blaikie (1985)
3	Australia	413	Australia	Climate Change	Land Use	Property Rights	Bryan et al. (2018a), (2018b)
4	Canada	271	Land Rights	Africa	Canada	Sub-Saharan Africa	Li (2011)
5	Germany	259	Land Use	Land Rights	Land Management	Deforestation	Paustian et al. (1998)
6	The Netherlands	258	Land Rights	Africa	China	Land Use Planning	Borras et al. (2011)
7	South Africa	230	South Africa	Africa	Sub-Saharan Africa	Land Reform	Borras et al. (2011)
8	China	205	China	Land Use	Asia	Rural Area	Borras et al. (2011)
9	France	193	Brazil	Agroforestry	Land Management	Land Rights	Mottet et al. (2006)
10	Brazil	147	Brazil	Deforestation	Amazonia	Amazon	Fearnside (2001)
11	Kenya	136	Kenya	Africa	Pastoralism	Sub-Saharan Africa	Reid et al. (2000)
12	Indonesia	131	Indonesia	Deforestation	Forestry	Agriculture	Rist et al. (2010)
13	Japan	104	Land Use	Indonesia	Cultivation	Forest Management	Braimoh and Onishi (2007)

search term "land tenure" was excluded as it appears in all analyzed publications. The table highlights that deforestation and forest management are significant concerns across many countries. Additionally, Africa is a region of considerable interest, studied not only by African nations such as Kenya and South Africa, but also by other countries such as the United Kingdom, the Netherlands, and Canada. The Amazon region is also a focal point, with France studying it in addition to Brazil.

It's worth noting that many of the highly cited publications arise from international collaborations with countries where land tenure is a

significant issue. Even research conducted in these areas by authors affiliated with third countries without collaboration is observed. Table 3 summarizes the top 10 countries in Africa, Central and South America, and Asia. Notably, the problem of land tenure appears to be less extensively studied in the Americas than in other continents.

The analysis of land tenure publications by country reveals two scenarios. Firstly, countries with a large number of high-level universities and research institutes, such as the United States and the United Kingdom, tend to have a relatively larger number of publications.

Table 3
Top countries by continent.

Rank	Africa	N	South/Central America	N	Asia	N
1	South Africa	230	Brazil	152	China	212
2	Kenya	136	Argentina	53	Indonesia	139
3	Ethiopia	98	Colombia	43	Japan	109
4	Ghana	91	Peru	38	India	92
5	Nigeria	66	Chile	27	Thailand	61
6	Tanzania	50	Ecuador	17	Hong Kong	32
7	Zimbabwe	41	Costa Rica	15	Philippines	30
8	Cameroon	39	Venezuela	12	Pakistan	28
9	Uganda	38	Bolivia	11	Viet Nam	27
10	Botswana	31	Panama	9	Malaysia	24

Secondly, researchers from these countries tend to investigate land tenure issues in other countries (as shown in Table 2). Therefore, the number of publications in a particular country cannot be directly correlated with the availability of arable land in that country.

4.4. Institutions (affiliations)

In the previous section, we discussed the countries that are showing special interest in land tenure. In this section, we will look at the most active affiliations in this field. Table 4 summarizes the top affiliations in terms of the number of publications related to land tenure. The table also includes the two main keywords of each affiliation as an indicator of their research focus.

The two most active institutions in this field are the Wageningen University & Research Center and the University of Twente, both located in The Netherlands. While the Wageningen University focuses mainly on land tenure in China and Africa, with a research focus on land rights and

property rights, the University of Twente is more focused on land administration, land use planning, land management, and land registration.

The US institutions, such as the University of Wisconsin-Madison, University of Florida, University of California, Berkeley, and Cornell University, are primarily focused on the issue of deforestation and forest management, with a particular emphasis on Brazil and the Amazon. In addition, The World Bank and the International Food Policy Research Institute are also working on land rights in Africa, specifically in sub-Saharan Africa.

The Norwegian University of Life Sciences is the fourth most relevant institution in this field, with a particular interest in deforestation in Africa, especially in Ethiopia.

The Australian National University, the University of Queensland, and the University of Melbourne are highly focused on Australia, with a research focus on agriculture, climate change, indigenous population, property rights, and sustainable development.

Other European institutions, such as CIRAD Centre de Recherche de Montpellier (France), CNRS (Centre National de la Recherche Scientifique in France), University of Oxford (UK), and University of Cambridge (UK), are mainly focused on deforestation in areas of their commercial influence.

Table 4 also shows the degree of specialization of each institution by calculating the number of publications related to land tenure per thousand publications. Notably, the Center for International Forestry Research (West Java), the World Agroforestry Centre (Kenya), and the International Food Policy Research Institute (USA) have a high degree of specialization in this field.

It should be noted that while the data in Table 4 should be viewed with caution, as well-known institutions may have a low degree of specialization in any area of knowledge, the degree of specialization can provide an indication of the institutions' expertise in this field. However,

Table 4
Top affiliations and main keywords. (N_{LT} = Number of publications on Land Tenure; N_{TOT} = Number of total publications of the institution in the studied period).

Affiliation	N_{ToT}	N_{LT}	‰ (N_{LT}/ N_{TOT})	Country	Keyword (excluded "land tenure")		
					1	2	3
Wageningen University & Research	84,904	91	1.1	Netherlands	China	Africa	Land Rights/ Property Rights
University of Twente	54,840	86	1.6	Netherlands	Land Administration	Land Planning	Land Management/Land Registration
University of Wisconsin-Madison	230,613	76	0.3	USA	Deforestation	Forest Management	Property Rights
Norwegian University of Life Sciences	19,859	51	2.6	Norway	Deforestation	Africa	Ethiopia/ Land Rights
University of Florida	204,701	51	0.2	USA	Brazil	Forest Management	Deforestation/ Amazon
The Australian National University	118,396	50	0.4	Australia	Agriculture	Australia	Climate Change/ Forestry
The University of Queensland	169,737	49	0.3	Australia	Australia	Indigenous Population/ Queensland	Property Rights
McGill University	170,610	46	0.3	Canada	Land Rights	Africa	Deforestation/ Conservation
Michigan State University	148,015	45	0.3	USA	Africa	Sub-Saharan Africa	Brazil/Gender
The World Bank	12,880	45	3.5	USA	Property Rights	Africa	Land Rights/ Sub-Saharan Africa
University of Melbourne	197,947	44	0.2	Australia	Australia	Sustainable Development	Land Management/ Victoria (Australia)
CIRAD Centre de Recherche de Montpellier	14,186	42	3.0	France	Land Use	Agroforestry	Mali/ Deforestation
University of California, Berkeley	274,336	41	0.1	USA	Land Use	United States	Agricultural Land/ Sustainability
World Agroforestry Centre	2280	41	18.0	Kenya	Agroforestry	Deforestation/ Indonesia	Africa
University of Oxford	265,552	40	0.2	UK	Africa	Land Rights	Agriculture/ Landownership
Center for International Forestry Research	1979	39	19.7	West Java	Deforestation	Indonesia	Property Rights/Brazil
University of Cambridge	248,271	39	0.2	UK	Land Reform	Biodiversity	China/ Deforestation
Københavns Universitet	148,967	37	0.2	Denmark	Land Use	Deforestation	Agriculture/ Smallholder
University of Cape Town	67,371	36	0.5	South Africa	Land Use	Africa	South Africa/ Biodiversity
International Food Policy Research Institute	3770	36	9.5	USA	Land Rights	Africa	Property Rights
Cornell University	187,228	32	0.2	USA	Livelihood	Africa	China
Chinese Academy of Sciences	813,965	32	0.0	China	China	Rural Area	Agricultural Management/Asia
CNRS Centre National de la Recherche Scientifique	570,062	31	0.1	France	Brazil	Agricultural Land	Amazon
University of KwaZulu-Natal	45,511	31	0.7	South Africa	South Africa	Africa	Sustainable Development

there are three institutions with a high degree of specialization: Center for International Forestry Research (West Java) with almost 20%$_0$, World Agroforestry Centre (Kenya) with 18%$_0$ and International Food Policy Research Institute (USA) with 9.5%$_0$.

4.5. Authors

Table 5 displays the authors who have published more than 10 articles related to land tenure (LT). Notably, only 16 authors meet this criterion, and most of them are affiliated with the institutions described in the previous section, although their ranking by importance varies.

In an attempt to assess their degree of specialization, the total number of their indexed publications (N_{ToT}) was calculated, along with the percentage of those publications that pertain to land tenure (100 x N_{LT}/N_{TOT}). Topping the list of specialized authors is Suyanto, S. (World Agroforestry Centre, Nairobi, Kenya) with 60% of their publications dedicated to land tenure. In second place, we find Barry, M. (University of Calgary, Calgary, Canada) with 50% of their total work focused on land tenure.

Fig. 7 displays the collaboration network among the main authors in the field of land tenure analyzed in this study, revealing five interconnected groups. Notably, the author who links these groups is Deininger from the World Bank (USA). Deininger connects the group from China (Deininger and Jin, 2006), the group from Central Europe, the Netherlands and Germany, the group from the University of Florida (USA), the group from Kobe University (Japan), and the group from India and Indonesia.

In this section, we have identified groups of authors that can be useful for setting up scientific collaborations on specific topics, as there is generally a wide spread of publications on a given topic or area among different sources of information. For example, in the cluster of the Netherlands and Germany, the central author is Zevenbergen. His research, which includes the use of new technologies such as Remote Sensing from Landsat images (Abdelkader et al., 2020) and 3D Cadasters (Ghawana et al., 2020), as well as work applied to areas of Africa (Flores et al., 2020), can be observed.

It should be noted that productivity studies of authors and their bibliometric indicators, such as the H index, allow us to indicate the impact of their publications. In this work, we have also determined the degree of specialization of authors in the subject of land tenure. For instance, we have observed authors with a high H-index of 53, but with a rather low degree of specialization in this subject, with only 4% of their publications focused on land tenure. Conversely, other authors with an H-index of 8 have a degree of specialization of 50%.

Fig. 7. A collaborative network of top authors of land tenure. Data retrieved from Scopus database in the year 2022.

5. Analysis of research clusters

This study uses bibliometric parameters to examine research activity related to land tenure, with analysis based on all scientific publications indexed in the Scopus database. However, it is important to note that this study's first limitation is that it only relies on the Scopus database, and other databases could yield somewhat different results (Mongeon and Paul-Hus, 2016; Aghaei Chadegani et al., 2013).

Secondly, this study only analyzes publications by their number, whereas another relevant aspect of scientific impact is the number of citations of published papers (Glänzel and Moed, 2002). Lastly, bibliometric indicators are more valid in areas where publications are a primary outcome of research, making them more applicable in the study of basic research areas where scientific publications predominate, and less so in areas of social sciences or law (Nederhof, 2006).

The primary goal of bibliometric research is to study keywords in publications and establish scientific groups or communities based on relationships among them, thereby grouping different topics related to the research field. By extracting keywords from the total number of publications, it is possible to summarize the most frequently used keywords for topics related to land tenure. Fig. 8 shows a word cloud summarizing the 3 periods detected in the trend of land tenure

Table 5

Main authors in land tenure publications. (N_{LT} = Number of publications on Land Tenure; N_{TOT} = Number of total publications of the institution in the studied period).

	Author	Scopus author ID	Affiliation, City, Country	N_{ToT}	N_{LT}	% (N_{LT}/N_{TOT})	H-index
1	Bennett, R.M.	56268184900	Cadastre, Arnhem, Netherlands	101	34	34	23
2	Zevenbergen, J.	24463072700	Faculty of Geo-Information Science and Earth Observation – ITC, Enschede, Netherlands	101	27	27	20
3	Otsuka, K.	7402086854	Kobe University, Kobe, Japan	168	22	13	33
4	Barry, M.	8261650100	University of Calgary, Calgary, Canada	38	19	50	8
5	Deininger, K.	6701857553	The World Bank, USA, Washington, D.C., United States	118	17	14	42
6	de Vries, W.T.	7102036759	Technical University of Munich, Munich, Germany	61	17	25	8
7	Crist, R.E.	56930987200	University of Florida, Gainesville, United States	46	14	30	3
8	Heerink, N.	7801568028	Wageningen University & Research, Wageningen, Netherlands	70	14	20	25
9	Unruh, J.D.	7005223401	McGill University, Montreal, Canada	70	16	20	18
10	Lund, C.	7102278186	Københavns Universitet, Copenhagen, Denmark	46	12	26	21
11	Suyanto, S.	6507424949	World Agroforestry Centre, Nairobi, Kenya	20	12	60	14
12	Zhang, Y.	8693543800	Auburn University, Auburn, United States	91	11	12	25
13	Fearnside, P.M.	7006700988	Instituto Nacional de Pesquisas Da Amazonia, Manaus, Brazil	268	11	4	53
14	Barnes, G.	7202142550	University of Florida, Gainesville, United States	45	10	22	12
15	Place, F.	55962922700	Institutions and Markets (PIM), United States	53	10	19	22
16	Shi, X.	16319989500	Nanjing Agricultural University, Nanjing, China	35	10	29	14

Fig. 8. Main keywords of the 3 periods detected on land tenure research.
Data retrieved from Scopus database in the year 2022.

publications (Fig. 4).

The first period, up to and including 1999, is focused on economic and demographic aspects, with the top 10 keywords being (excluding land tenure): Developing Country, Economic Factors, Economics, Socioeconomic Factors, Socioeconomics, Developing Countries, Population, Agriculture, Demography, and Demographic Factors.

During the second period (2000–2009), the top 10 keywords (excluding land tenure) were Africa, Sub-Saharan Africa, Eurasia, Asia, Land Use, Land Rights, Land Reform, Property Rights, East Africa, and Landownership. This period was characterized by a focus on area-specific studies and land rights.

In the third period (2010–2020), the top 10 keywords (excluding land tenure) were Land Use, Land Rights, Agriculture, Land Management, Deforestation, Property Rights, Landownership, Climate Change, Agricultural Land, and Land Reform. In addition to continuing concerns about land use and property rights, this period also highlighted issues related to deforestation and climate change.

By analyzing the clusters formed by keywords, this study can classify the different research trends into groups. The documents from three periods (1950–1999, 2000–2009, and 2010–2020) were analyzed, and the main keywords with a frequency of more than 300 times were examined in Fig. 9. The figure illustrates that "Developing country"
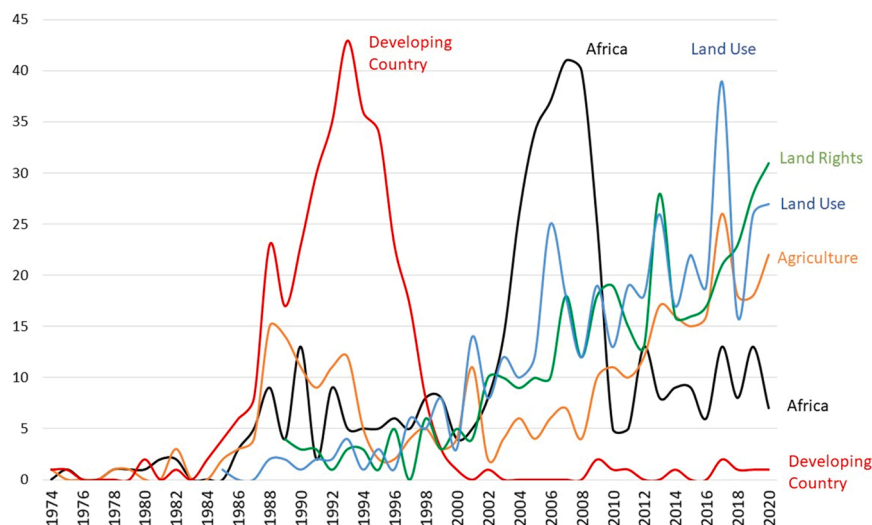

Fig. 9. Evolution of 5 main keywords (excluded land tenure).
Data retrieved from Scopus database in the year 2022.

reached its peak in 1993, while "Africa" and "Land Use" reached their highest frequency in 2007 and 2006, respectively. At the end of the analyzed period, "Land rights" ranked first in 2020, followed by "Land use" and "Agriculture," which ranked third.

5.1. Research focus for the period 1950–1999

Fig. 10 depicts the clusters formed during the period of 1950–1999, which comprise five clusters that have been distinguished by color. Table 6 presents the primary keywords for each cluster. Notably, during this period, the primary affiliations were with US universities such as University of Wisconsin-Madison, University of Florida, and Harvard University. These clusters have been named based on their main keywords: Developing country, Social issues, Macroeconomy, Demography, and Socioeconomics issues.

Fig. 10 shows a red-colored cluster (1.1) labeled as Developing Country, which is located slightly away from the core of the studies. This suggests that, at the beginning of the period, the issue of land tenure was not as prominent as other clusters, such as Social Issues, Macroeconomy, Demography, and Socioeconomic Issues. The main keywords associated with this cluster are related to geographical locations, such as Africa, Indonesia, Burkina Faso, the Amazon, and China. These locations are linked to the issue of land tenure in developing countries.

The green-colored cluster (1.2) labeled as Social Issues appears to be widely dispersed, with land tenure being one of the many social aspects related mainly to the rural population, poverty, socioeconomic situation, social class, health, family size, and land supply. Notable studies

within this cluster include those published in the World Bank's Economic Review, such as those examining indigenous land rights systems in sub-Saharan Africa and whether they constrain productivity (Migot-Adholla et al., 1991) and the impact of privatization on gender and property rights in Africa (Lastarria-Cornhiel, 1997).

The blue-colored cluster (1.3) appears to be highly interconnected with the other clusters, indicating that there is significant collaboration between this issue and other factors. This is because the theme of macroeconomic factors is closely related to the other factors. The main keywords associated with this cluster include political factors, economic development, population growth, employment, sociology, and labor. Notably, the journal World Development has had a significant influence in this area, as demonstrated by its work on "State credit programs and the peasantry under populist regimes: Lessons from the APRA experience in the Peruvian Amazon" (Coomes, 1996).

The yellow-colored cluster (1.4) is named Demography and includes keywords such as demographic factors, migration, emigration and immigration, population dynamics, and population characteristics. Although this cluster does not have a large number of contributions, it is central to this period and closely linked to cluster 1.3 (Macroeconomic) and cluster 1.5 (Socioeconomic issues). A noteworthy study related to this cluster is one that examines population-driven land use changes in developing countries (Bilsborrow and Okoth-Ogendo, 1992), which focuses on Latin America (Guatemala) and sub-Saharan Africa (Kenya).

The purple-colored cluster (1.5) is named Socioeconomic issues, and its main keywords include economic factors, socioeconomics, environmental protection, law, agriculture, rural development, and natural
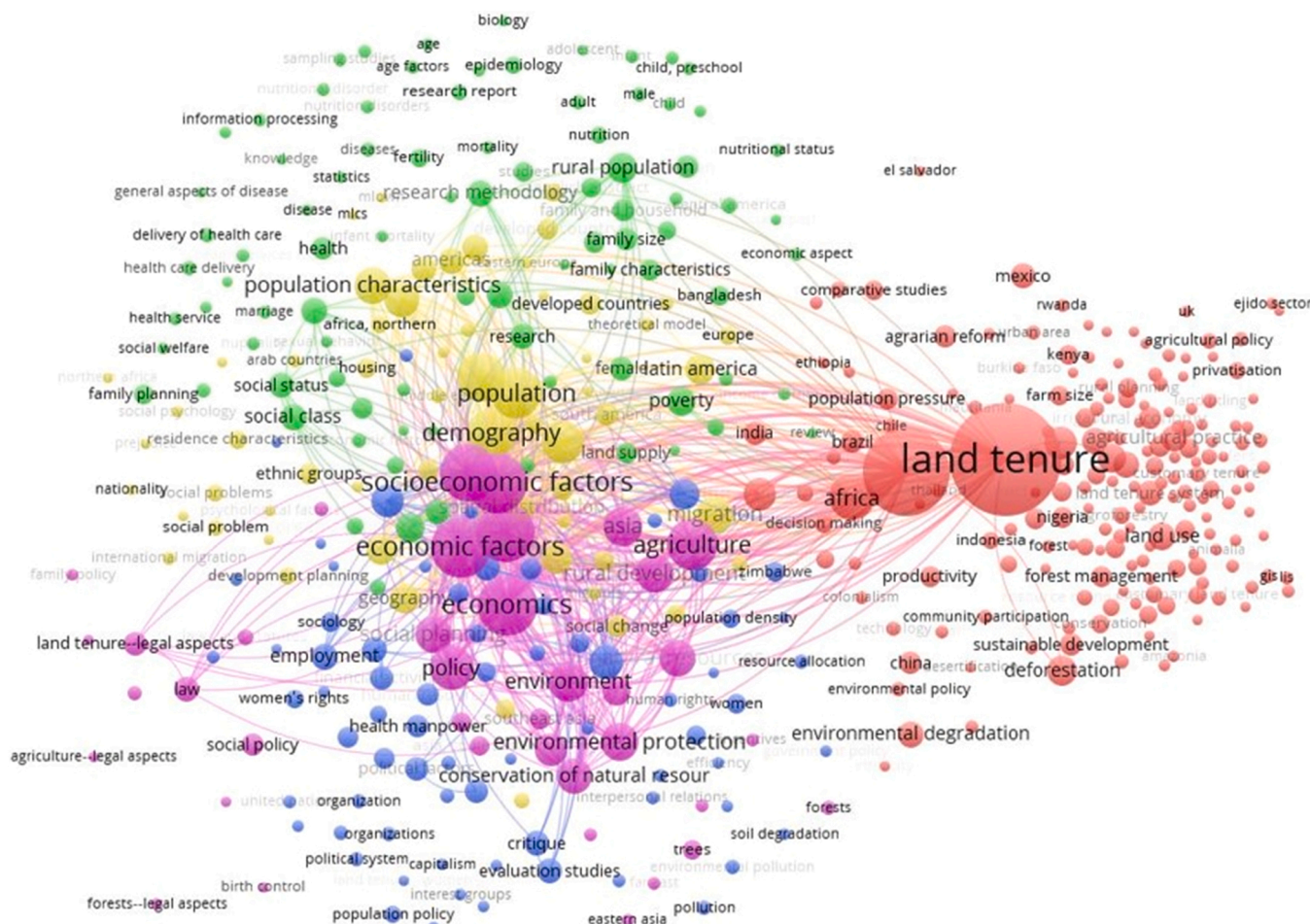

Fig. 10.. Network of keywords in land tenure publications: Clusters between 1950-1999.
Data retrieved from Scopus database in the year 2022.

Table 6
Main keywords used by the communities detected in the topic in the period 1950–1999.

Cluster	Color	Main Keywords	Topic	Cluster weight (%)
1–1	Red	Developing country, Africa, agricultural development, land reform, property rights, agricultural practice, Indonesia, Burkina Faso, Amazonia, China, deforestation	Developing country	41
1–2	Green	Rural population, poverty, socioeconomics status, social class, health, family size, land supply	Social issues	20
1–3	Blue	Macroeconomics factors, political factors, economic development, population growth, employment, sociology, employment	Macroeconomy	16
1–4	Yellow	Demographic factors, migration, emigration and immigration, population dynamics, population characteristics	Demography	13
1–5	Purple	Economic factors, socioeconomics, environmental protection, economics, rural development, natural resources, law, agriculture	Socioeconomics issues	10

resources. Notably, this cluster includes terms such as environmental protection and natural resources, with works related to climate change such as "CO2 mitigation by agriculture" (Paustian et al., 1998).

The Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 with the aim of eradicating poverty, protecting the planet, and promoting peace and prosperity for all by 2030. While still a relatively recent development, it is clear from the publications on land tenure in the first period that there is a strong emphasis on the first three SDGs, as shown in Fig. 2 of the conceptual framework section: eliminate poverty; erase hunger; and establish good health and well-being. This trend is particularly evident in cluster 1–2, which features keywords such as poverty and health.

5.2. Research focus for the period 2000–2009

The central period of analysis is from 2000–2009, and Fig. 11 displays the 9 clusters identified for this period. Table 7 provides the main keywords for each cluster, which have been named after their distinctive themes, including Environment, Sustainable Development, Land Reform, Agriculture in Africa, South America and China, America and Australia, Europe, Asia, and Sub-Saharan Africa. Geographical locations were used to name the clusters since this was found to be the best way to distinguish them. Additionally, it is important to note that these clusters are closely interlinked, highlighting the interconnectedness of these issues. There are no significant differences between the clusters in terms of the percentage of publications, indicating the close relationships between these topics.

In Fig. 11, there are nine clusters that have been identified for the period between 2000 and 2009. The red-colored cluster 2.1, named Environment, is focused on resource management, environmental sustainability, biodiversity ecosystem, management, and forest. The work on "soybean cultivation as a threat to the environment in Brazil" is representative of this cluster (Fearnside, 2001).

The green-colored cluster 2.2, named Sustainable Development, highlights the theme of indigenous development, particularly in Bolivia. The main keywords associated with this cluster are sustainable development, property rights, deforestation, Bolivia, and indigenous population. The study on "the effectiveness of market-based conservation in the tropics" (Ebeling and Yasué, 2009) is one of the notable works in this cluster.

The blue-dark colored cluster 2.3, named Land Reform, centers on land tenure, rural economy, agricultural land, land reform, agrarian change, and land market. The land reform works that can be cited are those focused on India (Banerjee and Iyer, 2005), China (Tan et al., 2006) or Africa (Peters, 2004) and deserve special attention to those of sub-Saharan Africa (Whitehead and Tsikata, 2003).

The yellow-colored cluster 2.4, named Agriculture and Africa, focuses on agriculture, water, poverty, cultivation, and livelihood. The works on Burkina Faso, Ethiopia, Uganda, and west Africa related to water scarcity or poverty are notable in this cluster. The works that can be cited are those focused on Burkina Faso (Brasselle et al., 2002), Ethiopia (Deininger and Jin, 2006) or Uganda (Tripp, 2004; Pender et al., 2004), or west Africa (Ouédraogo et al., 2001) related to water scarcity or poverty.

The purple-colored cluster 2.5, named South America and China, highlights land use planning, peasant agriculture, and the far east. The studies in this cluster are mainly focused on Brazil and China, such as private agricultural colonization on a Brazilian frontier and hazards of expropriation in rural China. For South America, work is mainly focused on Brazil, such "Private agricultural colonization on a Brazilian frontier, 1970–1980" (Jepson, 2006) or "Urban land policy and new land tenure paradigms: Legitimacy vs. legality in Brazilian cities" (Macedo, 2008). In the case of China, mention should be made of the study "Hazards of expropriation: Tenure insecurity and investment in Rural China" (Jacoby et al., 2002).

The cyan-colored cluster 2.6, named Pastoralism and Nature Conservation. It can be seen by the main key words: Australia, Kenya, pastoralism, United States, north America, nature conservation, land degradation. Details of pastoralism changes which are caused by a number of socioeconomic factors such as changes in land tenure are described for Kenya (Galvin, 2009), or Australia (Stokes et al., 2006). Regarding nature conservation, then studies focused on USA, e.g "Ranchland ownership change in the greater Yellowstone ecosystem, 1990–2001: Implications for conservation" (Gosnell et al., 2006).

The grey-colored cluster 2.7, named Europe. It can be seen by the main key words: Eurasia, Europe, Spain, southern Europe, UK, Ireland, central Europe. Here there is a great deal of historical research, e.g. "Garden cultivation of staple crops and its implications for settlement location and continuity" for the population mobility and land tenure in prehistory study (Jones, 2005), or the proposed land tenure in England (1066–1166) (Garnett, 2007).

The orange-colored cluster 2.8, named Asia. It can be seen by the main key words Asia, southeast Asia, India, Thailand, Philippines, Vietnam, Indonesia, poverty alleviation. So related to poverty alleviation, and the oil palm expansion in Malaysian and Indonesian frontiers (McCarthy and Cramb, 2009).

Lastly, the dark-colored cluster 2.9, has been named Africa. It can be seen by the main key words: Africa, sub-Saharan Africa, Mozambique, Botswana, Namibia, Malawi, Zimbabwe. It is worth citing some of the outstanding work related to Mozambique (Eriksen and Silva, 2009), Botswana (Kalabamu, 2000), or Malawi (Peters and Kambewa, 2007) concerning land tenure.

Over time, some of the 17 SDG targets have been studied in relation to land tenure, although this was not always explicitly stated. The earliest manuscript on this topic dates back to 2007, in which experts shared their different perspectives on the issue (Gyasi et al., 2007). Ensuring equitable access to land tenure security is a critical factor in securing and improving sustainable agricultural production. In addition, land tenure security is crucial for the survival of indigenous peoples and environmental protection. In recent years, publications on land tenure have increasingly focused on specific SDGs, as shown in Fig. 2 in the conceptual framework section. These SDGs include Enforce Gender

Fig. 11.. Network of keywords in land tenure publications: Clusters between 2000-2009.
Data retrieved from Scopus database in the year 2022.

Equality, Create Decent Work and Economic Growth, Reduce Inequality, and Organize Climate Action.

Enforce Gender Equality is particularly evident in cluster 2–3, referred to as Land Reform, which emphasizes gender relations as a key issue. Create Decent Work and Economic Growth is highlighted in cluster 2–2, named Sustainable Development, which includes keywords such as rural economy and rural planning. Finally, Organize Climate Action is addressed in all clusters, but particularly in cluster 2–1, named Environment, which focuses on resource management, environmental sustainability, biodiversity ecosystem management, and forest. Another relevant cluster is 2–6, named Pastoralism and Nature Conservation, which emphasizes keywords such as nature conservation and land degradation.

5.3. Research focus for the period 2010–2020

The period from 2010 to 2020 is the latest period examined in this study, and Fig. 12 presents the five distinct clusters identified during this period. Each of these clusters has been named after its main keywords, which are summarized in Table 8: Land reform, Land use, Agriculture, Deforestation and America, and Sociology. Although the clusters are

clearly differentiated, it is important to note that they are closely interrelated, and none of them exists in isolation.

The clusters found in Fig. 12 cover the period from 2010–2020, and are closely related to each other. Each cluster has been named after its main focus, which is reflected in its keywords.

The red-colored cluster 3.1, named Land reform, focuses on the issue of law and tenure. Key topics include land tenure, land rights, land-ownership, property rights, governance approach, rural area, and land reform. Representative work in this cluster includes the paper "New frontiers of land control" (Peluso and Lund, 2011). Other notable studies related to the ownership structure of smallholders (Rist et al., 2010) and large farms to encourage investment (Deininger and Byerlee, 2012).

The green-colored cluster 3.2, named Land use, emphasizes land use and ecosystem services. Key topics include land use change, land use, forestry, the United States, ecosystem service, conservation, and pro-tected area. For example, research related to ecosystem services stands out in countries such as Ecuador (Bremer et al., 2014) or Vietnam (To et al., 2012). The scarcity of water resources has become a major global challenge for ecosystems (Aznar-Sánchez et al., 2019a, 2019b). Notable studies in this cluster linking land and freshwater use include "The per capita volume of water captured often exceeds the water requirements

Table 7
Main keywords used by the communities detected in the topic in the period 2000–2009.

Cluster	Color	Main Keywords	Topic	Cluster weight (%)
2–1	Red	Resource management, environmental management environmental sustainability, biodiversity ecosystem, management, forest	Environment	14.4
2–2	Green	Sustainable development, property rights, deforestation, Bolivia, indigenous population	Sustainable development	13.6
2–3	Blue-Dark	Land tenure, rural economy, rural planning, agricultural land, land reform, agrarian change, land market, gender relations	Land reform	12.6
2–4	Yellow	Agriculture, water, poverty, cultivation, Ethiopia, east Africa, Uganda, Burkina Faso, west Africa livelihood	Agriculture/ Africa	12.6
2–5	Purple	Land use planning, south America, China, far east, western hemisphere, peasant agriculture	south America/ China	12
2–6	Cian	Australia, Kenya, pastoralism, United States, north America, nature conservation, land degradation	Pastoralism and nature conservation	10.6
2–7	Grey	Eurasia, Europe, Spain, southern Europe, UK, Ireland, central Europe	Europe	10
2–8	Orange	Asia, southeast Asia, India, Thailand, Philippines, Vietnam, Indonesia, poverty alleviation	Asia	8.6
2–9	Dark	Africa, sub-Saharan Africa, Mozambique, Botswana, Namibia, Malawi, Zimbabwe	sub-Saharan Africa	5.6

for a balanced diet and would be sufficient to improve food security and reduce malnutrition in the grabbed countries" (Rulli et al., 2013).

The blue-colored cluster 3.3, named Agriculture, focuses on agricultural land, sustainability, climate change, developing countries, smallholder, agroforestry, and farming systems. Notable studies include concerns about large-scale investment in agricultural land (De Schutter, 2011) and the debate on land grabbing (Li, 2011).

The yellow-colored cluster 3.4, named Deforestation and America, focuses on deforestation, sustainable development, indigenous population, forest management, and countries such as Mexico, Brazil, Canada, and Colombia. Agriculture, deforestation, and regional climate change are closely related in all parts of the world, but especially in Brazil, so, addressing land tenure issues is a fundamental step in mitigating the adverse effects of agricultural intensification and a sustainable way of using land in Brazil (Lapola et al., 2014). Land tenure policies are therefore needed in order to reduce deforestation and its impact on agricultural production (Angelsen, 2010). It should be mentioned that within this cluster, although it has not been highlighted as a key word, the RDD+ topic is very prominent (Reducing Emissions from Deforestation and forest Degradation), it is considered an essential element of global efforts to mitigate climate change (Larson et al., 2013).

The yellow-colored cluster 3.5, named Sociology, focuses on household, social status, rural population, government, socioeconomic factors, economics, and community. The issue of social status related to land tenure has a long history, dating back to the time of the classical world, specifically to the beginning of the Roman Empire (Kehoe, 2007; Bang, 2011). Recently, this topic has had a gender focus (White, 2012), with studies on how the agricultural system has undermined the position and livelihood of indigenous women in communities such as Indonesia (Ball, 2020; Saville and Adams, 2020).

Overall, publications on land tenure in this period have a clear trend towards the Sustainable Development Goal of Organising for Climate Action, as seen in Fig. 2 of the conceptual framework section. Clusters 3–2 of Land use with keywords such as ecosystem service or conservation, 3–3 of Agriculture with keywords such as sustainability or climate change, and 3–4 of Deforestation/America with keywords such as deforestation or sustainable development all align with the Sustainable Development Goals (SDGs), especially SDG 14. Notable studies in this field include those carried out for China (Bryan et al., 2018a, 2018b).

6. Discussion

6.1. Research trends for the period 1950–1999

Fig. 13 demonstrates the evolution of the relevant works over time. Blue indicates the beginning of the period, and red indicates the end. In 1986, keywords such as sociology and family planning were prevalent. In 1988, population characteristics, geographic factors, macroeconomic factors, agriculture, and migration were the most commonly used terms. Demographic factors, demography, and population dynamics emerged in 1990, followed by a growing interest in poverty and specific geographical areas like Africa, Brazil, Peru, and India in 1991. In 1992, developing countries, agricultural development, and rural development were introduced. By 1995, property rights, deforestation, and land use were being discussed, and in 1996, the focus shifted to rural planning, privatization, tenure relations, land market, and South Africa as a geographical area. Notably, Nelson Mandela was the first president of South Africa to be elected in a fully representative democratic election and governed from 1994 to 1996. The period concluded with a focus on environmental policy in 1997.

The review articles on land tenure were published in 1985, and a review of the literature on land tenure systems in Sub-Saharan Africa was conducted (Noronha, 1985). This study identifies the relevance of land tenure as a socioeconomic issue in cluster 1.5 of the first period (1950–1999). The second review paper, edited by the University of Wisconsin-Madison, focused on food security and land tenure (Maxwell and Wiebe, 1998), while the other book (Bruce, 1998) on land tenure terminology was identified as the second most relevant institution on the subject. Both works fall within cluster 1.2 of the first period, which is related to social issues such as rural population, poverty, socioeconomic status, social class, health, family size, and land supply.

6.2. Research trends for the period 2000–2009

In the second period under examination, the topics have demonstrated a clear evolution, as illustrated in Fig. 14. At the beginning of this period, in 2003, there appears to be a growing awareness of soil degradation and desertification, and their impact on the population. Subsequently, in 2004, issues such as deforestation, land management, resource management, and the countries of interest for research, including Peru, China, Australia, the United States, and Indonesia, were analyzed.

In 2005, concepts such as property rights, tenure systems, and liberalization began to emerge. In 2006, land tenure took center stage, along with topics such as land use, land reform, and countries like Ethiopia, Tanzania, and Kenya. The geographical areas of interest continued to be Africa, particularly southern Africa, but expanded to other regions such as Asia, Europe, Western Europe, and Eurasia. By 2007, there was an increasing focus on regions such as the Pacific Islands and the European Union. Finally, in 2008, ethnic conflicts, particularly

Fig. 12.. Network of keywords in land tenure publications: Clusters between 2010-2020.
Data retrieved from Scopus database in the year 2022.

those related to land tenure, emerged as a prominent topic.

6.3. Research trends for the period 2010–2020

The evolution of topics in this period is depicted in Fig. 15, with the blue color representing the earlier period and the red color representing the more recent one. In 2014, key terms such as human rights, property rights, rangeland, and habitat fragmentation stand out. In 2015, ecosystem services, stakeholders, reforestation, and developing countries are prominent. Between 2015 and 2016, terms like land use, land rights, and agricultural land are introduced. From 2016–2017, the term REDD+ appears along with specific countries like Canada, Peru, Ethiopia, and China. Finally, terms such as conservation status and landscape changes are observed. Notably, a study by Hausner et al. (2015) explores the relationship between physical landscapes, ecosystem services, and land use preferences in southern Norway, highlighting the connection between landscape and land tenure.

In this period (2010–2020), the concern over deforestation related to

land tenure is evident in some literature reviews. Such reviews emphasize that land deforestation is linked to a complex set of socio-economic and political factors (Robinson et al., 2011), which was identified in this study as cluster 3.4, Deforestation/America.

6.4. The geographical trends of land tenure studies during the three periods

The study has identified significant trends by analyzing the main keywords used in three different periods, as depicted in Fig. 8. This section aims to examine the changes in the geographical location of research during each period, investigating how the geographic focus of land tenure studies changed over time and whether these changes are related to shifts in content. Table 9 provides a summary of the geographic keywords used in the analyzed periods.

During the first period analyzed (1950–1999), the research mainly focused on continents, with a particular emphasis on Africa, followed by Asia and Latin America. The primary keywords associated with Africa

Table 8

Main keywords used by the communities detected in the topic in the period 2010–2020.

Cluster	Color	Main Keywords	Topic	Cluster weight (%)
3–1	Red	Land tenure, land rights, landownership, property rights, governance approach, rural area, land reform	Land reform	27.2
3–2	Green	Land use change, land use, forestry, ecosystem service, conservation, protected area	Land use	25
3–3	Blue	Agricultural land, agriculture, sustainability, climate change, developing countries, smallholder, agroforestry, farming system	Agriculture	21.2
3–4	Yellow	deforestation, sustainable development, indigenous population, forest management, Mexico, Brazil, Canada, Colombia	Deforestation/ America	16
3–5	Purple	Household, social status, rural population, government, socioeconomic factors, economics, community	Sociology	10.6

during this period were economic and population factors, such as Economic Factors, Economics, Socioeconomic Factors, Socioeconomics, Population, Demographic Factors, Demography, and Population Dynamics. For instance, studies conducted during this time examined issues such as changing patterns of population distribution in Zimbabwe (Zinyama and Whitlow, 1986) and resettlement and land policy in the context of national development in Zimbabwe (Kinsey, 1982).

Similarly, the main keywords related to Asia during this period were socioeconomic factors such as Economic Factors, Economics, Socioeconomic Factors, Socioeconomics, and Population. Research on Southeast Asia predicted that 40% of the population would be urban by the year 2000, raising concerns about urban infrastructure provision, land use conflicts, and environmental degradation (McGee and Greenberg, 1992). In Latin America, the studies were focused on economic and socioeconomic factors, including Population, Demographic Factors, Economic Factors, Socioeconomic Factors, Socioeconomics, and their effects on environmental degradation issues such as deforestation or soil erosion (Bilsborrow et al., 1992). Indigenous land tenure and tropical forest management were also topics of investigation (Davis and Wali, 1994).

During the second period analyzed (2000–2009), researchers focused on continents, with Africa taking the lead, followed by Asia and Eurasia. The term "World" was introduced as a new geographical concept. In Africa, land reform and land rights were the most important topics, particularly in Sub-Saharan Africa and East Africa. Scholars from the United States, United Kingdom, and South Africa studied these

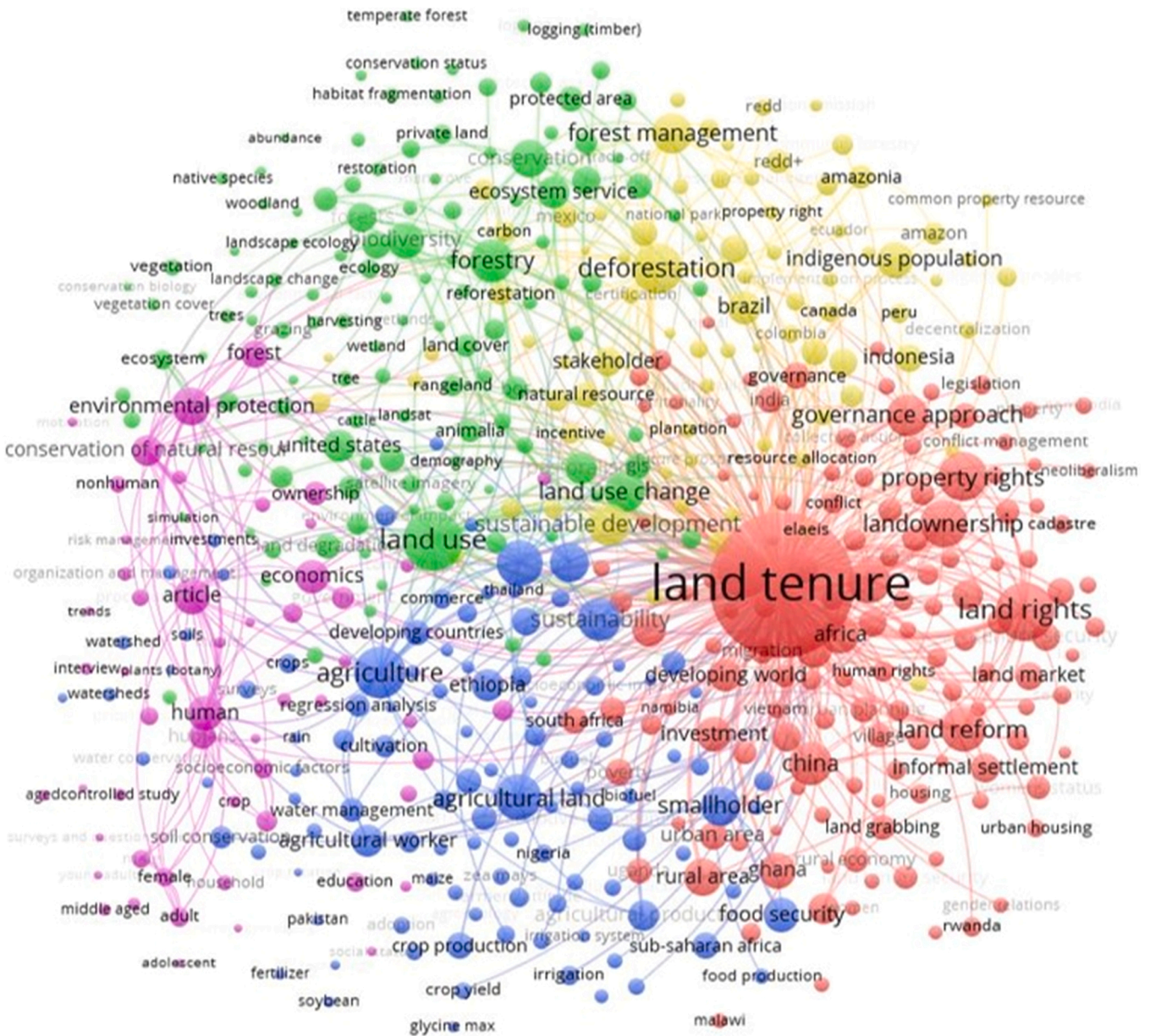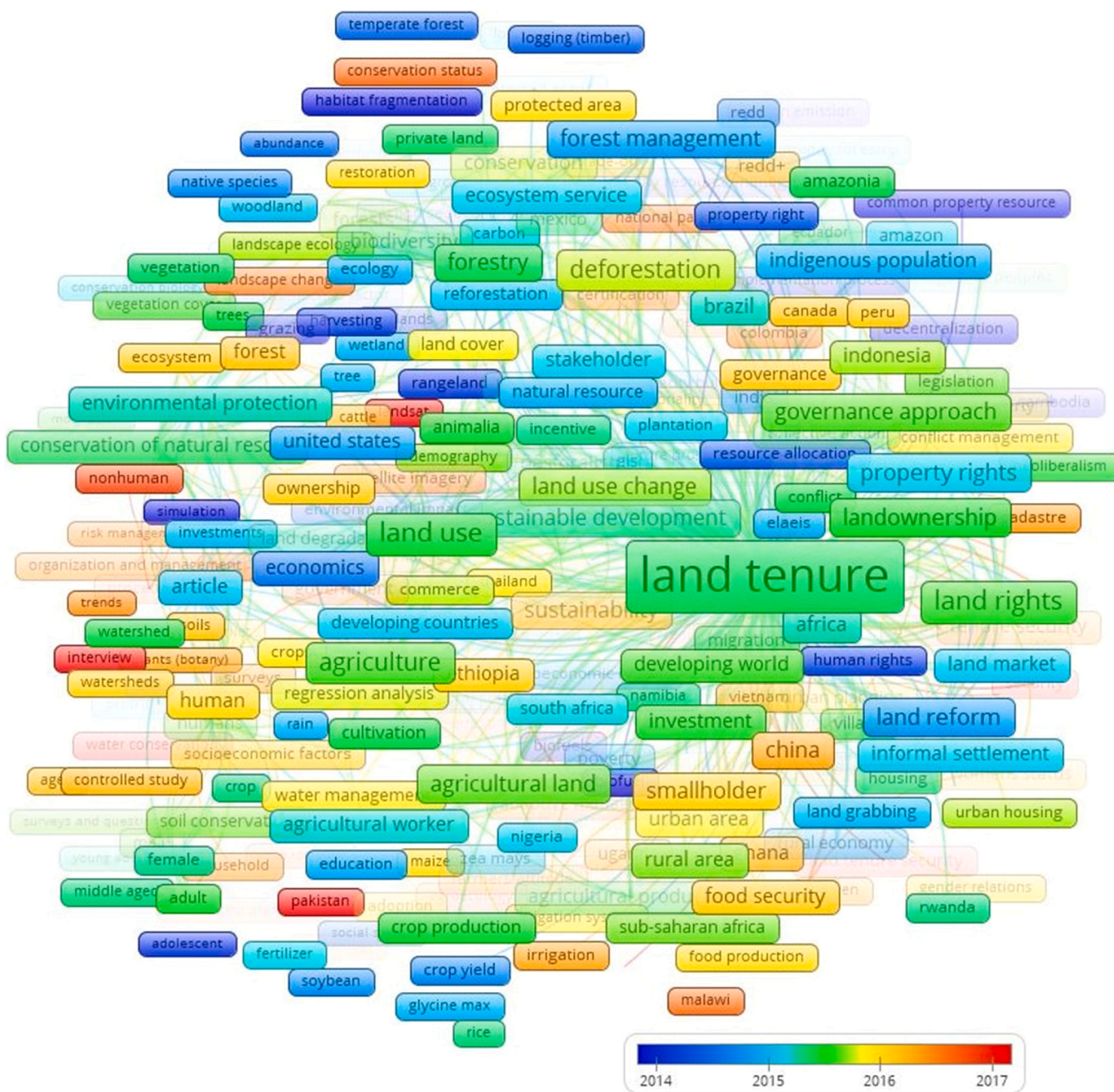**Fig. 13..** Trend of keywords in land tenure publications between 1950-1999. Data retrieved from Scopus database in the year 2022.

Fig. 14. Trend of keywords in land tenure publications between 2000-2009.
Data retrieved from Scopus database in the year 2022.

issues. For Asia and Eurasia, China was the primary focus, with research centered on land use, land rights, and land reform. Fragmentation of landholdings was identified as a significant constraint to agricultural production in China (Tan et al., 2006). Concerns about farm size and productivity efficiency were raised in relation to the "World" concept (Helfand and Levine, 2004). Furthermore, the importance of market mechanisms for forest environmental issues was highlighted (Grieg-Gran et al., 2005).

In the third period analyzed (2010–2020), researchers focused mainly on China, with studies centered on property rights, rural areas, agricultural land, and land rights. One notable analysis examined large-scale programs designed to solve the national land system sustainability emergency in China, which had affected over 630 million hectares of land and over 500 million people since 1998 (Bryan et al., 2018a, 2018b). Investigations continued on land tenure arrangements and rural-urban migration (Mullan et al., 2011).

Mexico and North America were the second focus, with primary concerns for environmental issues such as deforestation, forest management, environmental policy, land use change, biodiversity,

environmental protection, and community forestry. Scholars discussed land tenure and carbon rights as key issues to be considered to ensure transparent benefit sharing and to determine liabilities for non-permanence or non-compliance in the context of REDD+ (Reduce Emissions from Deforestation and forest Degradation) strategies and projects (Corbera et al., 2011). Africa remained the third most important geographical term in this period, mainly related to land rights, land-ownership, property rights, or land administration (Flores et al., 2020). Studies highlighted the threats that large-scale land deals for biofuel production posed to local poor people who depended on these assets (Vermeulen and Cotula, 2010) or how the acquisition of agricultural land by foreigners could affect water resources, particularly in sub-Saharan Africa (Woodhouse, 2012). Climate change and deforestation were also areas of concern (Asare et al., 2013).

To compare the weight of geographical terms, Table 9 calculates the percentage of the total number of publications in each period. However, it should be noted that the analysis is based on keywords that index the manuscripts, and as it is common for a manuscript to have at least five keywords, these keywords cannot be added together independently.

Fig. 15. Trend of keywords in land tenure publications between 2010-2020. Data retrieved from Scopus database in the year 2022.

Therefore, only similar terms have been added together to make this geographical analysis, such as Mexico [North America] + Mexico.

Table 9 shows that the term Africa increased from 6.6% in the period up to 1999–17.3% in the period up to 2009, and then dropped to 2.9% in the last period. Fig. 9 provides a detailed view of the evolution of this keyword. The term China was used in 1.7% of the publications in the first period, rose to 4.6% in the second period, and slightly decreased to 4.1% in the third period, indicating stability since the second period. Interestingly, the term Europe was present in the first period, albeit with a low percentage of 1%, had some significance with 3.4% in the second period, and disappeared in the last period.

When the geographical terms from Table 9 are grouped by continents, Fig. 16 provides an insightful view. In the first period (1950–1999), the number of studies conducted on Asian and African regions was each above 30%. However, in the second period

(2000–2009), research on African areas far outnumbered those of Asia. In the third period (2010–2020), studies related to land tenure in African areas continue to lead the research. During this period, the number of publications on Asia, North America, and South and Central America were quite similar. Notably, there were no land tenure studies for Europe in the last period.

7. Conclusions

This manuscript examines the literature on land tenure with three objectives in mind: first, to assess the current state of research and identify the main areas of focus; second, to evaluate research trends by period; and third, to identify areas in need of further research.

After analyzing publications related to land tenure, it was found that they were mainly indexed in the scientific categories of Social Sciences

Table 9

Main geographical keywords used by period.

Period 1950–1999			Period 2000–2009			Period 2010–2020		
Keyword	N	%	Keyword	N	%	Keyword	N	%
Africa	95	6.6	Africa	234	17.3	China	128	4.1
Asia	66	4.6	Sub-Saharan Africa	187	13.8	Mexico [North America] + Mexico	94	3.0
Latin America	39	2.7	Eurasia	175	12.9	Africa	93	2.9
Africa South of the Sahara	31	2.1	Asia	145	10.7	Ghana	91	2.9
Southern Asia	31	2.1	East Africa	83	6.1	Brazil	77	2.4
Mexico	30	2.1	World	76	5.6	Kenya	76	2.4
Americas	29	2.0	China	62	4.6	Ethiopia	70	2.2
Western Hemisphere	29	2.0	Southeast Asia	60	4.4	United States	69	2.2
India	26	1.8	Eastern Hemisphere	57	4.2	Indonesia	53	1.7
South And Central America	26	1.8	Southern Africa	57	4.2	Australia	51	1.6
Brazil	25	1.7	North America	55	4.1	South Africa	47	1.5
China	24	1.7	West Africa	49	3.6	India	46	1.5
South America	21	1.4	South America	47	3.5	Uganda	44	1.4
Nigeria	20	1.4	Europe	46	3.4	Sub-Saharan Africa	41	1.3
Eastern Africa	18	1.2	United States	44	3.2	Amazonia	40	1.3
Kenya	18	1.2	Far East	41	3.0	Tanzania	40	1.3
Southeast Asia	18	1.2	Brazil	40	3.0	Amazon	34	1.1
Africa. Eastern	17	1.2	Ethiopia	36	2.7	Cameroon	33	1.0
Asia. Southeastern	17	1.2	Mexico+ Mexico [North America]	36	2.7			
Australia	17	1.2	South Asia	35	2.6			
South Africa	17	1.2	South Africa	34	2.5			
Southeastern Asia	17	1.2	Australia	31	2.3			
Zimbabwe	17	1.2	Indonesia	26	1.9			
Bangladesh	16	1.1	Kenya	26	1.9			
Philippines	16	1.1	India	24	1.8			
Tanzania	16	1.1	Tanzania	23	1.7			
Europe	15	1.0	Ghana	21	1.5			
North America	14	1.0	Australasia	20	1.5			
Papua New Guinea	14	1.0	Zimbabwe	20	1.5			
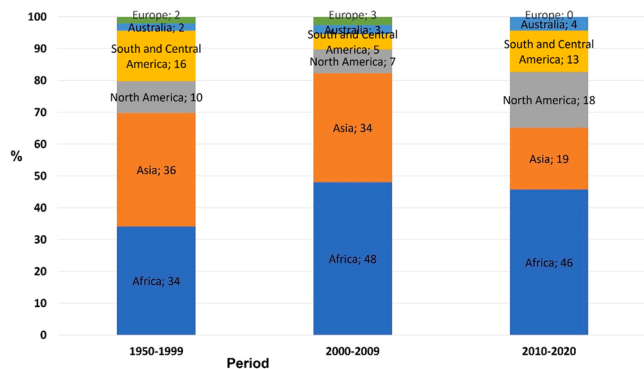
Fig. 16. Percentage of geographic keywords grouped by continents and period.

(33%), Environmental Science (21%), and Agricultural and Biological Science (14%). The main keywords of these categories, Land Rights and Land Use, were similar. The most active countries in this field are the United States, the United Kingdom, and Australia, which has the most arable land per person in the world. The institutions that research this subject the most are Wageningen University & Research, University of Wisconsin-Madison, Norwegian University of Life Sciences, University of Florida, The Australian National University, University of Twente, and The University of Queensland.

The study identifies three research periods: the first period, up to 1999, focused on developing countries; from 2000 to 2009, the focus shifted to Africa, with some attention to Asia; and from 2009 to 2020, the focus was on land use, specifically agriculture, forestry, and deforestation. The analysis of keywords for each period led to the identification of research clusters or focus areas. The first period had five clusters: Developing Countries, Social Issues, Macroeconomy, Demography, and Socioeconomics Issues. The second period had nine clusters: Environment, Sustainable Development, Land Reform, Agriculture and Africa, South America and China, America and Australia, Europe, Asia,

and Sub-Saharan Africa. The third period had five clusters: Land Reform, Land Use, Agriculture, Deforestation and America, and Sociology. The latest clusters aimed to reform land tenure mechanisms, not only to resolve conflicts or promote economic development but also to improve environmental conditions, promote gender equality, and ensure sustainable agriculture to produce food for the whole society. Furthermore, the analysis of clusters in the last period identified a subject that has not been sufficiently studied, the conservation of native species and traditional varieties, which is a future line of research.

The main research trends of the first period started with macroeconomic or migration factors and ended with land use and deforestation. The second period focused on soil awareness and desertification, and how they affect the population, with ethnic conflicts related to land tenure being highlighted. The trends for the last period focused on human rights and habitat fragmentation, ending with ecosystem services, stakeholders, and reforestation.

This study provides an overview of research activity in the field of land tenure over the last 70 years. While there may be objections to this study, it offers a snapshot of the scientific work carried out in this field. It is recommended that articles be written to review each of the clusters found, allowing progress to be made based on existing knowledge. Finally, this study opens new perspectives for the study of land tenure in relation to the Sustainable Development Goals (SDGs).

CRediT authorship contribution statement

Esther Salmerón-Manzano: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Francisco Manzano-Agugliaro:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Data Availability

Data will be made available on request.

References

Abdelkader, M., Sliuzas, R., Boerboom, L., Elseicy, A., Zevenbergen, J., 2020. Spatial and temporal human settlement growth differentiation with symbolic machine learning for verifying spatial policy targets: assiut governorate. Egypt Case Study Remote Sens. 12 (22), 3799.

Abera, W., Assen, M., Budds, J., 2020. Determinants of agricultural land management practices among smallholder farmers in the Wanka watershed, northwestern highlands of EthiopiaI. Land Use Policy 99, 104841.

Aghaei Chadegani, A., Salehi, H., Yunus, M., Farhadi, H., Fooladi, M., Farhadi, M., 2013. A comparison between two main academic literature collections: Web of Science and Scopus databases. Asian Soc. Sci. 9 (5), 18–26.

Allred, S., Stedman, R., Heady, L., Strong, K., 2021. Incorporating biodiversity in municipal land-use planning: an assessment of technical assistance, policy capacity, and conservation outcomes in New York's Hudson Valley. Land Use Policy 104, 105344.

Altieri, M.A., Nicholls, C.I., 2020. Agroecology and the emergence of a post COVID-19 agriculture. Agric. Hum. Values 37 (3), 525–526.

Anderson, M.D., 2008. Rights-based food systems and the goals of food systems reform. Agric. Hum. Values 25 (4), 593–608.

Angelsen, A., 2010. Policies for reduced deforestation and their impact on agricultural production. Proc. Natl. Acad. Sci. 107 (46), 19639–19644.

Anonymous, 1921. Melanesian land-tenure. Nature 108, 354-354.

Asare, R.A., Kyei, A., Mason, J.J., 2013. The community resource management area mechanism: a strategy to manage African forest resources for REDD+. Philos. Trans. R. Soc. B: Biol. Sci. 368 (1625), 20120311.

Assies, W., 2009. Land tenure, land law and development: some thoughts on recent debates. J. Peasant Stud. 36 (3), 573–589.

Aznar-Sánchez, J.A., Velasco-Muñoz, J.F., Belmonte-Ureña, L.J., Manzano-Agugliaro, F., 2019. The worldwide research trends on water ecosystem services. Ecol. Indic. 99, 310–323.

Aznar-Sánchez, J.A., Piquer-Rodríguez, M., Velasco-Muñoz, J.F., Manzano-Agugliaro, F., 2019. Worldwide research trends on sustainable land use in agriculture. Land Use Policy 87, 104069.

Bahar, N.H., Lo, M., Sanjaya, M., Van Vianen, J., Alexander, P., Ickowitz, A., Sunderland, T., 2020. Meeting the food security challenge for nine billion people in 2050: what impact on forests? Glob. Environ. Change 62, 102056.

Ball, J.A., 2020. Women farmers in developed countries: a literature review. Agric. Hum. Values 37 (1), 147–160.

Banerjee, A., Iyer, L., 2005. History, institutions, and economic performance: the legacy of colonial land tenure systems in India. Am. Econ. Rev. 95 (4), 1190–1213.

Bang, P.F., 2011. Law and the rural economy in the Roman empire. Class. Rev. 61 (1), 246.

Bebbington, A., 1999. Capitals and capabilities: a framework for analyzing peasant viability, rural livelihoods and poverty. World Dev. 27 (12), 2021–2044.

Betts, J.T., Urquhart, G.R., Román-Heracleo, J., 2021. Effects of deforestation from cattle ranching over time on protected rainforest streams in the Rama-Kriol Territory, Nicaragua. Hydrobiologia 1–22. https://doi.org/10.1007/s10750-021-04684-w.

Bilsborrow, R.E., Okoth-Ogendo, H.W.O., 1992. Population-driven changes in land use in developing countries. Ambio Stockh. 21 (1), 37–45.

Blaikie, P., 1985. The political economy of soil erosion in developing countries. Longman Sci. Tech. 188.

Borras Jr, S.M., Hall, R., Scoones, I., White, B., Wolford, W., 2011. Towards a better understanding of global land grabbing: an editorial introduction. J. Peasant Stud. 38 (2), 209–216.

Braimoh, A.K., Onishi, T., 2007. Spatial determinants of urban land use change in Lagos, Nigeria. Land Use Policy 24 (2), 502–515.

Brasselle, A.S., Gaspart, F., Platteau, J.P., 2002. Land tenure security and investment incentives: puzzling evidence from Burkina Faso. J. Dev. Econ. 67 (2), 373–418.

Bremer, L.L., Farley, K.A., Lopez-Carr, D., 2014. What factors influence participation in payment for ecosystem services programs? An evaluation of Ecuador's SocioPáramo program. Land Use Policy 36, 122–133.

Brown, S., 1990. Tropical secondary forests. J. Trop. Ecol. (6 1), 1–32.

Bruce, J.W. Review of tenure terminology. Land Tenure Center, University of Wisconsin-Madison. 1998.

Bryan, B.A., Gao, L., Ye, Y., Sun, X., Connor, J.D., Crossman, N.D., Hou, X., 2018a. China's response to a national land-system sustainability emergency. Nature 559 (7713), 193–204.

Bryan, B.A., Gao, L., Ye, Y., Sun, X., Connor, J.D., Crossman, N.D., Liu, Z., 2018b. China's response to a national land-system sustainability emergency. Nature 559 (7713), 193–204.

Cascajares, M., Alcayde, A., Salmerón-Manzano, E., Manzano-Agugliaro, F., 2021. The bibliometric literature on scopus and WoS: the medicine and environmental sciences categories as case of study. Int. J. Environ. Res. Public Health 18 (11), 5851.

Chambers, R.; Conway, G. Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies UK. 1992.

Cheyns, E., Riisgaard, L., 2014. The exercise of power through multi-stakeholder initiatives for sustainable agriculture and its inclusion and exclusion outcomes. Agric. Hum. Values 31 (3), 409–423.

Coomes, O.T., 1996. State credit programs and the peasantry under populist regimes: lessons from the APRA experience in the Peruvian Amazon. World Dev. 24 (8), 1333–1346.

Corbera, E., Estrada, M., May, P., Navarro, G., Pacheco, P., 2011. Rights to land, forests and carbon in REDD+: insights from Mexico, Brazil and Costa Rica. Forests 2 (1), 301–342.

Davis, S.H., Wali, A., 1994. Indigenous land tenure and tropical forest management in Latin America. Ambio 485–490.

De Oliveira, J.A.P., 2002. Implementing environmental policies in developing countries through decentralization: the case of protected areas in Bahia, Brazil. World Dev. 30 (10), 1713–1736.

De Schutter, O., 2010. The emerging human right to land. Int. Community Law Rev. 12 (3), 303–334.

De Schutter, O., 2011. How not to think of land-grabbing: three critiques of large-scale investments in farmland. J. Peasant Stud. 38 (2), 249–279.

Deininger, K., Byerlee, D., 2012. The rise of large farms in land abundant countries: do they have a future? World Dev. 40 (4), 701–714.

Deininger, K., Jin, S., 2006. Tenure security and land-related investment: evidence from Ethiopia. Eur. Econ. Rev. 50 (5), 1245–1277.

Ducourtieux, O., Laffort, J.R., Sacklokham, S., 2005. Land policy and farming practices in Laos. Dev. Change 36 (3), 499–526.

Ebeling, J., Yasué, M., 2009. The effectiveness of market-based conservation in the tropics: forest certification in Ecuador and Bolivia. J. Environ. Manag. 90 (2), 1145–1153.

Eriksen, S., Silva, J.A., 2009. The vulnerability context of a savanna area in Mozambique: household drought coping strategies and responses to economic change. Environ. Sci. Policy 12 (1), 33–52.

Escadafal, R., Barbero-Sierra, C., Exbrayat, W., Marques, M.J., Akhtar-Schuster, M., El Haddadi, A., Ruiz, M., 2015. First appraisal of the current structure of research on land and soil degradation as evidenced by bibliometric analysis of publications on desertification. Land Degrad. Dev. 26 (5), 413–422.

Fearnside, P.M., 2001. Soybean cultivation as a threat to the environment in Brazil. Environ. Conserv. 23–38.

Feder, G., Feeny, D., 1991. Land tenure and property rights: theory and implications for development policy. World Bank Econ. Rev. 5 (1), 135–153.

Flores, C.C., Tan, E., Buntinx, I., Crompvoets, J., Stöcker, C., Zevenbergen, J., 2020. Governance assessment of the UAVs implementation in Rwanda under the fit-for-purpose land administration approach. Land Use Policy 99, 104725.

Fontana, L.B., 2014. Indigenous peoples vs peasant unions: land conflicts and rural movements in plurinational Bolivia. J. Peasant Stud. 41 (3), 297–319.

Galvin, K.A., 2009. Transitions: pastoralists living with change. Annu. Rev. Anthropol. 38, 185–198.

Garnett, G., 2007. Conquered England: kingship. Succession, and Tenure. Oxford University Press,, pp. 1066–1166.

Garrido-Cardenas, J.A., González-Cerón, L., García-Maroto, F., Cebrián-Carmona, J., Manzano-Agugliaro, F., Mesa-Valle, C.M., 2023. Analysis of fifty years of severe malaria worldwide research. Pathogens 12 (3), 373.

Garrido-Cárdenas, J.A., De Lamo-Sevilla, C., Cabezas-Fernández, M., Manzano-Agugliaro, F., Martínez-Lirola, M., 2020. Global tuberculosis research and its future prospects. Tuberculosis 121, 101917. https://doi.org/10.1016/j.tube.2020.101917.

Ghawana, T., Sargent, J., Bennett, R.M., Zevenbergen, J., Khandelwal, P., Rahman, S., 2020. 3D Cadastres in India: examining the status and potential for land administration and management in Delhi. Land Use Policy 98, 104389.

Glänzel, W., Moed, H.F., 2002. Journal impact measures in bibliometric research. Scientometrics 53 (2), 171–193.

Gosnell, H., Haggerty, J.H., Travis, W.R., 2006. Ranchland ownership change in the Greater Yellowstone Ecosystem, 1990–2001: implications for conservation. Soc. Nat. Resour. 19 (8), 743–758.

Grieg-Gran, M., Porras, I., Wunder, S., 2005. How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. World Dev. 33 (9), 1511–1527.

Guerrero, M., Montoya, F.G., Baños, R., Alcayde, A., Gil, C., 2017. Adaptive community detection in complex networks using genetic algorithms. Neurocomputing 266, 101–113.

Guerrero, M., Montoya, F.G., Baños, R., Alcayde, A., Gil, C., 2018. Community detection in national-scale high voltage transmission networks using genetic algorithms. Adv. Eng. Inform. 38, 232–241.

Guerrero, M., Baños, R., Gil, C., Montoya, F.G., Alcayde, A., 2019. Evolutionary algorithms for community detection in continental-scale high-voltage transmission grids. Symmetry 11 (12), 1472.

Gyasi, K.O., Diaz, E.C., Martínez-torres, M.E., Rosset, P.M., Palmer, C., Kibii, K., Mycoo, M., de Eiden, T.V., Mwangi, E., Astonitas, L.M., 2007. Experts address the

question: How important is security of land tenure for achieving sustainable development goals? Nat. Resour. Forum 31 (3), 238–240.

Harrison, P.; Bruinsma, J.; de Haen, H.; Alexandratos, N.; Schmidhuber, J.; Bödeker, G.; Ottaviani, M.G. 2002. World agriculture: towards 2015/2030. Online, http://www.fao. org/documents.

Hausner, V.H., Brown, G., Lægreid, E., 2015. Effects of land tenure and protected areas on ecosystem services and land use preferences in Norway. Land Use Policy 49, 446–461.

Hecht, S.B., 1993. The logic of livestock and deforestation in Amazonia. Bioscience 43 (10), 687–695.

Helfand, S.M., Levine, E.S., 2004. Farm size and the determinants of productive efficiency in the Brazilian Center-West. Agric. Econ. 31 (2–3), 241–249.

Houghton, R.A., 1994. The worldwide extent of land-use change. BioScience 44 (5), 305–313.

Jacobus, C.J., Harwood, B., Chmura, L.J., 2010. Real estate principles, Vol. 9. Cengage Learning.

Jacoby, H.G., Li, G., Rozelle, S., 2002. Hazards of expropriation: tenure insecurity and investment in rural China. Am. Econ. Rev. 92 (5), 1420–1447.

Jarosz, L., 2000. Understanding agri-food networks as social relations. Agric. Hum. Values 17 (3), 279–283.

Jepson, W., 2006. Private agricultural colonization on a Brazilian frontier, 1970–1980. J. Hist. Geogr. 32 (4), 839–863.

Joireman, S.F., 2008. The mystery of capital formation in Sub-Saharan Africa: women, property rights and customary law. World Dev. 36 (7), 1233–1246.

Jones, G., 2005. Garden cultivation of staple crops and its implications for settlement location and continuity. World Archaeol. 37 (2), 164–176.

Kalabamu, F.T., 2000. Land tenure and management reforms in East and Southern Africa–the case of Botswana. Land Use Policy 17 (4), 305–319.

Kehoe, D.P., 2007. Law and the rural economy in the Roman Empire. University of Michigan Press.

Kinsey, B.H., 1982. Forever gained: 1 resettlement and land policy in the context of national development in Zimbabwe. Africa 52 (3), 92–113.

Lapola, D.M., Martinelli, L.A., Peres, C.A., Ometto, J.P., Ferreira, M.E., Nobre, C.A., Joly, C.A., 2014. Pervasive transition of the Brazilian land-use system. Nat. Clim. Change 4 (1), 27–35.

Larson, A.M., Brockhaus, M., Sunderlin, W.D., Duchelle, A., Babon, A., Dokken, T., Huynh, T.B., 2013. Land tenure and REDD+: the good, the bad and the ugly. Glob. Environ. Change 23 (3), 678–689.

Lastarria-Cornhiel, S., 1997. Impact of privatization on gender and property rights in Africa. World Dev. 25 (8), 1317–1333.

Lawrence, T.J., Morreale, S.J., Stedman, R.C., Louis, L.V., 2020. Linking changes in ejido land tenure to changes in landscape patterns over 30 years across Yucatán, México. Reg. Environ. Change 20 (4), 1–13.

Leicht, E.A., Newman, M.E., 2008. Community structure in directed networks. Phys. Rev. Lett. 100 (11), 118703.

Li, T.M., 2011. Centering labor in the land grab debate. J. Peasant Stud. 38 (2), 281–298.

Li, W.J., Ali, S.H., Zhang, Q., 2007. Property rights and grassland degradation: a study of the Xilingol Pasture, Inner Mongolia, China. J. Environ. Manag. 85 (2), 461–470.

Lozano, I., 1994. Origen de la propiedad romana y de sus limitaciones. Proy. Soc.: Rev. De. Relac. Labor. 2, 83–94.

Ma, X., Heerink, N., Feng, S., Shi, X., 2015. Farmland tenure in China: comparing legal, actual and perceived security. Land Use Policy 42, 293–306.

Macedo, J., 2008. Urban land policy and new land tenure paradigms: legitimacy vs. legality in Brazilian cities. Land Use Policy 25 (2), 259–270.

Masitera, E., 2021. Individual justice in land redistribution: appropriating some ideas from the capability approach. In: Masitera, E. (Ed.), Philosophical Perspectives on Land Reform in Southern Africa. Palgrave Macmillan, Cham. https://doi.org/ 10.1007/978-3-030-49705-7_13.

Maxwell, D.; Wiebe, K.D. Land tenure and food security: A review of concepts, evidence, and methods. Land Tenure Center, University of Wisconsin-Madison. 1998.

McCarthy, J.F., Cramb, R.A., 2009. Policy narratives, landholder engagement, and oil palm expansion on the Malaysian and Indonesian frontiers. Geogr. J. 175 (2), 112–123.

McGee, T.G., Greenberg, C., 1992. The emergence of extended metropolitan regions in ASEAN: towards the year 2000. ASEAN Econ. Bull. 22–44.

Merrill, T.W., 1998. Property and the right to exclude. Neb. L. Rev. 77, 730.

Migot-Adholla, S., Hazell, P., Blarel, B., Place, F., 1991. Indigenous land rights systems in sub-Saharan Africa: a constraint on productivity? World Bank Econ. Rev. 5 (1), 155–175.

Mongeon, P., Paul-Hus, A., 2016. The journal coverage of Web of Science and Scopus: a comparative analysis. Scientometrics 106 (1), 213–228.

Mottet, A., Ladet, S., Coqué, N., Gibon, A., 2006. Agricultural land-use change and its drivers in mountain landscapes: a case study in the Pyrenees. Agric., Ecosyst. Environ. 114 (2–4), 296–310.

Mullan, K., Grosjean, P., Kontoleon, A., 2011. Land tenure arrangements and rural–urban migration in China. World Dev. 39 (1), 123–133.

Murty, D., Kirschbaum, M.U., Mcmurtrie, R.E., Mcgilvray, H., 2002. Does conversion of forest to agricultural land change soil carbon and nitrogen? A review of the literature. Glob. Change Biol. 8 (2), 105–123.

Nederhof, A.J., 2006. Bibliometric monitoring of research performance in the social sciences and the humanities: a review. Scientometrics 66 (1), 81–100.

Newman, M.E., 2004. Fast algorithm for detecting community structure in networks. Phys. Rev. E 69 (6), 066133.

Noronha, R., 1985. A review of the literature on land tenure systems in Sub-Saharan Africa No. ARU43. The World Bank, pp. 1–364.

Ostrom, E., Nagendra, H., 2006. Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory. Proc. Natl. Acad. Sci. 103 (51), 19224–19231.

Ouédraogo, E., Mando, A., Zombré, N.P., 2001. Use of compost to improve soil properties and crop productivity under low input agricultural system in West Africa. Agric., Ecosyst. Environ. 84 (3), 259–266.

Padilla, F.M., Gallardo, M., Manzano-Agugliaro, F., 2018. Global trends in nitrate leaching research in the 1960–2017 period. Sci. Total Environ. 643, 400–413.

Paneque-Gálvez, J., Mas, J.F., Guèze, M., Luz, A.C., Macía, M.J., Orta-Martínez, M., Reyes-García, V., 2013. Land tenure and forest cover change. The case of southwestern Beni, Bolivian Amazon, 1986–2009. Appl. Geogr. 43, 113–126.

Paustian, K., Cole, C.V., Sauerbeck, D., Sampson, N., 1998. CO_2 mitigation by agriculture: an overview. Clim. Change 40 (1), 135–162.

Pedroso-Junior, N.N., Adams, C., Murrieta, R.S., 2009. Slash-and-burn agriculture: a system in transformation. Curr. Trends Hum. Ecol. 12 (34), 12–34.

Peluso, N.L., Lund, C., 2011. New frontiers of land control: Introduction. J. Peasant Stud. 38 (4), 667–681.

Pender, J., Nkonya, E., Jagger, P., Sserunkuuma, D., Ssali, H., 2004. Strategies to increase agricultural productivity and reduce land degradation: evidence from Uganda. Agric. Econ. 31 (2–3), 181–195.

Perea-Moreno, A.J., Perea-Moreno, M.Á., Hernandez-Escobedo, Q., Manzano-Agugliaro, F., 2017. Towards forest sustainability in Mediterranean countries using biomass as fuel for heating. J. Clean. Prod. 156, 624–634.

Peters, P.E., 2004. Inequality and social conflict over land in Africa. J. Agrar. Change 4 (3), 269–314.

Peters, P.E., Kambewa, D., 2007. Whose security? Deepening social conflict over'customary'land in the shadow of land tenure reform in Malawi. J. Mod. Afr. Stud. 447–472.

Plant, R., Hvalkof, S., 2001. Land titling and indigenous peoples. Inter-American Development Bank, Washington, DC (Available at). ⟨https://citeseerx.ist.psu.edu /viewdoc/download?doi=10.1.1.199.4722&rep=rep1&type=pdf⟩.

Reid, R.S., Kruska, R.L., Muthui, N., Taye, A., Wotton, S., Wilson, C.J., Mulatu, W., 2000. Land-use and land-cover dynamics in response to changes in climatic, biological and socio-political forces: the case of southwestern Ethiopia. Landsc. Ecol. 15 (4), 339–355.

Reydon, B.P., Fernandes, V.B., Telles, T.S., 2015. Land tenure in Brazil: the question of regulation and governance. Land Use Policy 42, 509–516.

Rist, L., Feintrenie, L., Levang, P., 2010. The livelihood impacts of oil palm: smallholders in Indonesia. Biodivers. Conserv. 19 (4), 1009–1024.

Robinson, B.E.; Holland, M.B.; Naughton-Treves, L. Does secure land tenure save forests? A review of the relationship between land tenure and tropical deforestation. 2011.

Rondhi, M., Pratiwi, P.A., Handini, V.T., Sunartomo, A.F., Budiman, S.A., 2018. Agricultural land conversion, land economic value, and sustainable agriculture: a case study in East Java, Indonesia. Land 7 (4), 148.

Rulli, M.C., Saviori, A., D'Odorico, P., 2013. Global land and water grabbing. Proc. Natl. Acad. Sci. 110 (3), 892–897.

Salmerón-Manzano, E., Manzano-Agugliaro, F., 2019. The role of smart contracts in sustainability: worldwide research trends. Sustainability 11 (11), 3049.

Salmerón-Manzano, E., Manzano-Agugliaro, F., 2020. Worldwide research on low cost technologies through bibliometric analysis. Inventions 5 (1), 9.

Salmerón-Manzano, E., Rahmani-Andebili, M., Alcayde, A., Manzano-Agugliaro, F., 2021. Worldwide Research Trends on Smart Homes. In Operation of Smart Homes. Springer, Cham, pp. 1–31.

Saville, A., Adams, A.E., 2020. Environmental justice in the American south: an analysis of black women farmworkers in Apopka, Florida. Agric. Hum. Values 1–12.

Shin, H.B., 2009. Property-based redevelopment and gentrification: the case of Seoul, South Korea. Geoforum 40 (5), 906–917.

Stamatopoulou, E., 1995. Women's rights and the United Nations. Women's rights. Hum. Right.: Int. Fem. Perspect. 36–48.

Stokes, C.J., McAllister, R.R., Ash, A.J., 2006. Fragmentation of Australian rangelands: processes, benefits and risks of changing patterns of land use. Rangel. J. 28 (2), 83–96.

Tan, S., Heerink, N., Qu, F., 2006. Land fragmentation and its driving forces in China. Land Use Policy 23 (3), 272–285.

The World Data Bank. World Development Indicators. https://databank.worldbank.org.

To, P.X., Dressler, W.H., Mahanty, S., Pham, T.T., Zingerli, C., 2012. The prospects for payment for ecosystem services PES) in Vietnam: a look at three payment schemes. Hum. Ecol. 40 (2), 237–249.

Totin, E., Segnon, A., Roncoli, C., Thompson-Hall, M., Sidibé, A., Carr, E.R., 2021. Property rights and wrongs: Land reforms for sustainable food production in rural Mali. Land Use Policy 109, 105610.

Toulmin, C., 2009. Securing land and property rights in sub-Saharan Africa: the role of local institutions. Land Use Policy 26 (1), 10–19.

Tripp, A.M., 2004. Women's movements, customary law, and land rights in. Afr.: Case Uganda Afr. Stud. Q. 7 (4), 1–19.

Vandevelde, K.J., 1980. The new property of the nineteenth century: the development of the modern concept of property. Buff. L. Rev. 29, 325.

Vermeulen, S., Cotula, L., 2010. Over the heads of local people: consultation, consent, and recompense in large-scale land deals for biofuels projects in Africa. J. Peasant Stud. 37 (4), 899–916.

Vosviewer. 2021. VOSViewer software tool. Available on-line https://www.vosviewer. com/.

Waltman, L., Van Eck, N.J., 2013. A smart local moving algorithm for large-scale modularity-based community detection. Eur. Phys. J. B 86 (11), 471.

White, J.B., 2012. Gendered experiences of dispossession: oil palm expansion in a Dayak Hibun community in West Kalimantan. J. Peasant Stud. 39 (3–4), 995–1016.

Whitehead, A., Tsikata, D., 2003. Policy discourses on women's land rights in Sub–Saharan Africa: the implications of the re–turn to the Customary. J. Agrar. Change 3 (1–2), 67–112.

Wily, L.A., 2011. 'The law is to blame': the vulnerable status of common property rights in sub-Saharan Africa. Dev. Change 42 (3), 733–757.

Woodhouse, P., 2012. Foreign agricultural land acquisition and the visibility of water resource impacts in Sub-Saharan Africa. Water Altern. 5 (2), 208.

Xie, H., Zhang, Y., Wu, Z., Lv, T., 2020. A bibliometric analysis on land degradation: current status. Dev., Future Dir. Land 9 (1), 28.

Zhang, K., Yu, Z., Li, X., Zhou, W., Zhang, D., 2007. Land use change and land degradation in China from 1991 to 2001. Land Degrad. Dev. 18 (2), 209–219.

Zinyama, L., Whitlow, R., 1986. Changing patterns of population distribution in Zimbabwe. GeoJournal 13 (4), 365–384.