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Research Paper

Unravelling Land Use Dynamics and Environmental Sustainability: A Decade-Long Bibliometric Exploration of Remote Sensing and Degradation Studies

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I. Introduction

Due to its significant contribution to global environmental change, land use change is one of the drivers that push the Earth system out of its safe operating space according to the planetary boundaries framework (Steffen et al., 2015). Recent calculations show that 1/3 of the worldwide land territory has been influenced by land use change since 1960, which is fourfold higher than they were supposed to be (Winkler et al., 2021). Such modifications together with natural forces like climatic changes or urbanization as a result of human activities like agricultural expansion, urbanization, or exploitation of resources, has serious consequences through affecting the environment consistency through modification of landscapes, functions of the ecosystems, or availability of resources (Foley et al., 2005; Lambin&Meyfroidt, 2011). Such changes impact essential ecological processes, such as carbon sequestration, water cycling, soil fertility, and maintenance of biodiversity (Turner et al., 2007; Newbold et al., 2015).Worldwide, land use and cover modification play a pivotal role since they impact on food security, climate control, and services of various ecosystems. The current amounts of agricultural land in 2023, including cropland and permanent meadows and pastures, are estimated to encompass 4,800 million hectares of land use representing a chunk of land of around 32 per cent of the land surface on earth and forests encompass 4,050 million hectares of the land surface accounting to 27 per cent of the earth surface (FAO, 2023). There is going on extreme change in these regions because of human interactions, and therefore leading to environmental degradation such as deforestation activities, urban sprawl, accelerated agriculture, and related effects such as loss of specimen diversity, land erosion, desertification, and climate change catastrophization (Song et al., 2018; Winkler et al., 2021). As an example of such issues, agricultural growth has raised food production globally, although largely at the expense of deforestation and loss of wetlands through annual degradation of 12 million hectares of tropical forests between the year 2001 and 2015 (Hansen et al., 2013). Land cover change is also enhanced by the population of 68 percent of the global population living in urban areas projected to reside in cities by 2050, fragmenting the ecosystems they inhabit and raising the emitted greenhouse gasses (United Nations, 2018; Seto et al., 2012).

The effects of such changes have resulted in a threat to natural resources sustainability in the form of ecosystem disruption that affects human well-being and planet health (MEA, 2005).To resolve these issues, remote sensing technologies are necessary to provide high-resolution land-specific data on studying change dynamics in land cover and their impacts on the environment (Hansen et al., 2013; Wulder et al., 2019). Using satellite imagery, geographic information systems (GIS) and other higher-level computational approaches, remote sensing is used to accurately track all areas where the land is being degraded and how this impacts environmental sustainability (Zhu et al., 2016; Pekel et al., 2016). Starting with seminal studies, like those presented by Hansen et al. (2013), information on satellite data all over the world was used to map forest cover change by monitoring this information and how severe the deforestation process can be ecologically. In the same line of corroboration, Wulder et al. (2019) showed how the time-series remote sensing data can be applied in monitoring land use dynamics in varied ecosystems such as grasslands and forests. Machine learning and big data analytics have also contributed to increasing the capacity of the land cover changes detection, analysis of degradation processes, and evaluation of the socio-economic and ecological results at a spatial and temporal resolution (Gong et al., 2020; Zhang et al., 2020).Nonetheless, the interdisciplinarity as well as complexity of the land use processes and environmental sustainability make it difficult on synthesis of crucial trends, methodologies, and research gaps. Bibliometric analysis also offers a sound way in which the intellectual landscape can be quantitatively map to determine influential studies, hot spots and nascent frontiers (Aria &Cuccurullo, 2017). The current bibliometric analyses, e.g. (Zhang et al., 2020) followed the development of remote sensing use in environmental monitoring, including the increased presence of machine learning and big data analytics. In a similar manner, Viana et al. (2022) did a bibliometric review of the Dealing with land degradation literature, and the research themes that have been on the rise are soil erosion, desertification, and ecosystem restoration. Such works highlight the emergence of the necessity to do reviews to summarise the research findings and inform further research.

The purpose of this paper is to undertake a 10-year bibliometric study to understand how research on remote sensing and land degradation has been developed in the margins of land use processes and environmental sustainability. The research questions it handles include: (1) What are the big trends and evolutionary paths of remote sensing and land degradation studies over the past few years? Which remote sensing methods and technology are common in this field? (2) What are the hot scientists and cross disciplinary links?

II. Material and Methods

It is a bibliometric research conducted to analyse structure, trends, and areas of knowledge on remote sensing and land degradation, in terms of landscape dynamics and sustainability of the environment (Pritchard, 1969). This measurement method applies mathematical and statistical principles in investigation of the course of publications, influential authors, organizations and journals and the networks of references and thereby allow one to discover areas of hot research and research gap (Garfield, 1979). The research takes into account the information retrieved through the Scopus database based on peer-reviewed articles and reviews published in 2014-2024. The workflow included the following steps: (1) the Scopus-collected data were cleaned to determine its veracity and significance; (2) bibliometric package in R Studio (Aria & Cuccurullo, 2017) used to quantify the trends in terms of data on publications, influential authors, institutions, journals, and citation rates, including the number of citations and the frequency of publications; (3) the VOS viewer (Waltman et al., 2010), which produced a map of co-occurrence of keywords and cluster.It is a simplified method, which with the help of R Studio and VOS viewer will give the quick but detailed assessment of the state of the research, discussing the trends of research publications, prevalent methods, interdisciplinary relationships, and potential future research areas.

III. Results

This bibliometric study elucidates the intellectual structure and dynamics of research in environmental science, land use, and geospatial technologies through a multifaceted analysis of author productivity, thematic evolution, and collaboration networks. The following subsections synthesize key findings from the visualizations, presented in a concise yet comprehensive manner.

3.1 Data Sources

The data for this bibliometric analysis were retrieved from the Scopus database, a comprehensive source for peer-reviewed scientific literature. As the Figure 1 shows the dataset, which includes 2,177 documents published between 2014 and 2024, sourced from 461 journals, books, and other publication types. The search focused on peer-reviewed articles and reviews related to remote sensing, land degradation, land use dynamics, and environmental sustainability. The dataset encompasses 135,717 references, 8,169 Keywords Plus, and 6,216 Author's Keywords, with an average of 5.48 co-authors per document and an international co-authorship rate of 44.46%. The annual publication growth rate is 16.98%, with an average document age of 4.41 years and an average of 24.6 citations per document. Key journals include Remote Sensing (191 articles), Sustainability (Switzerland) (140 articles), and Land (125 articles), reflecting the prominence of these outlets in the field shows in Fig.1. The data were cleaned to ensure accuracy and relevance, removing duplicates and irrelevant entries, to provide a robust foundation for analysing publication trends, key contributors, and research hotspots.

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2014:2024
Sources (Journals, Books, etc)	461
Documents	2177
Annual Growth Rate %	16.98
Document Average Age	4.41

Average citations per doc	24.6
References	135717
DOCUMENT CONTENTS	
Keywords Plus (ID)	8169
Author's Keywords (DE)	6216
AUTHORS	
Authors	9252
Authors of single-authored docs	54
AUTHORS COLLABORATION	
Single-authored docs	57
Co-Authors per Doc	5.48
International co-authorships %	44.46
DOCUMENT TYPES	
article	2177

Figure 1: Main Information

3.2 Average Citation per year

The line graphic illustrates the annual average of citations from 2014 to 2024 as shown in Figure 2. The citation trend exhibited relative stability from 2014 to 2019, culminating in a high in 2020, indicating increased scholarly focus during that year. A steady trend is noted after 2020, with citations significantly decreasing until 2024. This decline may suggest diminishing academic interest, thematic saturation, or the rise of alternate study agendas. Although the topic gained prominence around 2020, the following decrease underscores the necessity for revitalized academic involvement or novel research trajectories.

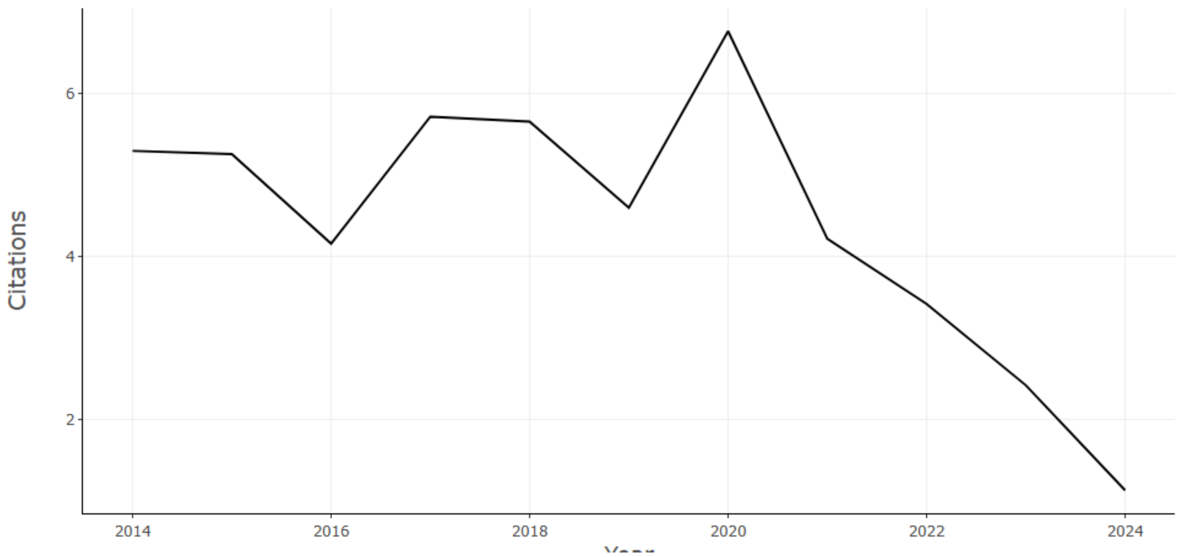

Figure 2: Average Citation per Year

3.3 Author Productivity and Lotka's Law

The Lotka plot confirms a highly skewed distribution of author productivity, adhering closely to Lotka's Law (Lotka, 1926). Fig. 3 indicates a steep left-hand segment indicates that the majority of authors contribute one or few publications, while a long, right tail highlights a small cohort of prolific authors accounting for a disproportionate share of output. Minor deviations at higher productivity levels likely stem from finite sample effects, author-name disambiguation challenges, and disciplinary variations in authorship practices. These findings reflect core–periphery dynamics driven by resource constraints, cumulative advantage (Merton, 1968), and stochastic publication processes.

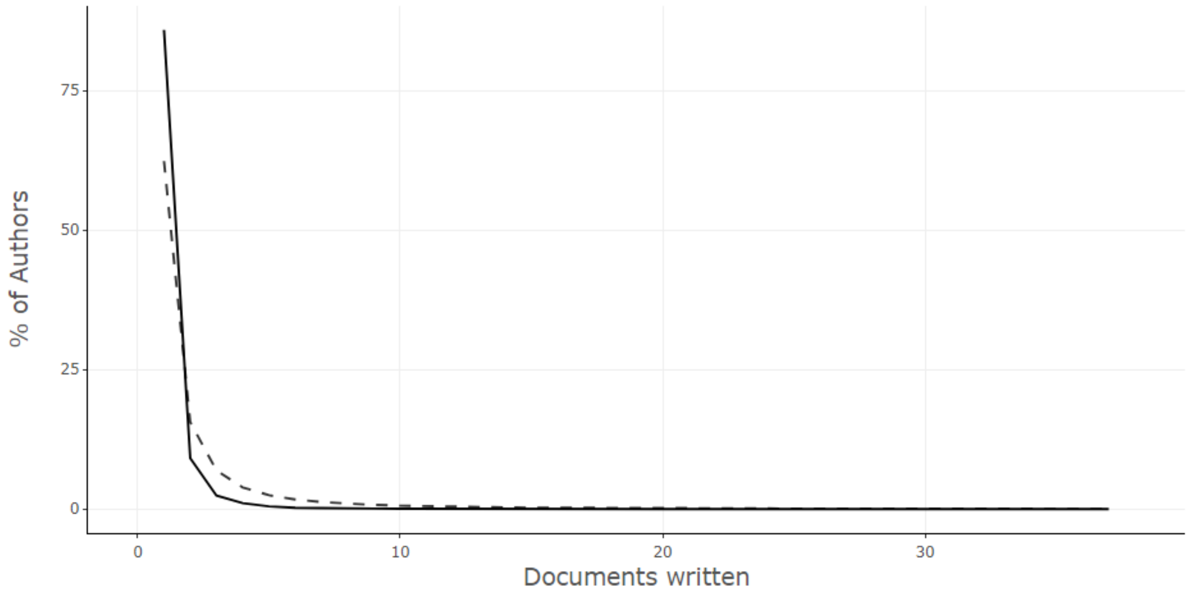

Figure 3: Author Productivity

3.4 Most Relevant Sources

The figure 4 depicts the leading authors ranked by the quantity of published documents. Zhang Y has 37 publications, followed by Li X with 31 and Wang X with 27, demonstrating their substantial academic influence in the discipline. A significant aggregation of contributions is evident among authors with prevalent Chinese surnames, indicating possible regional or institutional pre-eminence in the literature. This distribution emphasizes a central cohort of exceptionally prolific scholars propelling academic output in the field.

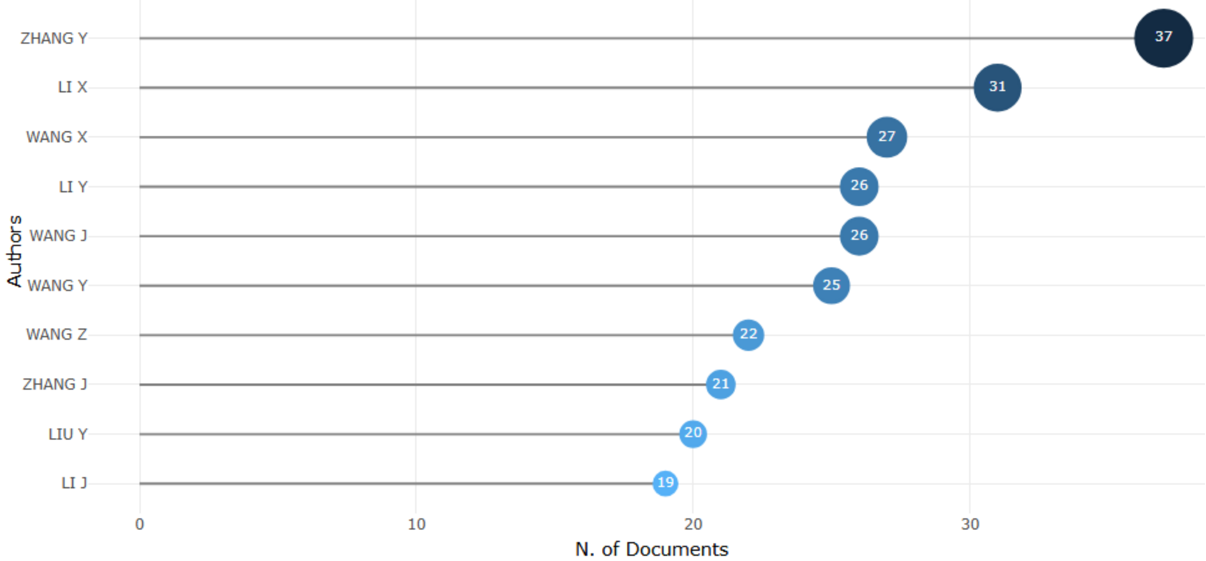

Figure 4: Most Relevant Sources

3.5Temporal Evolution of Research Themes

Figure 5 shows the temporal overlay graph (2014–2024) illustrates a dynamic thematic progression. Early research (2014–2016) emphasized *carbon budget*, *animal husbandry*, and *soil pollutants*, transitioning to *tropical forests*, *remote sensing*, and *environmental degradation* (2017–2019). Recent years (2020–2024) show intensified focus on *sustainable development goals (SDGs)*, *habitat quality*, and *land use*, as evidenced by larger bubbles indicating heightened publication activity. Declining prominence of terms like *emission inventory* suggests thematic saturation, while emerging keywords such as *salinity* signal new research frontiers, aligning with global sustainability priorities and advancements in geospatial methodologies.

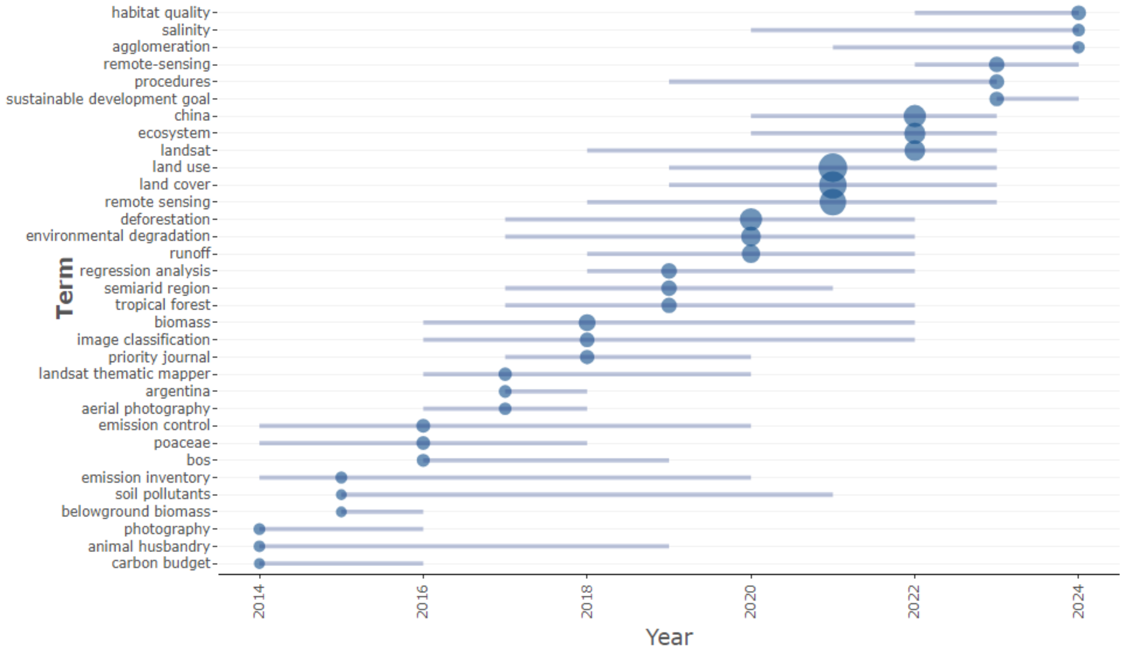

Figure 5: Temporal Evolution of Research Themes

3.6Thematic Structure and Strategic Positioning

The thematic map as shown in Figure 6, constructed using centrality (external relevance) and density (internal coherence), classifies themes into two quadrants. Niche themes (*land use*, *vegetation*, *biodiversity*) in the upper-left quadrant exhibit high density but low centrality, indicating well-developed, specialized research with limited cross-theme connectivity. Basic themes (*land cover*, *remote sensing*, *land use change*) in the lower-right quadrant are highly central but less mature, forming the field's foundational core. The absence of motor themes (high centrality and density) highlights opportunities for advancing thematic integration, particularly through innovative approaches like AI-enhanced remote sensing.

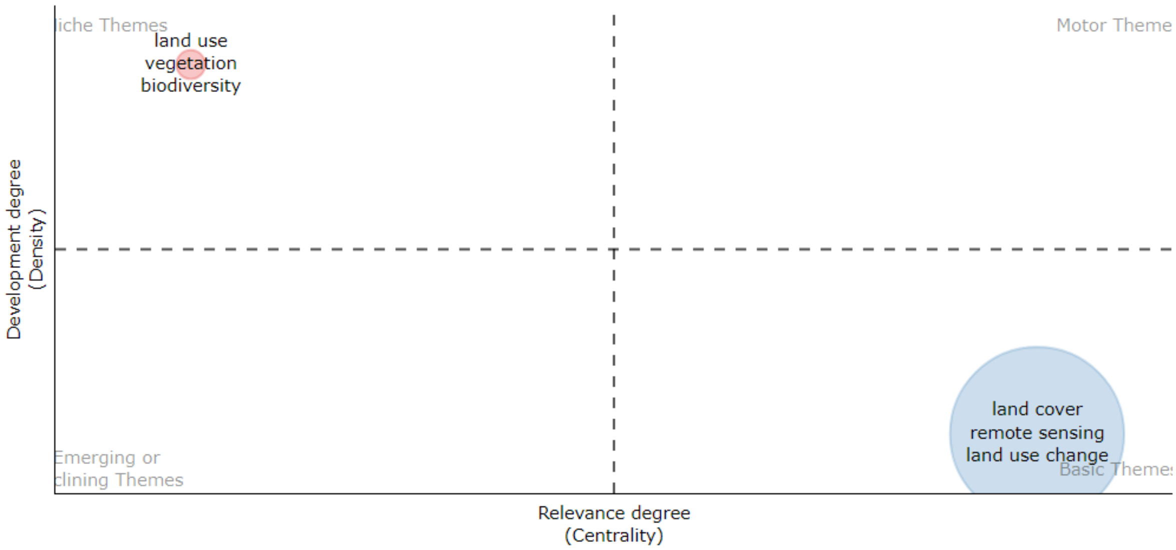

Figure 6: Thematic Evolution

3.7Author–Source–Keyword Interconnections

The three-field Sankey diagram shows in Figure 7 reveals robust linkages among authors, publication venues, and research themes. Prolific contributors (e.g., Li J, Zhang Y, Wang Z) predominantly publish in high-impact journals such as *Remote Sensing*, *Land*, and *Sustainability*, which serve as key conduits for land-system research. Dominant keywords (*remote sensing*, *land degradation*, *climate change*) underscore a focus on geospatial analysis and environmental change, supported by methodological tools like *NDVI* and *GIS*. While the diagram indicates strong thematic coherence, underrepresented areas such as ecosystem services and socio-economic drivers suggest avenues for future exploration.

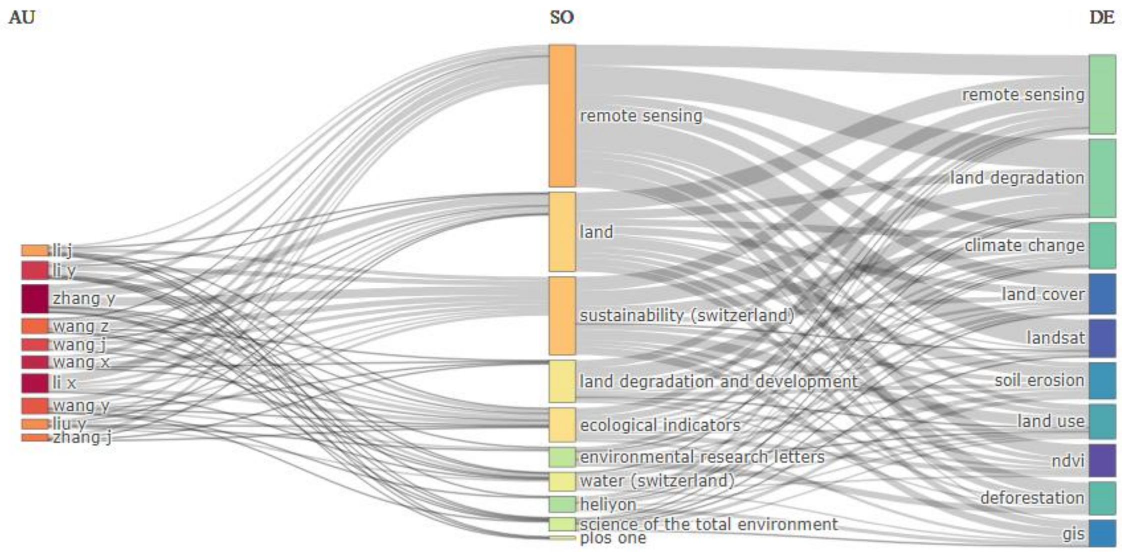

Figure 7: Thematic Map

3.8 Co-authorship Network Dynamics

The co-authorship network map as shows in Figure 8 reveals a structured yet partially fragmented collaboration landscape. The red cluster, centered around authors like Zhang Y and Li Y, forms a dense, likely regionally cohesive group focused on land use and remote sensing, possibly based in China. The green cluster (e.g., Hansen M.C., Lambin E.F.) represents a globally influential cohort in land cover mapping, while the blue cluster (e.g., Poesen J., Lal R.) emphasizes soil erosion and degradation. Smaller clusters (purple, yellow) address niche topics like permafrost ecology and ecosystem services. Bridging nodes (e.g., Verburg P.H.) facilitate interdisciplinary integration, but a secondary sparse network, featuring isolated dyads (e.g., Lal R., Ewunetu A.), indicates limited cross-institutional collaboration, suggestive of an emerging field.

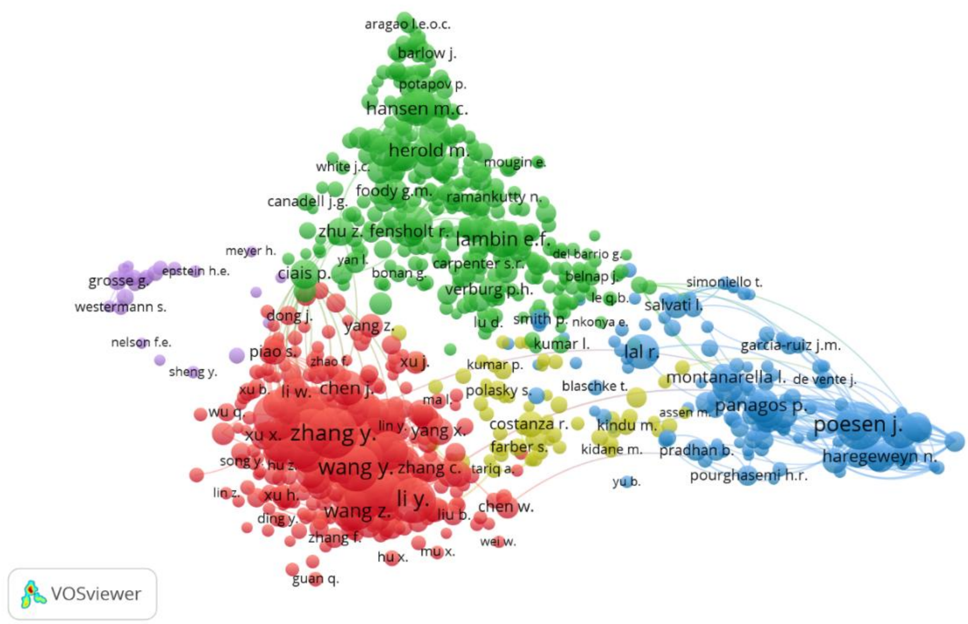

Figure 8: Co-authorship Network

3.7 Keyword Analysis

The keyword co-occurrence network as shown in Figure 9 delineates five thematic clusters: (1) environmental protection and human impact (red), focusing on forests and agricultural systems; (2) soil erosion and conservation (green), emphasizing hydrological modelling; (3) biodiversity and deforestation (blue), addressing ecosystem services; (4) remote sensing technologies (yellow), highlighting satellite-based methods; and (5) GIS and decision-making (purple), supporting environmental planning. Central nodes (*land use*, *remote sensing*, *land degradation*) serve as conceptual bridges, reflecting a mature, interdisciplinary field with strong methodological and policy relevance.

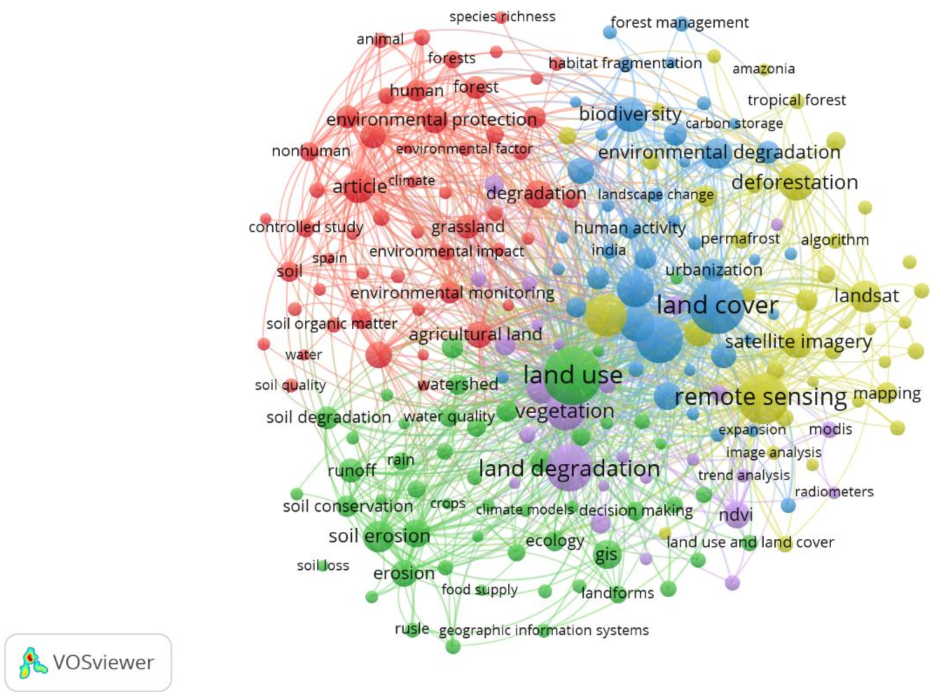

Figure 9: Keyword Analysis

3.9 Topic dendrogram

The dendrogram illustrates a hierarchical cluster analysis that is shown in Figure 10, demonstrating the grouping of elements (e.g., keywords, authors, or texts) based on similarity. The vertical height of the links signifies the distance or dissimilarity between clusters. Prominent clusters arise, indicating significant subgroupings within the data. The structure exhibits both closely-knit clusters and wider separations, illustrating the fundamental thematic or relational patterns within the dataset. This hierarchical structure facilitates the identification of principal research streams or conceptual affinities within the examined domain.

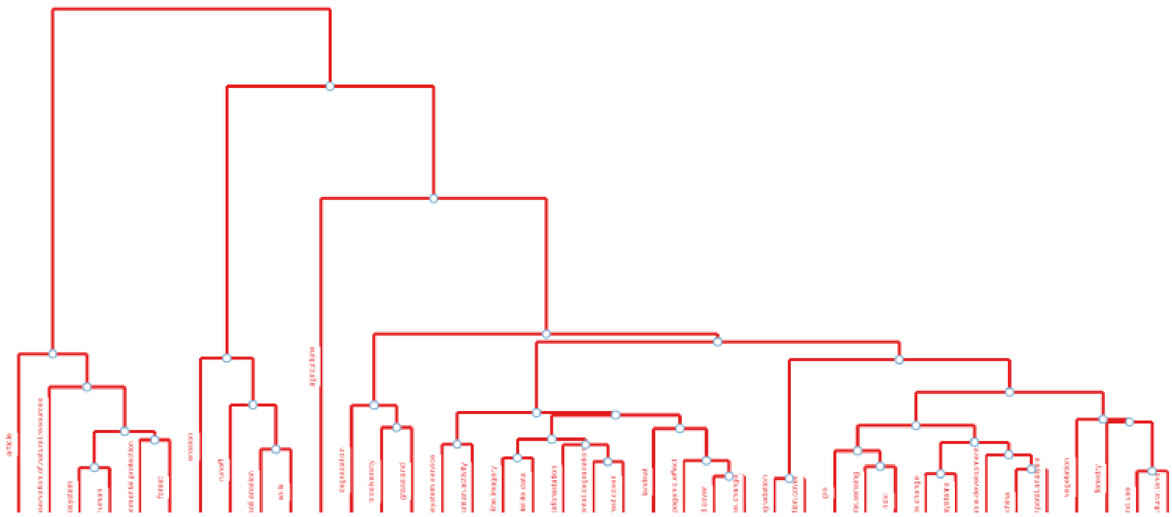

Figure 10: Topic Dendrogram

3.10 Authors Production over time

The line graph as shown in Figure 11 depicts the publication trends over time of five prominent academic institutions from 2014 to 2024. Beijing demonstrates the most significant development, especially post-2019, with approximately 150 articles by 2024. Beijing Normal University and the Northwest Institute of Eco-Environment and Resources exhibit persistent rising trends, particularly from 2021 onward. Conversely, Addis Ababa University and the University of Maryland exhibit more temperate expansion. The report highlights China's increasing academic supremacy in this research field, especially in environmental and land-related studies.

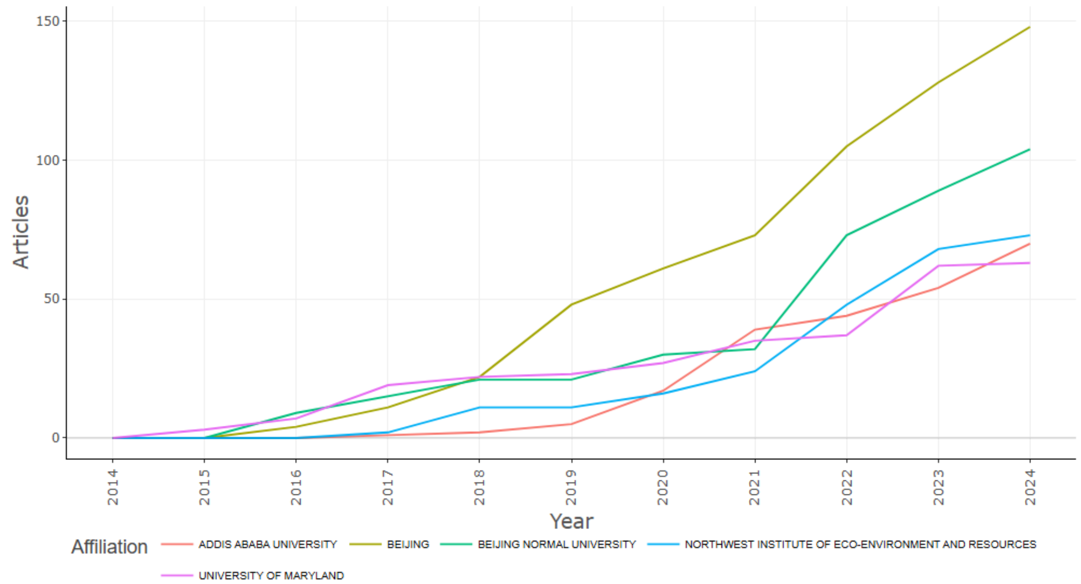

Figure 11: Author Production Over time

The analysis reveals a highly skewed productivity distribution, a dynamic shift toward sustainability and geospatial technologies, and a collaboration landscape with both cohesive and fragmented elements. Core themes like remote sensing and land use dominate, while niche areas such as biodiversity offer growth potential. These findings underscore opportunities for interdisciplinary synthesis, enhanced collaboration, and methodological innovation to advance the field’s theoretical and applied contributions.

IV. Conclusion and Discussion

This paper explains major trends, approaches, and interdisciplinary relations in the research on land use and environmental sustainability answering the research questions. The analysis of the structure confirms a very unequal structure of productivity, a switch toward sustainability and the involvement of geospatial technologies, as well as an environment of collaboration with both unified and diffuse aspects. The key topics (remote sensing, land use) prevail, and there is an opportunity to expand in the niche areas (biodiversity). These results highlight the adherence of the field to the worldwide sustainability efforts and its own dependence on the high-tier geospatial instruments which can give a guideline to develop theoretical or applied studies to the science of the environment. The research paper has a number of limitations. First, the use of the Scopus database can lead to coverage biases, i.e., the non-English publications, books, or conference proceedings may be under-represented. Second, the problem of author-name disambiguation can skew productivity and collaboration measures especially where the researchers have such generic names or are interdisciplinary. Third, the time frame (2014--2024) does not correspond to the long-term tendencies, and sample sizes are finite, which can influence the tail properties of the Lotka plot. Lastly, the productivity can be skewed by disciplinary differences in the practice of authorship, e.g., hyper-authorship in massive collaborations, and to eliminate this phase normalization is necessary for respective fields. In a bid to curb the observed limitations and to further contribute to the body of knowledge pertaining to land use dynamics and environmental sustainability, future researchers ought to broaden the scope of data by including databases such as Web of Science and Google scholar to increase the coverage of their data and also incorporate different types of publications. Through the use of author identifiers, including ORCID, disambiguation may be enhanced and productivity and collaboration measurements are accurate. Engagement of cross-cutting topics that have low representation including socio-economic drivers and ecosystem services will enhance interdisciplinary assimilation into social sciences and policy studies. Network fragmentation can be decreased by the promotion of cross-regional and cross-institutional partnerships via international consortia and conferences. Also, by incorporating the new technologies, machine learning and big data analytics, the accuracy of remote sensing applications will increase and enable predictive modelling of land degradation and sustainability. And, ultimately, at the temporal level, will be the increment in the temporal focus and the normalization of the productivity in terms of career duration which will not only reflect longer trends but counteract the temporal tendencies. Such undertakings will enhance the theoretical and practical inputs of the discipline, thus developing unique solutions to global environmental problems.

References

[1]. Aria, M., &Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11*(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

[2]. FAO. (2023). *Land statistics 2001–2023: Global, regional and country trends*. Food and Agriculture Organization of the United Nations. https://www.fao.org/statistics/highlights-archive/highlights-detail/land-statistics-2001-2023.-global--regional-and-country-trends/

[3]. Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., ... & Snyder, P. K. (2005). Global consequences of land use. *Science, 309*(5734), 570–574. https://doi.org/10.1126/science.1111772

[4]. Garfield, E. (1979). Citation indexing: Its theory and application in science, technology, and humanities. Wiley.

[5]. Gong, P., Li, X., & Zhang, W. (2020). 40-Year (1978–2018) human settlement changes in China reflected by impervious surface data from satellite imagery. *Science China Earth Sciences, 63*(1), 44–55. https://doi.org/10.1007/s11430-019-9460-6

[6]. Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., ... & Townshend, J. R. G. (2013). High-resolution global maps of 21st-century forest cover change. *Science, 342*(6160), 850–853. https://doi.org/10.1126/science.1244693

[7]. Lambin, E. F., &Meyfroidt, P. (2011). Global land use change, economic globalization, and the looming land scarcity. *Proceedings of the National Academy of Sciences, 108*(9), 3465–3472. https://doi.org/10.1073/pnas.1100480108

[8]. Lotka, A. J. (1926). The frequency distribution of scientific productivity. *Journal of the Washington Academy of Sciences, 16*(12), 317–323.

[9]. MEA. (2005). *Millennium Ecosystem Assessment: Ecosystems and human well-being: Synthesis*. Island Press.

[10]. Merton, R. K. (1968). The Matthew effect in science: The reward and communication systems of science are considered. *Science, 159*(3810), 56–63. https://doi.org/10.1126/science.159.3810.56

[11]. Newbold, T., Hudson, L. N., Hill, S. L., Contu, S., Lysenko, I., Senior, R. A., ... & Purvis, A. (2015). Global effects of land use on local terrestrial biodiversity. *Nature, 520*(7545), 45–50. https://doi.org/10.1038/nature14324

[12]. Pekel, J. F., Cottam, A., Gorelick, N., &Belward, A. S. (2016). High-resolution mapping of global surface water and its long-term changes. *Nature, 540*(7633), 418–422. https://doi.org/10.1038/nature20584

[13]. Pritchard, A. (1969). Statistical bibliography or bibliometrics? *Journal of Documentation, 25*(4), 348–349.

[14]. Ramankutty, N., Mehrabi, Z., Waha, K., Jarvis, L., Kremen, C., Herrero, M., &Rieseberg, L. H. (2018). Trends in global agricultural land use: Implications for environmental sustainability. *Annual Review of Environment and Resources, 43*, 789–815. https://doi.org/10.1146/annurev-environ-102017-030008

[15]. Seto, K. C., Güneralp, B., &Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences, 109*(40), 16083–16088. https://doi.org/10.1073/pnas.1211658109

[16]. Song, X. P., Hansen, M. C., Stehman, S. V., Potapov, P. V., Tyukavina, A., Vermote, E. F., & Townshend, J. R. (2018). Global land change from 1982 to 2016. *Nature, 560*(7720), 639–643. https://doi.org/10.1038/s41586-018-0411-9

[17]. Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... &Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science, 347*(6223), 1259855. https://doi.org/10.1126/science.1259855

[18]. Turner, B. L., Lambin, E. F., &Reenberg, A. (2007). The emergence of land change science for global environmental change and sustainability. *Proceedings of the National Academy of Sciences, 104*(52), 20666–20671. https://doi.org/10.1073/pnas.0704119104

[19]. United Nations. (2018). *World urbanization prospects: The 2018 revision*. United Nations Department of Economic and Social Affairs. https://population.un.org/wup/Publications/

[20]. Viana, C. M., Freire, D., Abrantes, P., Rocha, J., & Pereira, P. (2022). Agricultural land systems importance for supporting food security and sustainable land use: A bibliometric analysis. *Land, 11*(2), 245. https://doi.org/10.3390/land11020245

[21]. Waltman, L., van Eck, N. J., &Noyons, E. C. M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics, 4*(4), 629–635. https://doi.org/10.1016/j.joi.2010.07.002

[22]. Winkler, K., Fuchs, R., Rounsevell, M., & Herold, M. (2021). Global land use changes are four times greater than previously estimated. *Nature Communications, 12*(1), 2501. https://doi.org/10.1038/s41467-021-22702-2

[23]. Wulder, M. A., Loveland, T. R., Roy, D. P., Crawford, C. J., Masek, J. G., Woodcock, C. E., ... & Zhu, Z. (2019). Current status of Landsat program, science, and applications. *Remote Sensing of Environment, 225*, 127–147. https://doi.org/10.1016/j.rse.2019.02.015

[24]. Zhang, Y., Chen, Z., Zhu, B., Luo, X., Guan, Y., Guo, S., &Nie, Y. (2020). Land desertification monitoring and assessment using remote sensing and machine learning in China's Mu Us Desert. *Science of the Total Environment, 719*, 137493. https://doi.org/10.1016/j.scitotenv.2020.137493

[25]. Zhu, Z., Piao, S., Myneni, R. B., Huang, M., Zeng, Z., Canadell, J. G., ... & Zeng, N. (2016). Greening of the Earth and its drivers. *Nature Climate Change, 6*(8), 791–795. https://doi.org/10.1038/nclimate3004