# Biodiversity research in India: a bibliometric overview

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**Abstract:**

As one of the 'megadiverse' countries, biodiversity research in India is not only important, specifically for India, but also for the world. To investigate the condition of biodiversity in the Indian academic literature, bibliometric analysis was employed. The Web of Science Core Collection provided data (2000–2023). Out of a preliminary set of 1090 publications, 223 were finalised with a focus solely on the Indian context. The characteristics, clustering, networks, and trends within the field—published works, publishers, authors, journals, institutions, funding agencies, collaborations, and so on —were analysed and visualised using R and VOSviewer. Additionally, co-authorship, co-citation, co-occurrence, bibliographic coupling, etc., pertaining to Keyword Plus, authors, journals, organisations, etc., are the subject of the analysis. The three most relevant sources were '*Current Science*', '*Biodiversity and Conservation*', and '*Indian Journal of Animal Sciences*'. The best-performing affiliations were the Indian Council of Agricultural

Research (ICAR), Indian Institute of Science (IISc), Wildlife Institute of India (WII), and the National Remote Sensing Centre (NRSC). A significant portion of the research was focused on environmental science ecology (52.46%), Biodiversity Conservation (15.69%), Science Technology (15.24%), and agriculture (7.17%). Based on this study's findings, we propose six important policy recommendations. We anticipate that this study will provide policymakers with important information on the research needs of emerging nations such as India, as well as recommendations and insights.

**Keywords:** biodiversity; conservation; bibliometric; network analysis; India;

## Introduction:

Biodiversity is the exquisite fabric of life on Earth. It is an astounding diversity of bacteria, flora, and wildlife, as well as the complex ecosystems in which they live. Distinct genes found in each species and their interactions are included in biodiversity. If genes are the blueprints for life, then the variety in these blueprints enables species to adapt to and flourish in various situations. Genetic diversity, or a rich array of genes within a species, is like having a diverse toolbox that gives them the ability to adapt to change. The sheer quantity of species on Earth is known as the species diversity. Each species has distinct functions. Every organism plays a role in the smooth functioning of an ecosystem. The diversity of habitats on Earth is called ecosystem diversity. Each ecosystem is a complex web of interactions between living organisms and their environment.

The rates of species extinction and habitat destruction are unparalleled. Even in well-known habitats, new species continue to be discovered. Ecosystems are changing rapidly owing to pollution, changing land use, and climate change. A complex network of interactions is necessary for a healthy ecosystem, and even 'unseen' players play a crucial role. Research has enhanced our understanding of biodiversity, enabling us to make knowledgeable decisions for a sustainable future. It is an investment in the health of all life on Earth, including our own, and in the natural world. It provides fresh water and air, controls temperature, and yields an abundance of natural resources, food, and medicine. It is the foundation for a healthy planet, and its loss disrupts the delicate balance that sustains us. Only 17 of the approximately 190 countries on Earth are considered "megadiverse", meaning that they account for 70% of all biodiversity. One of these megadiverse nations, India occupies 2.4% of the planet's surface area and is home to 7-8% of all species, with 91,000 animal species and 45,500 plant species identified in its 10 biogeographic regions. Of these, 33% of Indian plants, 45.8% of reptiles, 45.8% of amphibians, 4.5% of birds, and 12.6% of mammals are endemic—found nowhere else in the world.

A bibliometric study provides guidance for future research areas, publication trends, collaboration opportunities, and ultimately, more successful protection of India's remarkable biodiversity. We can determine the facets of biodiversity that are given the greatest emphasis in India. Are scientists concentrating on certain taxa such as endangered mammals or particular ecosystems such as the Western Ghats? This can highlight gaps in knowledge, such as understudied species or uncharted territories. Future research initiatives to close important knowledge gaps in Indian biodiversity can be guided by these findings. How Indian biodiversity researchers collaborate may be seen in this analysis. Do they mostly operate in India or have close ties with other countries? This can help shape plans to improve collaboration and information sharing. Prominent Indian scholars and organisations at the forefront of biodiversity research can be identified. This enables policymakers to prioritise conservation efforts by recognising research patterns. This information may be essential for creating successful conservation plans and safeguarding the abundant biodiversity in India.

**Literature review:**

There are only a handful of bibliometric studies at the global, regional, and national levels. Liu et al. (2011) have composed first comprehensive bibliometric analysis of biodiversity research at global scale based on the Scientific Citation Index (SCI) bibliographic database, for a total of 75,860 publications. Liu et al. (2012) have completed a bibliometric study of 11,182 biodiversity research publications (1997-2009) using the Web of Knowledge (WoK) database from China. Arbeláez-Cortés (2013) have published a bibliometric analysis of 5,264 indexed publications (1990-2011) on biodiversity in Colombia from the WoK database. Stork and Astrin (2014) conducted a bibliometric analysis of 68,799 publications (1966–2014 Feb) from the Web of Science (WoS) database. Kim et al. (2016) have mapped the marine biodiversity research trends (2010-2015) in the China, Japan, and South Korea (i.e., the East Asian region) from WoS database. Ali and Kumari (2018) have presented a scientometric analysis of world biodiversity literature (1986-2016) with 1,54,654 publications from WoS database. Tydecks et al. (2018) analysed the systematic spatial biases in biodiversity-related research based on a comprehensive bibliometric analysis of 134,321 publications from the WoS database. Yan and Xue (2021) conducted a bibliometric analysis of biodiversity research in China (2009-2018) with 17035 papers from both WoS and China National Knowledge Internet (CNKI) databases. Abdullah et al. (2022) have studied the global biodiversity management research domain with 949 articles (1992-2022) from Scopus database. Blanco-Zaiteg et al. (2022) conducted a bibliometric analysis on biodiversity accounting and reporting using the Scopus and ProQuest database. Morales-Marroquín et al. (2022) analysed biodiversity research in Central America (viz. Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama), with 16,304 documents (1980-2020) from the WoS database. Mabele et al. (2023) studied biodiversity conservation knowledge (1972-2021) in Tanzania from 1354 peer-reviewed publications using the WoS database. Simion et al. (2023) conducted a bibliometric analysis of 'biodiversity' (2012-2022) using the ScienceDirect database. Tan et al. (2023) analysed global research trends in biodiversity loss (1990-2021) using 6599 publications from the WoS Core Collection database. Thus, bibliometric analyses have clearly shifted from global to regional (for example, Central America) to country scale (for example, China, Tanzania). However, a megadiverse country like India does not have any exclusively focused bibliometric analysis on biodiversity (either conservation, management, trends, or loss), be it on a national or subnational scale. As a result, writing such a study over the last few decades (2000s to present) is both necessary and justified.

## Methodology:

To maximise access to literature on biodiversity research in India, we searched the Web of Science (WoS) Core Collection by “Topic-search (TS)”. To compose a comprehensive search string, we used three components joined by ‘AND’. The first component included terms related to the place of research (43 terms): India, Indian states, and union territories. The second component was the level of analysis (40 terms), that is the national or subnational scale. The third component included 12 terms related to biodiversity. The full search string is provided in the Supplementary File. The search duration was from 1 January 2000 to 31 December 2023, i.e., 23 years. The inclusion of these 23 years ensures the coverage of the UN's MDG and SDG. From the initial search, we obtained a preliminary set of 1090 publications. We cross-checked all of these via the Title and Abstract, ensuring their focus on biodiversity research in the Indian context. After refinement, 223 studies were obtained. We used the ‘bibliometrix’ package (Aria and Cuccurullo, 2017) in R (v.4.3.2) and VOSviewer software (v.1.6.20) (Van Eck and Waltman, 2010) for all bibliometric analyses performed in this study.

## Results:

***Overview:***

Biodiversity research is a moderately growing field (with an annual growth rate of 4.89%) (Fig 1a). The average citation rate of 18.46/document indicates reasonable visibility and impact of the research. A high number of authors (1086) relative to the number of documents (223), suggests a collaborative research culture. The low number of single-authored documents (17) and the high number of co-authors (5.4/document) confirmed this collaborative trend. Over one-third (34.98%) of the collaborations involved international co-authors, highlighting the increasing number of international research partnerships.

Articles were the dominant document type (196, >93%), showing research findings in peer-reviewed journals (Fig 1b). A relatively small number of review articles (13, 6%) suggested a potential gap in synthesising existing knowledge within Indian biodiversity research. The minimal number of book chapters (3%) and conference proceedings (3%) indicates less focus on disseminating research through these channels.

The top three publishers, '*Springer-Nature*', '*Elsevier*', and '*Wiley*', account for a significant portion (>50%) of the publications (Fig 1c). This suggests a preference for publishing in established, well-regarded international commercial journals with a wider readership. There is a notable presence of Indian publishers such as the Indian Academy of Sciences (IAS) and Indian Council Agricultural Research (ICAR). This indicates that Indian researchers publish in domestic journals along with international ones. The inclusion of Public Library Science (PLOS) publications suggests that some researchers opted for the open-access (OA) model, in which research is freely available online.

Indian government agencies such as the UGC, DST, and CSIR are the most prominent funders (Fig 1d), highlighting significant governmental support for this research field. The presence of agencies, such as DBT and ICAR, suggests targeted funding for specific areas. Funding from agencies such as the NSF of the USA, the Royal Society (UK), and the Austrian Science Fund (FWF) indicates international collaboration and external financial support for Indian biodiversity research. A few publications acknowledge funding from private foundations (e.g. Ford Foundation and Rufford Foundation) and NGOs (e.g. WCS). This indicates an emerging trend in philanthropic contributions to biodiversity research in India.

Over a third (33.6%) of the publications were Open Access (OA) (Fig 1e), indicating a growing trend towards making research findings publicly available. The majority of OA publications (60%, combining Gold and Gold-Hybrid) suggest that researchers are increasingly opting to publish in journals that provide immediate open access.

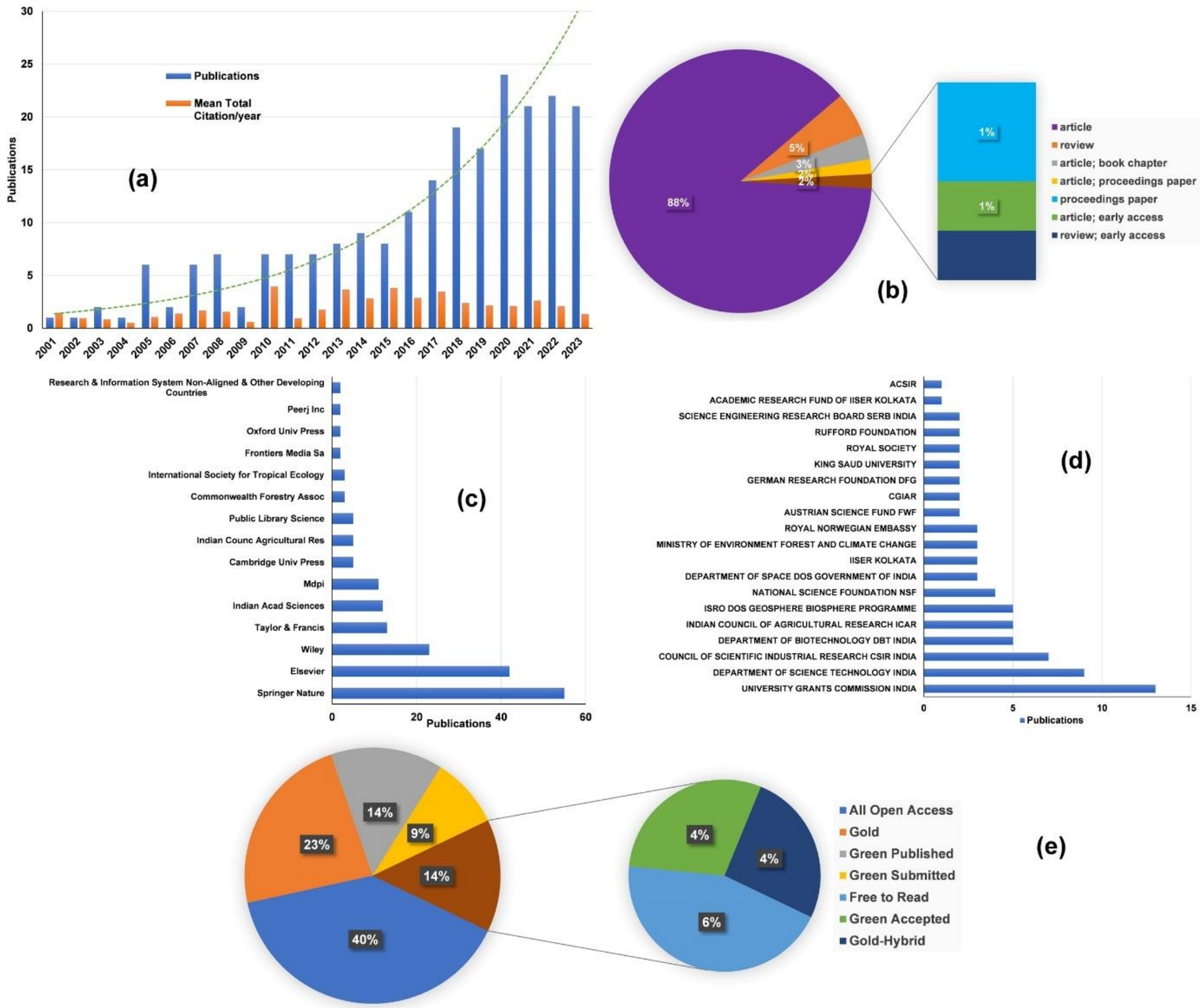


Figure 1. Characteristics of Biodiversity research on India. (a) year-wise articles publications, (b) types of published documents, (c) most relevant publishers, (d) most relevant funding agencies, and (e) categories of open access publishing.

***Analysis of authors:***

A small number of authors (e.g. Roy PS, Behera MD, Reddy CS) have published a significant number of papers, indicating their prominent contribution to the field in India. The long tail of authors with only 1-2 publications each, suggests a large pool of researchers actively contributing to biodiversity research. This is a positive sign for the vibrant research community. A small number of authors (e.g. Jha, Behera, Dadhwal) have published a substantial number (5-6) of articles (Fig 2a). This finding suggests a concentration of research expertise among certain individuals. From the analysis of author productivity (via Lotka's law), a significant proportion (92.2%) of publications had a single author (Fig 2b). The proportion of authors with 2-5 publications was significantly lower, indicating a lesser degree of collaborative research compared with single-authored work. Some authors (e.g. Bhat, Dhyani Shalini, and Shankar) had higher fractionalisation values, suggesting a tendency towards collaborative research. Authors such as Dadhwal, Jha, Reddy, and Ravindranath have received a high number of local citations (LC), suggesting their significant contributions to biodiversity research recognised within India. The authors reported varying publication rates across the years (Fig 2c). For instance, Jha and Reddy have consistently published at least 1 article/year, while others like Arora R and Bhatt Indra D show bursts of publications in certain years. Some authors (e.g. Behera, Negi, Pathak, and Rawal) have experienced years with particularly high citation counts (e.g. 68 citations for Negi in 2018).

From the bibliographic coupling analysis of authors, a large proportion of the authors have h-indexes of 2-3, indicating that they are in the early stages of their careers (Fig 2d). A significant number of authors are women, which is a positive trend given that women have historically been under-represented in the field of science. This increase in representation suggests that biodiversity research is becoming increasingly inclusive and welcome. Many authors are based on institutions in India, suggesting a strong focus on local biodiversity issues. This regional focus is important to address the specific conservation challenges faced by India's diverse ecosystems. Several authors have co-authored publications with international researchers, suggesting that international collaboration is becoming increasingly important in biodiversity research. This collaboration is essential for sharing knowledge and resources, and addressing global conservation challenges.

From the co-authorship analysis of authors (Fig 2e), a small number of authors were highly collaborative. This trend suggests that a select group of researchers in India plays a pivotal role in shaping the direction of biodiversity research. Collaboration among authors from different institutions is prevalent. The prevalence of interinstitutional collaboration highlights the interdisciplinary nature of biodiversity research. International collaboration in biodiversity research is also increasing. Increasing international collaboration reflects the global nature of biodiversity.

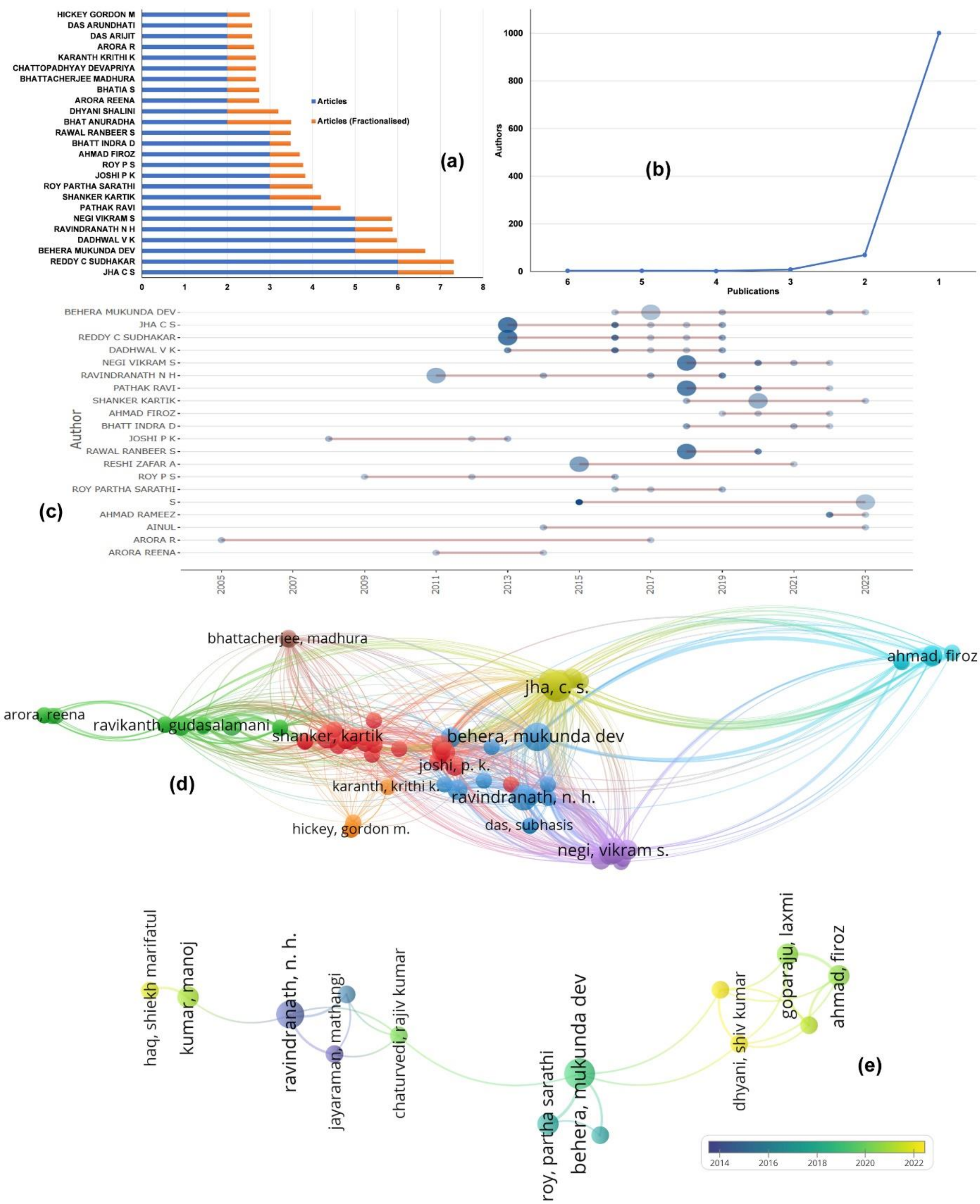

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Figure 2. Characteristics of Biodiversity research on India. (a) most relevant authors, (b) author productivity via Lotka’s law, (c) Authors' production with time, (d) bibliographic coupling of authors and (e) co-authorship of authors.

***Analysis of affiliations:***

Leading institutions include the ICAR and its affiliated institutes, IISc, and DOS organisations, such as ISRO (Fig 3a). This finding highlights the prominent role of government-funded institutions in biodiversity research in India. The prominence of NRSC, WII, and FRI indicates a strong focus on utilising remote sensing technologies and studying forest ecosystems. The presence of affiliations such as ETH Zurich (Switzerland), CIRAD, James Cook University (Australia), and University of Oxford (UK) suggests active international collaboration among Indian researchers. The inclusion of private institutions, such as Amity University and ATREE, points to the growing participation of non-governmental entities in biodiversity research. Affiliations, such as TERI University and CSIR, highlight the integration of science and technology disciplines in studying biodiversity. The Center for Ecological Sciences is the single most prominent department, highlighting the central role of ecological studies in Indian biodiversity research. The presence of departments like ‘Centre for Sustainable Technologies’ and IIT Kharagpur’s ‘Centre for Oceans Rivers Atmosphere and Land Sciences’ indicates an integration of various disciplines to study biodiversity. IIT Kharagpur's multiple departments (e.g. The Faculty of Engineering and Architecture and the School of Water Resources’) suggest the application of engineering and remote sensing technologies in biodiversity research. Departments such as the University of Oxford’s ‘Department of Zoology’ and the Kerala University of Fisheries and Ocean Studies Department of Fisheries Resource Management have focused on specific ecosystems (marine and fisheries).

A significant portion of the research comes from Indian institutions, including prominent names, such as IISc, WII, NRSC, FRI, and various universities. Institutions such as the NRSC and the IIRS hold prominent positions. The presence of international universities, such as Colorado State University, the University of Göttingen, James Cook University, and others, indicates a rise in collaborative research efforts between Indian and international institutions. Institutions such as the GB Pant National Institute of Himalayan Environment and Sustainability and the French Institute of Pondicherry suggest a focus on specific ecosystems, such as the Himalayas and coastal areas. Newer institutions, such as TERI University, Amity University, and Azim Premji University, which have contributed to research, signify a growing interest in biodiversity conservation among a wider range of academic institutions.

From the bibliographic coupling analysis of institutions (Fig 3b), many Indian institutions appeared together, suggesting a robust network of collaborations within the country. Examples include the Wildlife Institute of India, Indian Institute of Science (IISc), and TERI University with the University of Agricultural Sciences.

We see a steady increase in the number of articles published by some affiliations such as TERI University, Amity University, and BHU. This indicates a growing interest in biodiversity research among the new institutions. Prominent institutions such as the IISc, WII, and NRSC continue to publish a significant number of articles. Some institutions, such as Pondicherry University and the French Institute of Pondicherry, show a period of initial activity followed by a plateau. This could suggest a shift in research focus or resource allocation.

***<u>Analysis of publications</u>:***

This is dominated by publications in international peer-reviewed journals like *Conservation Biology*, *Global Change Biology*, *Remote Sensing*, and *Ecological Engineering*. The topics covered in these publications are wide-ranging, and include invasive species (Pyšek et al. 2017, Kannan et al. 2013), land use changes (DeFries et al. 2010), and ecosystem services (Roy et al. 2015; Bustamante et al. 2014), ecological modelling (Hardy et al., 2012), and conservation planning (Reddy et al. 2016, 2013). There is substantial variation in citation counts, with the highest being 304 (Pyšek et al. 2017) and several publications with <30 citations. This suggests a mix of highly influential and less cited works. Notably, several publications from the last five years (2018-2023) have had high citation rates (for example, Das et al. 2020; Srivastava et al. 2023). This indicates that the quality and impact of Indian biodiversity research is increasing.

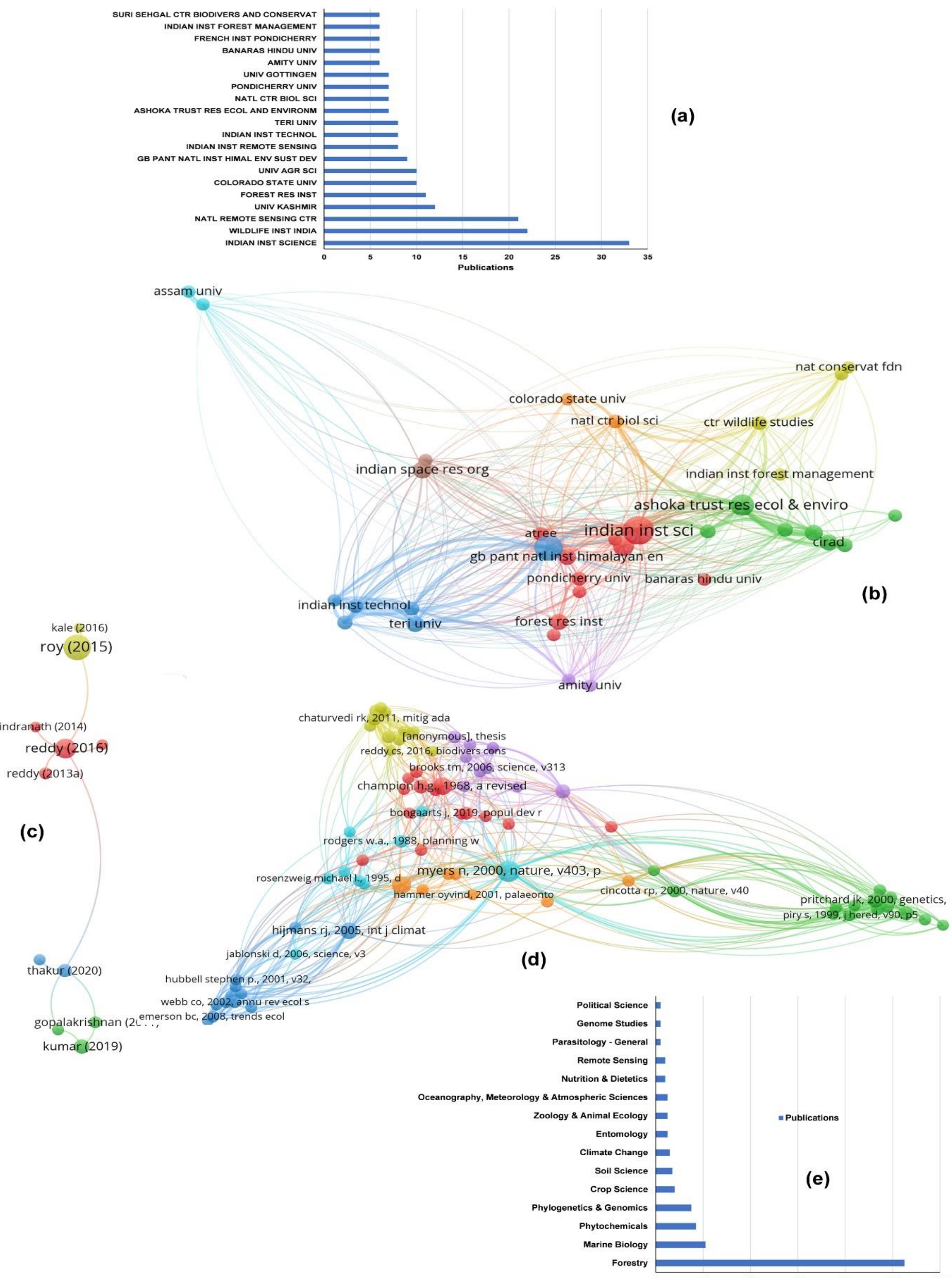
A significant proportion (60%) of publications did not receive any citations within the Indian research community (Fig 3c). Even highly cited publications globally (e.g. Reddy et al. 2016; Kumar et al. 2019) have relatively low local citations. This could indicate that Indian researchers prioritise publishing in international journals for wider recognition. There are a few exceptions, like Sharma et al. (2017) and Yadav et al. (2011), with a high local citations/global citation (LC/GC) ratio. This suggests that these publications had a significant influence within India. Publications from 2017 onwards seem to have a higher LC/GC ratio than earlier publications. This might be due to the increasing focus on research relevant to the Indian context. Several publications on LC are from Indian journals (e.g. *Current Science* and *Tropical Ecology*). This highlights the potential role of national journals in the dissemination of biodiversity research in India.

From the co-citation analysis of cited publications (Fig 3d), several publications appeared frequently, including Myers (2000) on biodiversity hotspots, Hijmans et al. (2005) on climate data, and Jha et al. (2000) on biodiversity in India. These highly cited works likely form the cornerstone of biodiversity research in the country. The use of references to population genetics (Peakall et al. 2006, Cornuet et al. 1996), and conservation biology (Piry et al. 1999, IUCN Red List Threat classification) highlights their significance in understanding and managing biodiversity threats. Citations to Elith and Le Lay (2006) on MaxEnt for species distribution modelling and Xu et al. (2009) on climate change impacts suggest a focus on using these techniques for biodiversity conservation planning. Similarly, references to Joshi et al. (2006) on remote sensing applications in ecology indicate the integration of technology into biodiversity research. Co-citations of seminal works such as Whittaker's beta diversity (Champion 1968) demonstrate the foundation of modern Indian biodiversity research. More recent publications on ecosystem services valuation (Costanza et al. 1997) and human population dynamics (Bongaarts 2019) highlight the broadening scope of Indian biodiversity research, encompassing the socioeconomic aspects of conservation.

***Analysis of citations*:**

The initial years of early fluctuations (2001-2010) show fluctuations in average citations, with some publications receiving high citations (e.g. 2005, 2010) and others receiving fewer citations. A gradual rise (2011-2018) in the average citation/article was observed. There seems to be a recent decline (2019-2023) in the average citations.

'Forestry' is the most prominent topic, with nearly half (47%) of the citations belonging to this category (Fig 3e). This highlights the significance of forest ecosystems and their management in India. 'Marine Biology' and 'Phytochemicals' (plant chemicals) are well-represented. Topics such as Phylogenetics & Genomics', 'Climate Change', and 'Remote Sensing suggest an increased focus on utilising advanced techniques and understanding the impact of climate change on biodiversity. The presence of 'Crop Science', 'Soil Science', and 'Nutrition & Dietetics' showcases the application of biodiversity research in agriculture and food security. Topics like ‘Entomology’, ‘Zoology & Animal Ecology’, and ‘Oceanography’ have a lower presence, suggesting a potential gap in research focus on certain faunal groups and marine environments. The inclusion of seemingly unrelated topics like ‘Political Science’ and ‘Social Psychology’ might indicate research on the social dimensions of biodiversity conservation or the human-wildlife interface. Prominence of ‘Deforestation’ as a topic highlights a major threat to Indian biodiversity. ‘Species Conservation’ and ‘Ecosystem Services’ indicate research efforts towards mitigating these threats. The dominance of ‘Maxent’ (species distribution modelling software) and ‘NDVI’ suggests reliance on ecological modelling and remote sensing for biodiversity assessments. The presence of ‘Microsatellites’ and ‘Mitochondrial Genome’ reveals the application of genetic techniques in biodiversity research, potentially for population genetics, species identification, and conservation forensics. ‘Seed Dispersal’, ‘Ethnobotany’, and ‘Terpenes’ (plant chemicals) showcase research on plant interactions with animals and traditional knowledge of plant uses. Topics like ‘Seagrass’, ‘Polychaeta’ (worms), ‘Formicidae’ (ants), ‘Lizards’, and ‘Rhodophyta’ (red algae) indicate research on specific taxa or ecosystems. The inclusion of ‘climate change adaptation’, ‘food insecurity’, ‘water governance’, and ‘urban agriculture’ reflects the exploration of links between biodiversity and broader environmental and social challenges. The presence of seemingly unrelated topics like ‘Influenza’ and ‘Malaria’ might indicate research on zoonotic diseases or the impact of biodiversity loss on disease emergence.



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Remote Sensing
Nutrition & Dietetics
Oceanography, Meteorology & Atmospheric Sciences
Zoology & Animal Ecology
Entomology
Climate Change
Soil Science
Crop Science
Phylogenetics & Genomics
Phytochemicals
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Figure 3. Characteristics of Biodiversity research on India. (a) most relevant affiliations, (b) bibliographic coupling of institutions, (c) most cited publications, (d) co-citation of cited publications, and (e) most cited topics.

Six clusters were identified in the authors' co-citation network (Fig 4a). Cluster 1 includes authors like Nei, Peakall, Singh S, and Arora. These authors are cited together, suggesting a potential focus on population genetics or evolutionary biology that is relevant to biodiversity. Cluster 2 (dominant) is the largest cluster, containing prominent researchers like Reddy, Roy, Singh RK, Ravindranath, Gadgil, and others. Keywords associated with some authors in this cluster (e.g. Reddy, ecosystem services; Roy, conservation biology) suggest a focus on conservation biology, ecosystem services valuation, and sustainable development in the Indian context. The presence of authors like Gadgil, championing community-based conservation, highlights a potential sub-theme within this cluster. Cluster 3 included Myers, Steffan-Dewenter, Karanth, Daniels, and Ostrom. The presence of Ostrom (known for work on common-pool resources) and Daniels (wildlife conservation) suggests a focus on human-wildlife interactions, governance, and community-based conservation approaches. Cluster 4 includes Maikhuri, Negi, Chaturvedi, Pandey, Sharma, and Kumar. The focus on researchers from the Indian Himalayas (e.g. Maikhuri, Negi) suggested a potential link to biodiversity research in this region. Cluster 5 included Webb, Ramesh, Hijmans, Kraft, Legendre, Davidar, Pascal, Colwell, and Phillips. The presence of researchers like Hijmans (spatial analysis) and Colwell (SDM), suggests a focus on applying spatial analysis tools and ecological niche modelling in biodiversity research. Cluster 6 contained Dhar (medicinal plants), Kala (ethnobotany), and Samant.

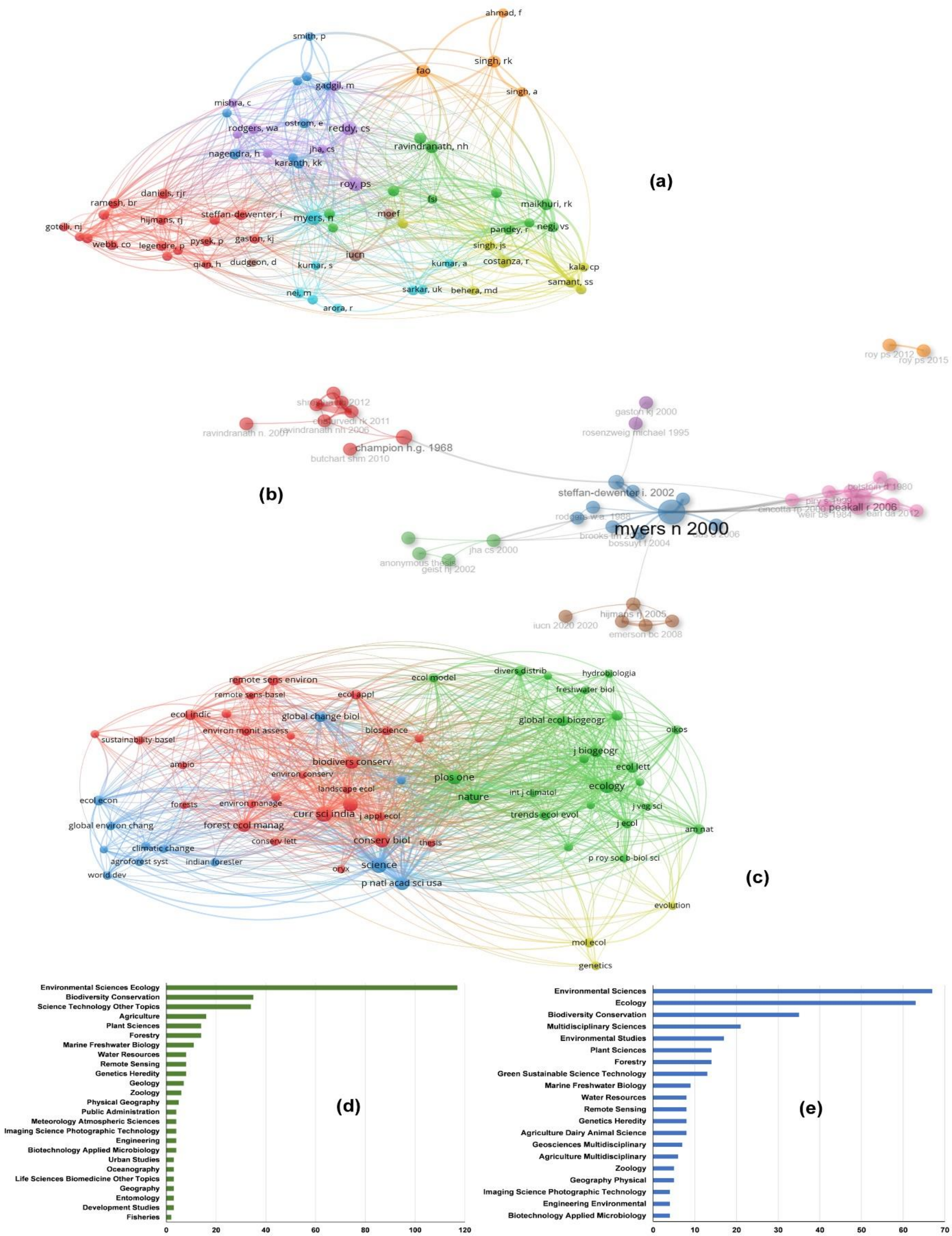
Seven clusters were identified in the co-citation network of publications (Fig 4b). Cluster 1 includes publications by Champion (1968), a pioneer in Indian forestry, and recent works (2006-2015) by Ravindranath, Chaturvedi, Sharma, Shrestha, and Upgupta. The presence of Champion suggests a link to historical forestry research, whereas keywords associated with some recent works (for example, Ravindranath, ecosystem services) indicate a focus on sustainable forest management and its ecological benefits. Cluster 2 features publications by Myers (2000), a prominent conservation biologist, along with studies on gap analysis, species distribution modelling (Oksanen, 2015), and community ecology (Menon, 1997). The focus on Myers and SDM suggests a theme for biodiversity conservation planning and identifying areas of importance. Cluster 3 includes publications by Jha (2000), Geist (2002), and Steffan-Dewenter (2002). The presence of Jha (known for work on human-wildlife interactions) and Geist (land-use change) suggests a potential theme around the impact of land-use change on biodiversity and human-wildlife interactions. Cluster 4 features publications by Gaston (2000) on biodiversity patterns and Rosenzweig (1995) on climate change effects. Considering the globally cited studies on biodiversity patterns and climate change, this cluster likely represents research on how these factors influence biodiversity in India. Cluster 5 contained two publications by Roy (2012, 2015). Cluster 6 featured publications on conservation planning (Emerson, 2008), spatial analysis (Hijmans, 2005), and population genetics (Nei, 1973; Peakall, 2006). This cluster likely represents the application of spatial analysis tools, genetic markers, and ecological niche modelling for biodiversity conservation planning in India. Cluster 7 features publications on population genetics (Nei, 1973; Peakall, 2006), alongside other studies on genetic diversity analysis techniques. This cluster highlights the use of population genetics tools to understand genetic diversity within Indian species and populations.

Four clusters were identified in the co-citation network of journals (Fig 4c). Cluster 1 (dominant) features high-impact general science journals like *Science*, *Nature*, *PNAS*, and *PLOS One* alongside prominent biodiversity journals like *Biological Conservation* and *Conservation Biology*. Cluster 2 (Ecology and Biogeography) includes established ecology journals like *Ecology*, *Journal of Biogeography*, *Ecology Letters*, and *Global Ecology and Biogeography*. This cluster highlights the centrality of the ecological and biogeographical themes in Indian biodiversity research. Cluster 3 (Environmental Science and applications) features journals like *Forest Ecology and Management*, *Ecological Indicators*, *Global Change Biology*, and *Remote Sensing of Environment*. This cluster highlights the application of ecological principles and remote-sensing tools for biodiversity research in India. Cluster 4 (specialized journals) includes a diverse range of specialized journals like *Molecular Ecology*, *Genetics*, *Oecologia*, *Freshwater Biology*, and *Biotropica*. The presence of these journals indicates research on specific aspects of biodiversity, such as population genetics, conservation genetics, and the ecology of specific ecosystems (e.g. freshwater systems and tropics).

***Analysis of research areas:***

From the analysis of research areas, 'Environmental Sciences Ecology' was the clear leader, accounting for over half (52%) of the publications (Fig 4d). 'Biodiversity Conservation' itself forms a significant portion (16%) of the research, highlighting India's recognition of the importance of preserving its rich biodiversity. The presence of 'Science Technology Other Topics' (15%) suggests research that explores biodiversity through various scientific lenses beyond pure ecology or conservation. 'Agriculture, Forestry, and Plant Sciences' all have a notable presence. While 'Marine and Freshwater Biology' are present, the numbers are lower than those in terrestrial ecosystems. This may indicate a gap in the research on India's aquatic biodiversity. The inclusion of fields like ‘Remote Sensing’, ‘Genetics’, and ‘Water Resources’ suggests researchers are employing interdisciplinary approaches to study biodiversity.

Among the WoS categories, the high presence of categories such as ‘Environmental Sciences’, ‘Ecology’, and ‘Biodiversity Conservation reflects a strong foundation in the core disciplines relevant to biodiversity research (Fig 4e). Categories like ‘Multidisciplinary Sciences’, ‘Green Sustainable Science Technology’, and ‘Environmental Studies’ highlight the integration of biodiversity research with other fields. The presence of categories like ‘Marine Freshwater Biology’, ‘Forestry’, ‘Plant Sciences’, and ‘Zoology’ suggests research focus on specific ecosystems (forests, aquatic systems) and taxonomic groups (plants, animals). The inclusion of categories like ‘Remote Sensing’, ‘Water Resources’, and ‘Agriculture Dairy Animal Science’ indicates the application of these disciplines in understanding and managing biodiversity. Fewer categories from Social Sciences (e.g. ‘Law’, ‘Sociology’) suggest a potential gap in incorporating social dimensions of biodiversity conservation within research.



(a)
ahmad, f
smith, p
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nagendra, h
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roy, ps
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(b)
roy ps 2012
roy ps 2015
chaturvedi rk 2011
ravindranath n. 2007
ravindranath nh 2006
champion h.g. 1968
butchart shm 2010
gaston kj 2000
rosenzweig michael 1995
steffan-dewenter i. 2002
peakall r 2006
cincotta rp 2000
weir bs 1984
myers n 2000
bossuyt f 2004
jha cs 2000
geist hj 2002
hijmans rj 2005
iucn 2020 2020
emerson bc 2008
(c)
remote sens environ
ecol model
divers distrib
hydrobiologia
remote sens-basel
ecol appl
freshwater biol
ecol indic
global change biol
global ecol biogeogr
environ monit assess
bioscience
oikos
sustainability-basel
j biogeogr
biodivers conserv
ambio
environ conserv
ecol lett
plos one
landscape ecol
ecology
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oryx
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Environmental Sciences Ecology
Biodiversity Conservation
Science Technology Other Topics
Agriculture
Plant Sciences
Forestry
Marine Freshwater Biology
Water Resources
Remote Sensing
Genetics Heredity
Geology
Zoology
Physical Geography
Public Administration
Meteorology Atmospheric Sciences
Imaging Science Photographic Technology
Engineering
Biotechnology Applied Microbiology
Urban Studies
Oceanography
Life Sciences Biomedicine Other Topics
Geography
Entomology
Development Studies
Fisheries
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Environmental Sciences
Ecology
Biodiversity Conservation
Multidisciplinary Sciences
Environmental Studies
Plant Sciences
Forestry
Green Sustainable Science Technology
Marine Freshwater Biology
Water Resources
Remote Sensing
Genetics Heredity
Agriculture Dairy Animal Science
Geosciences Multidisciplinary
Agriculture Multidisciplinary
Zoology
Geography Physical
Imaging Science Photographic Technology
Engineering Environmental
Biotechnology Applied Microbiology
0 10 20 30 40 50 60 70

Figure 4. Characteristics of Biodiversity research on India. (a) co-citation of authors, (b) co-citation of publications, (c) co-citation of journals, (d) most relevant research areas, and (e) WoS categories.

***Analysis of Journals:***

Publications are spread across a wide range of journals, indicating a decentralised publishing landscape. This can be both a strength (providing diverse outlets for research) and a weakness (scattering research findings across numerous sources). Several well-respected international journals in ecology, conservation biology, and environmental science are featured (e.g. *Conservation Biology*, *Global Ecology and Biogeography*, *Journal of Applied Ecology*) (Fig 5a). A few prominent Indian journals like *Current Science* and *the Journal of the Indian Society of Remote Sensing*, appear frequently. This suggests a need to focus on disseminating research within the Indian scientific community. Some journals (e.g. *Biodiversity for Sustainable Development*, *Tropical Ecology*) hint at potential thematic strengths in Indian biodiversity research.

Most locally cited journals are dominated by prestigious international journals in ecology, conservation biology, environmental science, and broader scientific fields (e.g. *Science*, *Nature*, *PNAS*, *Global Change Biology*, *Ecology Letters*) (Fig 5b). Several prominent biodiversity journals like *Biological Conservation*, *Biodiversity and Conservation*, and *Oryx*, are well-represented. While *Current Science* appears to have a high number of citations, other local journals are absent.

Three zones were identified according to Bradford's law (Fig 5c). Zone 1 (core) consists of 11 journals that contribute nearly half (48%) of the publications in this dataset. Journals like *Current Science*, *Biodiversity and Conservation*, and *Ecological Indicators* suggest a focus on broad ecological themes and biodiversity specific topics. Only one Indian journal (*Current Science*) appeared in Zone 1. Zone 2 (essential readership) includes 39 journals, accounting for roughly a third (33%) of the publications. These journals are likely important for updating current research and covering a broader range of ecological and biodiversity-related themes. Journals like *Conservation Biology*, *Global Change Biology*, and *the Journal of Ecology* indicate a strong international influence in the field. Zone 3 (scattered literature) encompasses the remaining 97 journals, contributing to the remaining 19% of publications.

Regarding the local impacts of journals, a significant number of journals (>30) had h-index, g-index, and m-index values of 1-2. This suggests that a large proportion of these publications might have limited the impact of LC. Many journals with high citation counts (e.g. *Current Science*, *Biodiversity and Conservation*) started publishing relatively recently (around 2005). Journals like *Ecological Indicators* and *Land Use Policy* hint at a potential focus on applied ecology and human-environment interactions within the local research community.

There has been a significant increase in the number of publications since 2010 across most journals. This suggests a growing emphasis on research and scholarly communication in the field. *Current Science* maintains a steadier annual output, while journals like *PLOS One* show bursts of publications in certain years (2015). This might indicate a growing preference for open-access publishing in Indian biodiversity research. Established journals like *Current Science*, *Biodiversity and Conservation* maintain a steady publication output.

***Analysis of Countries:***

There has been a clear and significant rise in the publication output of India. The overall spread of collaborating countries (57) signifies a global focus on biodiversity (Fig 5d). The presence of countries such as the USA (66 publications), Germany (27), the UK (24), France (18), Switzerland (18), Canada (17), and Australia (14) highlights significant collaboration with developed nations. The inclusion of countries like Brazil (10), China (11), South Africa (7), Argentina (6), and Kenya (5) indicates a growing collaboration with other biodiversity-rich developing nations. This could be due to the shared challenges and opportunities in biodiversity conservation and the recognition of the value of South-South collaboration. Some countries like the Netherlands and Spain, showed an initial rise in publications, followed by a plateau. The substantial growth in the number of collaborating countries, from zero in 2001 to 28 in 2023, highlights a global focus on biodiversity research and international efforts to address this challenge. India's average citations per article (13.9) suggest a moderate impact compared with some developed collaborators (e.g. USA: 43.7, Germany: 33). This may indicate areas for improvement in the visibility and dissemination of research. The exceptionally high average citation rate for the Czech Republic (304) could be due to a specific and highly impactful joint research project. The presence of developed nations like the USA, UK, Germany, France, Australia, Belgium, Italy among the most cited countries highlights the potential benefits India derives from collaborating with these research powerhouses. While collaborations with developed nations like Switzerland and Canada appear frequently, their average citation rate is lower.

***Analysis of Keywords*:**

From the most frequent words of Keywords Plus, ‘biodiversity’ (49 occurrences), ‘conservation’ (36), ‘diversity’ (34), and ‘biodiversity conservation’ (11) remain prominent. ‘Patterns’ (24), ‘dynamics’ (14), ‘richness’ (9), ‘species diversity’ (9), and ‘beta diversity’ (7) highlight the focus on uncovering patterns and processes that shape biodiversity across various scales. ‘Evolution’ (8) suggests research on the evolutionary origins and diversification of Indian biota. ‘Climate change’ (16), ‘deforestation’ (10), and ‘impacts’ (9) emphasise a continued focus on understanding the threats posed by climate change and human activities. ‘Vegetation’ (17) and ‘forest’ (10) suggest a specific interest in the impacts on forest ecosystems. ‘Ecology’ (10), ‘communities’ (7), ‘assemblages’ (5), and ‘habitat’ (4) indicate research on ecological interactions within communities and the importance of habitat characteristics for biodiversity. ‘Land-use’ (7) and ‘management’ (17) highlight research on how land-use practices influence biodiversity and the development of effective management strategies. ‘Carbon’ (7) and ‘biomass’ (6) suggest studies on the role of biodiversity in carbon storage and ecosystem functioning. ‘Western-ghats’ (13), ‘India’ (7), and ‘Garhwal Himalaya’ (4) continue to show a focus on specific geographical regions. ‘National Park’ (7) and ‘protected areas’ (7) indicate research on protected areas as conservation tools. ‘Food’ (4) and ‘knowledge’ (5) hint at the links between biodiversity and food security, and the potential of traditional knowledge in conservation.

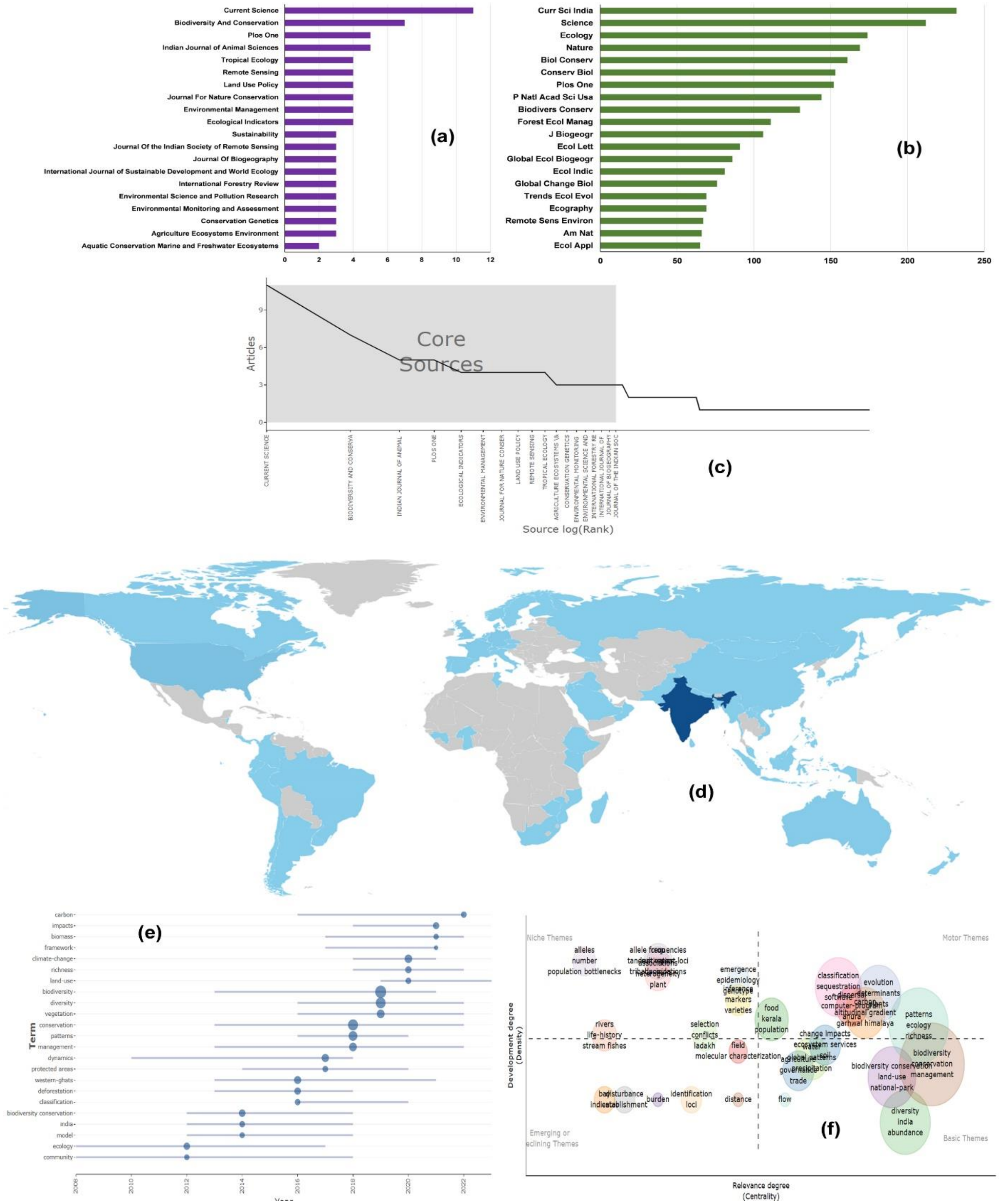
From the most frequent words of authors’ keywords, ‘conservation’ (26), ‘biodiversity conservation’ (4), and ‘protected areas’ (6) highlight the primary goal of conserving India's biodiversity. ‘Western ghats’ (9) and ‘Himalaya’ (7) indicate a focus on these critical biodiversity hotspots. ‘Climate change’ (16), ‘deforestation’ (6), and ‘fragmentation’ (5) highlight research on significant threats to Indian biodiversity. ‘Remote sensing’ (10) suggests the use of technology for monitoring these threats. ‘Restoration’ (5) and ‘sustainable development’ (4) indicate research on strategies to restore degraded ecosystems and achieve sustainable development alongside conservation. ‘Forest’ (7) and ‘forests’ (3) maintain their importance. ‘Ecosystem services’ (6) highlights the economic and societal value of biodiversity. ‘Environmental filtering’ (5), ‘species richness’ (4), ‘beta diversity’ (3), and ‘genetic diversity’ (3) suggest research on how environmental factors and human actions shape biodiversity patterns. ‘Traditional knowledge’ (4) underscores the potential of integrating indigenous knowledge into conservation efforts. Keywords like ‘soil organic carbon’ (4), ‘food security’ (4), and ‘agriculture’ (4) hint at research on the links between biodiversity, ecosystem functioning, and human well-being. ‘Access and benefit sharing’ (2) points towards research on equitable sharing of benefits arising from the use of genetic resources.

***Analysis of topics and themes*:**

From the trending topics of Keywords Plus (Fig 5e), ‘biodiversity conservation’ exhibits a sustained rise throughout the period, peaking in 2022 (36 occurrences). This finding confirms the enduring focus on conserving India's rich biodiversity. ‘Biodiversity’ itself shows a similar trend, peaking in 2021 (49). ‘Patterns’ shows a rise from 2016 onwards, peaking in 2020 (24). This suggests a growing interest in understanding spatial and temporal patterns of biodiversity. ‘Dynamics’ exhibits a similar trend, peaking in 2018 (14), indicating a focus on how biodiversity changes over time. ‘Ecology’ and ‘community’ show initial interest in 2008, with a later resurgence, suggesting a renewed focus on ecological processes shaping biodiversity patterns. ‘Deforestation’ exhibits a strong trend from 2013-2018 to (10), highlighting a period of heightened concern about deforestation as a major threat. ‘Climate change’ shows a later rise from 2018 onwards, peaking in 2021 (16), suggesting a growing focus on its potential impacts. ‘Conservation’ and ‘management’ show sustained growth throughout the period, peaking in 2022 (36 and 17). This emphasises the importance of developing effective conservation strategies. ‘Western Ghats’ maintains a strong presence throughout the period (13), indicating sustained research interest in this critical biodiversity hotspot. ‘Protected areas’ show a trend from 2014 to 2020 (7), suggesting growing interest in the role of protected areas in conservation. Emerging topics like ‘land-use’ (7), ‘impacts’ (9), ‘biomass’ (6), ‘carbon’ (7), and ‘framework’ (5) indicate research efforts on the ecological and societal impacts of biodiversity changes, the role of biodiversity in carbon sequestration, and the development of effective conservation frameworks.

From the trending topics of authors' keywords, 'fragmentation' showed an initial rise from 2008 to 2017 (5 occurrences), highlighting early concerns about habitat fragmentation as a threat to biodiversity. 'Deforestation' exhibits a later trend from 2013 to 2018 (6), suggesting a period of heightened focus on deforestation as a major driver of habitat loss. 'Conservation' shows a rise from 2013 to 2019 (26), highlighting a growing emphasis on developing effective conservation strategies. 'Remote sensing' exhibits a trend from 2012 to 2020 (10), indicating the growing adoption of technology for monitoring biodiversity threats like deforestation and habitat fragmentation. 'Forest' shows a trend from 2016 to 2020 (7), suggesting continued research interest in forest ecosystems, likely linked to deforestation concerns. 'Himalaya' exhibits a rise from 2016 to 2022 (7), indicating growing research focus on this critical biodiversity region alongside the Western Ghats. 'Climate change' shows a strong rise from 2016 to 2022 (16), highlighting a recent surge in research on its potential impacts on Indian biodiversity. New topics like 'indicators' (5), 'ecosystem services' (6), and 'restoration' (5) indicate emerging research on developing methods for monitoring biodiversity change, understanding the value of biodiversity for human well-being, and restoring degraded ecosystems.

From the thematic map of Keywords Plus (Fig 5f), biodiversity and conservation were the dominant themes, evident by the high frequency of keywords, such as biodiversity conservation', 'conservation biology', 'threats', 'management', and 'protected areas'. A significant focus lies on analysing patterns of biodiversity across India. This is reflected by keywords like 'diversity', 'patterns', 'species richness', 'distribution', 'habitat', and 'vegetation'. The impact of climate change on biodiversity is a growing concern, as indicated by keywords like 'climate change', ‘climate impact’, and ‘vulnerability’. The link between agriculture and biodiversity is another prominent theme, with keywords such as agriculture, agricultural governance, and ‘land-use change’. It also highlights research on specific aspects of biodiversity, including: dispersal patterns of species (e.g. ‘dispersal’, ‘phylogeography’), evolutionary processes shaping biodiversity (e.g. ‘evolution’, ‘selection’), and application of molecular tools for biodiversity assessment (e.g. ‘DNA’, ‘genetic markers’).



(a)
Current Science
Biodiversity And Conservation
Plos One
Indian Journal of Animal Sciences
Tropical Ecology
Remote Sensing
Land Use Policy
Journal For Nature Conservation
Environmental Management
Ecological Indicators
Sustainability
Journal Of the Indian Society of Remote Sensing
Journal Of Biogeography
International Journal of Sustainable Development and World Ecology
International Forestry Review
Environmental Science and Pollution Research
Environmental Monitoring and Assessment
Conservation Genetics
Agriculture Ecosystems Environment
Aquatic Conservation Marine and Freshwater Ecosystems
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(b)
Curr Sci India
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Plos One
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J Biogeogr
Ecol Lett
Global Ecol Biogeogr
Ecol Indic
Global Change Biol
Trends Ecol Evol
Ecography
Remote Sens Environ
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Ecol Appl
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land-use
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vegetation
conservation
patterns
management
dynamics
protected areas
western-ghats
deforestation
classification
biodiversity conservation
india
model
ecology
community
Term
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(f)
Niche Themes
Motor Themes
Emerging or Declining Themes
Basic Themes
Development degree (Density)
Relevance degree (Centrality)
alleles
number
population bottlenecks
rivers
life-history
stream fishes
selection
conflicts
ladakh
molecular characterization
food
kerala
population
classification
sequestration
evolution
patterns
ecology
richness
biodiversity conservation
land-use
national-park
diversity
india
abundance
distance
flow

Figure 5. Characteristics of Biodiversity research on India. (a) most relevant journals, (b) most locally cited journals, (c) distribution of journals as per Bradford's law, (d) scientific production of countries, (e) trending topics of Keywords Plus, and (f) thematic map of Keywords Plus.

From the thematic map of the authors' keywords, conservation biology was the dominant theme, evident from the high frequency of keywords such as conservation', 'conservation biology', 'threatened', 'protected areas', and 'species richness'. The cluster 'climate change' and the frequent occurrence of keywords such as 'climate change', 'climate impact', 'vulnerability', and 'adaptation' highlight a growing concern regarding the impact of climate change on Indian biodiversity. The 'India' cluster along with terms like 'Western Ghats', 'Himalayas', and 'Eastern Ghats' indicate a strong emphasis on understanding biodiversity patterns in specific Indian regions. Keywords like 'remote sensing', 'GIS', 'spatial scale', and 'fragmentation' suggest a significant focus on applying spatial tools and techniques to biodiversity research. The results suggest a strong focus on documenting biodiversity patterns ('diversity', 'species composition') and using this information for conservation efforts ('biodiversity conservation'). There is an interest in applying advanced tools like molecular markers ('genetic') to study genetic diversity and population connectivity.

***Analysis of collaborations:***

Six clusters were found in the collaboration network of countries (Fig 6a). Cluster 1 (dominant) features India along with developed nations like the USA, UK, Germany, France, and others (Italy, Switzerland, Canada, Australia). This cluster represents the core of international collaboration in biodiversity research in India. Cluster 2 (developing countries) includes Indonesia, Ghana, and some African nations (Burkina Faso, Guinea, Vanuatu). This cluster suggests a South-South collaboration on biodiversity research, potentially focusing on issues like tropical ecology, conservation in developing countries, and sustainable resource management. Cluster 3 (Europe and South Africa) features Spain, Portugal, South Africa, Russia, and Eastern European countries (Czech Republic, Belgium). Potential areas of focus include conservation biology, wildlife management, and ecological modelling. Cluster 4 (Latin America) includes Costa Rica, Colombia, Belize, Chile, Panama, and Ecuador, likely focusing on rainforest ecology, conservation in the tropics, and issues like climate change impacts on biodiversity. Cluster 5 (West Asia and Southeast Asia) features Pakistan, Korea, Singapore, and Georgia. Potential areas of focus include Central Asian biodiversity, conservation challenges in these regions, and sustainable development. Cluster 6 (Scandinavia and Japan) includes Denmark, Sweden, and Japan.

Seven clusters can be found in the collaboration network of the authors (Fig 6b). Cluster 1 is centered on Behra, Dhyani, and Gopuraju, with moderate betweenness and closeness values. Cluster 2 features Joshi PK, Roy PS, Chavan, Das, Joshi C, and Kale. The presence of Roy PS, known for conservation biology research, suggests a potential focus on conservation-related collaboration. Cluster 3 includes Ravindranath, Chaturvedi, and Jayaraman. The presence of Ravindranath (known for ecosystem services research) and Chaturvedi (a leading forest ecologist) suggest a focus on sustainable forest management and ecosystem services. Cluster 4 features Arora R. Cluster 5 included Bhattacharjee and Chattopadhyay. Cluster 6 features Jha, Reddy, Dadhwal, Diwakar, and Dutta. The presence of Jha (known for human-wildlife interactions) and Reddy (a conservation biologist) suggests a potential focus on human-wildlife conflict and conservation. Cluster 7 included Negi, Pathak, Bhatt, Rawal, and Dhyani. The presence of Negi (a Himalayan ecologist) suggests a focus on biodiversity research in the Indian Himalayas.

Six clusters were found in the collaboration network of institutions (Fig 6c). Cluster 1 features the ATREE, a leading Indian environmental research institution. ATREE's focus on ecological and environmental issues suggests that collaborations are likely to be centred around these areas. Cluster 2 (Wildlife and Conservation) features the NCBS, CWS, and James Cook University (Australia). Cluster 3 (IITs and International Collaboration) features the IISc and IITs alongside the Swiss Federal Institute of Technology and University of Oxford. Cluster 4 (Remote Sensing and Resource Management) features the NRSC, IIRS, IITs, TERI University, and the NIRS. Cluster 5 (Agricultural Sciences and Biodiversity) features agricultural universities in India and abroad (University of Göttingen) alongside the French Institute of Pondicherry and Suri Sehgal Centre for Biodiversity and Conservation. Cluster 6 features the WII as a central node with collaborations likely focused on wildlife biology, conservation management, and policy.

***Analysis of association with UN Sustainable Development Goals*:**

The vast majority of publications (>81%) associated with SDG 15 (Life on Land) emphasise the importance of biodiversity research to our knowledge of and ability to preserve terrestrial ecosystems (Fig 6d). A considerable percentage of publications (37%) included a link to SDG 13 (Climate Action), emphasising the established relationship between climate change and biodiversity loss. Other SDGs such as No Poverty (SDG 1), Zero Hunger (SDG 2), Good Health and Well-Being (SDG 3), and Sustainable Cities and Communities (SDG 11), are associated with fewer publications.

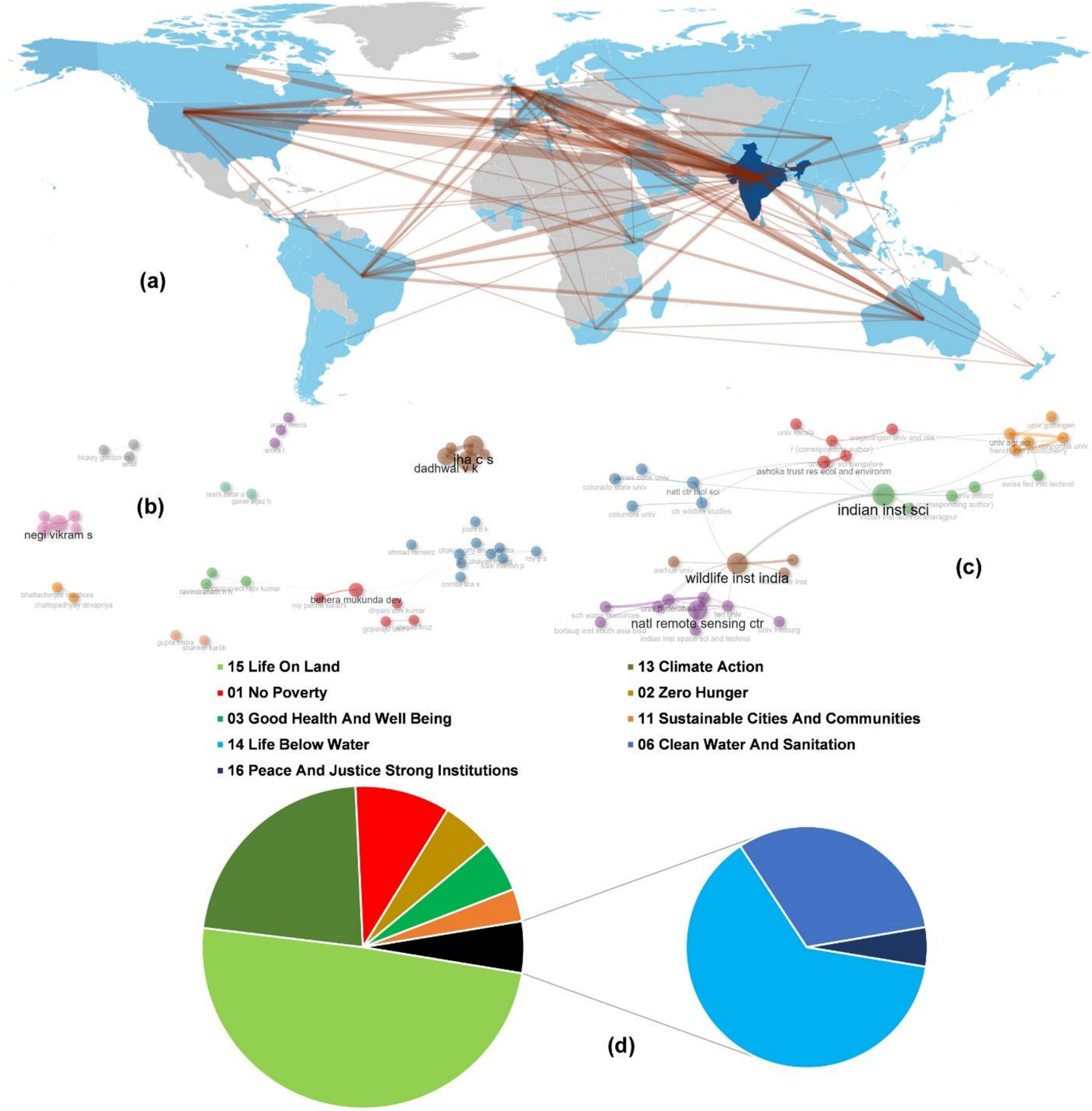


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Figure 6. Characteristics of Biodiversity research on India. (a) collaboration network of countries, (b) collaboration network of authors, (c) collaboration network of institutions, and (d) publications' association with UN-SDGs.

**Policy suggestions:**

Based on the outcomes from this analysis, we would like to convey a few suggestions to policymakers, which, we hope, would be helpful to make Indian biodiversity more prosperous.

1. *Foster targeted international collaborations and knowledge sharing*: Encourage and support international research collaborations for knowledge exchange and increased research visibility, particularly with industrialised countries with high citation rates such as the United States, the United Kingdom, and Germany. Encourage South-South cooperation to exchange best practices and tackle shared issues with other emerging nations with high biodiversity (such as China and Brazil). To better understand the social aspects of conservation, promote interdisciplinary research that combines the science of biodiversity with the social sciences (such as law and sociology).

2. *Prioritizing research focus*: To fill in any knowledge gaps, increase the amount of research focused on understudied habitats, such as freshwater and marine biodiversity. Promote studies on the effects of invasive species and other new concerns, such as climate change, on Indian biodiversity. Encourage studies on the use of biodiversity research for broader social benefit in agriculture, food security, and ecosystem services valuation.

3. *Enhancing research quality and dissemination*: Promote the publication of Indian research findings in high-impact, open-access journals to increase their prominence and accessibility. To develop a new generation of highly qualified biodiversity experts, research mentorship programs should be strengthened. Encourage the development of researchers' abilities to use cutting-edge instruments like ecological modelling, genetic methods, and remote sensing.

4. *Bridge research and policy through focused institutional collaborations*: Encourage closer ties between scientists studying biodiversity and decision makers to guarantee that studies influence practical conservation plans. Establish a systematic structure for joint research initiatives between think tanks focused on environmental policy, such as ATREE, and wildlife research institutes,

such as WII. Ultimately, this improves conservation results by facilitating the translation of scientific findings from organisations such as WII into workable policy recommendations through organisations such as ATREE. Invest to create frameworks for conservation grounded in science and monitoring procedures to ensure successful implementation. Encourage the incorporation of indigenous tribes' traditional ecological knowledge into conservation plans.

5. *Building a robust research infrastructure*: Through public-private partnerships and government grants, increase financing for biodiversity research. Make investments to upgrade state-of-the-art labs and field research facilities that are part of the research infrastructure of universities’ and research institutions’. Encourage the establishment of national repositories of biodiversity data so that scientists and decision makers can freely access this information.

6. *Leverage expertise for focused research in specific ecosystems*: Promote cooperation between organisations with experience in understudied ecosystems and existing research clusters. For instance, work with experts in forest ecology and marine research organisations to conduct studies on mangrove ecosystems, which are essential for the biodiversity of coastal areas. This makes use of the current knowledge to conduct targeted studies on important but little-studied ecosystems.

**Conclusion:**

This bibliometric analysis provides useful information regarding the current state of biodiversity research in India. Although this study included only 223 publications, the authors ensured that all of the selected studies were exclusively focused on India, whether on a national, regional, or local scale. The data revealed a thriving research climate, with an increasing number of publications. Collaboration networks have revealed a solid foundation for international collaborations with industrialised countries, particularly for knowledge transfer and increased research visibility. Furthermore, prospective South-South relationships with developing nations were identified, demonstrating the potential for knowledge exchange and solving common difficulties. Thematic analysis found a strong emphasis on conservation biology, notably in terms of human-wildlife interactions and sustainable forest management. However, research on understudied environments, such as marine and freshwater biodiversity, appears to be restricted. Examination of collaboration networks revealed possible research gaps. Significant clusters exist in specific areas, such as Himalayan ecology and forest management, and combining them with knowledge of understudied ecosystems could be advantageous.

This study design was subject to specific limitations. The datasets used in this study were sourced from the Web of Science (WoS) database, which is considered one of the most prominent global scientific databases. However, it is recommended that WoS be supplemented with other reputable international databases, such as Dimensions, Google Scholar, and Scopus. This limitation may contribute to the underrepresentation of lower-middle-class and lower-income nations such as India in this study. Some argue that non-mainstream journals should be given greater weight, because they play a role in disseminating new and potentially valuable knowledge (Vessuri et al., 2014; Chavarro et al., 2017). Although keywords in abstracts and titles may indicate the content of a published paper, they may not always accurately convey the substance of an article. The conclusions of the analysis may be misinterpreted because the authors' intentions and writings in the article are not always apparent in the title or abstract. To avoid this issue, we recommend that future studies conduct more comprehensive content analysis to determine the impact of important publications on the discipline.

India can strengthen its status as a biodiversity research leader by implementing policy recommendations and leveraging existing research strengths. This would not only improve academic contributions, but also contribute critical scientific knowledge for successful conservation measures, assuring the long-term preservation of India's diverse natural heritage.

**CRediT (Contributor Roles Taxonomy) roles:**

Conceptualization: AR; Data curation: AR; Formal analysis: AR; Funding acquisition: KP; Investigation: AR; Methodology: AR; Project administration: KP; Resources: AR; Software: AR; Supervision: KP; Validation: AR; Visualization: AR; Writing – original draft: AR; Writing – review and editing: AR, NG, KP;

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