



Exploring Open Access Trends in State Agricultural Universities of India: Insights from OpenAlex

Abhijit Roy^a, Akhandanand Shukla^b and Aditya Tripathi^c

^aSenior Research Fellow, Department of Library & Information Science, Central University of Tamil Nadu, Thiruvavur, Pin 610005, India. E-mail: royabhijit75@gmail.com

^bAssociate Professor, Department of Library & Information Science, Central University of Tamil Nadu, Thiruvavur, Pin 610005, India. E-mail: akhandanandshukla@cutn.ac.in

^cProfessor, Department of Library & Information Science, Banaras Hindu University, Varanasi, Pin 221005, India. E-mail: aditya.tripath@gmail.com

Received: 4 October 2024; Accepted: 17 December 2024

The study examines the Open Access (OA) landscape of Indian state agricultural universities, focusing on OA growth, leading institutions, prolific authors, preferred sources, funding, article processing charge (APC) usage, and trending topics. It aims to identify research gaps, guide future studies, and support policymakers in developing effective OA policies. The research utilized the OpenAlex database to collect global OA publications from Indian state agricultural universities over the past ten years (2014-2023). Using the Research Organization Registry ID (ROR ID), 97,536 publications were extracted. Data analysis was performed with OpenRefine, and ArcGIS 10.8 was used for visualization. The global OA research output from state agricultural universities amounted to 65,889 publications across five OA categories. Notably, 78.34% of OA publications were published in 864 domestic journals. Tamil Nadu Agricultural University produced the most publications in Gold OA, followed by Diamond OA, Hybrid OA, and Bronze OA, while Punjab Agricultural University excelled in Green OA and received the highest funding, incurring the most APCs. Collaborative research focusing on agricultural policies, rice water management, soil fertility, and crop productivity had a greater impact. This study is the first effort to evaluate the global OA research output of Indian state agricultural universities. The findings offer institutions, state governments, and funding agencies the opportunity to prioritize open-access publishing to promote sustainable agricultural research.

Keywords: Open Access, Open Access Publications, State Agriculture University, OpenAlex, OpenRefine.

1. Introduction and Review of Literature

Agriculture forms the foundation of India's civilization, culture, and heritage. About 60% of the population lives in rural areas and derives their livelihood from agriculture and allied sectors^{1,2}. After independence, various agricultural revolutions transformed India from a food importer to a food exporter, including the Round Revolution (potatoes), Green Revolution (rice and wheat), Grey Revolution (fertilizers and wool production), Pink Revolution (prawn and onion production), White Revolution (milk production), Blue Revolution (fish production), Red Revolution (meat and tomato production), Yellow Revolution (oilseed production), Brown Revolution (leather and cocoa production), Golden Fibre Revolution (jute production), Golden Revolution (fruits, honey, and horticulture), Silver Revolution (egg and poultry production), Silver Fibre Revolution (cotton), and the Evergreen Revolution (overall agricultural development³). However, challenges remain

for Indian agriculture, including the need to feed a large population, climate change, degradation of natural resources, and insect infestations.

The Indian Council of Agricultural Research (ICAR) is an autonomous organization under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India. Established on July 16, 1929, ICAR encompasses sixty-six research institutions, eleven Agricultural Technology Application Research Institutes, twelve Project Directorates, six National Bureaux, and fifteen National Research Centres. Additionally, three types of universities—three central universities, four deemed universities, and sixty-three state universities—collaborate within this system. This constitutes the largest agricultural education and research network in the world (<https://icar.org.in/about-us>).

Scientometric and bibliometric analyses measure the growth of scholarly publishing and its impacts on countries, institutions, and scholars within specific

subjects, fields, or domains. They also investigate scholarly communication trends and information-seeking behaviors. Balasubramanian and Ravanan (2011), Nayak and Bankapur (2017), and Sagar *et al.* (2013) examined the growth of global agricultural research across various databases in their studies⁴⁻⁶. They employed scientometric approaches to visualize productive countries, journals, publishers, research fields, and major keywords. Additionally, the research highlights the agricultural research performance of India, Bangladesh, Zambia, Nigeria, Pakistan, Tanzania, and Malaysia⁷⁻¹³. Furthermore, some bibliometric studies explore the scientific outputs, international collaborations, journals, authors, trending topics, and keywords associated with ICAR-affiliated institutions, universities, and research centers¹⁴⁻²³.

In the last two decades, advancements in the Internet and ICT applications have led to a major shift in scholarly communication. Scholars have increasingly submitted papers through open access (OA) routes, gaining advantages for scholarly impact²⁴. Five major OA routes are now prominent in scholarly communications. Green OA involves publishing a copy in an archive, personal website, or blog²⁵. Diamond OA refers to articles published in OA journals without author fees²⁶. Gold OA is published in OA journals that charge article processing fees^{27,28}. Hybrid OA refers to articles in closed-access journals that offer an OA option for a fee, charging authors article processing charges (APCs)²⁹. Finally, Bronze OA is freely available to readers on the publishers' websites without any licensing information³⁰. Other types of publications remain closed access.

OpenAlex is a global open-access scholarly catalog created by OurResearch, a non-profit organization³¹. It describes seven entities: works, authors, sources, institutions, topics, publishers, and funders. This extensive, open, and easy-to-access database enables scholars to analyze and access global research simply. It provides free REST API and data snapshot services³². This paper highlights the open-access academic outputs of Indian state agriculture universities, reflecting the Government of India's commitment to OA policies.

In 2009, the National Knowledge Commission recommended that all educational resources be made open. The Council of Scientific and Industrial Research (CSIR) initiated discussions in 2011 for implementing an open access policy across CSIR labs. That same year, the UGC and INFLIBNET Centre launched the Shodhganga repository for theses from Indian universities. The Indian Council of

Agricultural Research (ICAR) also adopted an OA policy and established institutional repositories, providing funding support for innovative research projects. Additionally, the Department of Biotechnology (DBT) and the Department of Science and Technology (DST) jointly offer funding for OA publishing. As a result, previous studies indicate that India is a responsible contributor to global OA publications³³. Nazim (2021) found that 23 percent of publications from Indian institutions are shared through OA routes³⁴. Authors are also focusing on the open access friendliness of Indian IITs, central universities, state universities, NITs, and non-profit organizations^{32,35-38}.

In light of the above circumstances, the present study examines the open-access academic outputs of Indian state agriculture universities. The data cleaning and analysis are conducted using the data carpentry tool OpenRefine, while ArcGIS 10.8 is employed to create maps of OA publishing. The research fulfills the following objectives:

- To assess the state of OA at Indian state agriculture universities over the last ten years (2014-2023)
- To identify the top productive sources
- To analyze collaborations among countries, institutions, and authors, as well as their scholarly impact
- To investigate funding received, article processing charges, and their correlation with scholarly impacts
- To identify the most frequently used keywords
- To explore OA publications related to specific domains and trending topics

This study addresses gaps in existing research by providing a comprehensive overview of the open-access publishing landscape at Indian state agriculture universities. Authors, institutions, and policymakers can review the current scenario and make informed decisions for future improvements. The remaining sections of the article are organized as follows: Section 2 discusses the research methodology using data carpentry approaches; Section 3 covers data analysis and interpretation; Section 4 presents the discussion and findings; and Section 5 concludes the study.

2. Methodology

2.1 Selection of Institutions

The investigations focus on the open access (OA) academic outputs of Indian state agriculture universities based on the OpenAlex database. A total of 63 state

agriculture universities are affiliated with ICAR (<https://icar.org.in/state-agricultural-universities>).

2.2 Data Collection and Cleaning

The research utilized the Research Organization Registry (ROR ID) for data collection through OpenAlex. ROR ID is a global community-led registry of open persistent identifiers for research organizations, making it easy to identify specific institutions and their scholarly outputs. Among the 63 universities, seven (Bihar Animal Sciences University, Patna; Junagadh Agricultural University, Junagadh; Haryana State University of Horticultural Sciences, Karnal; Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior; Agricultural University, Kota; Agricultural University, Jodhpur; and Banda University of Agricultural and Technology, Banda) are not listed in ROR. Consequently, OpenAlex does not include the scholarly outputs of these institutions, leading to their exclusion from the study.

For the remaining 56 universities, academic outputs from the last ten years (2014-2023) were filtered and downloaded in CSV format. The data cleaning and merging of datasets were performed using the data carpentry tool OpenRefine^{32,39}. A total of 97,881 records were downloaded from OpenAlex, of which 345 records were deemed irrelevant and excluded from the study. Figure 1 illustrates the details of the methodology in a flowchart.

During the data verification process, it was found that 67.55% (65,889 out of 97,536) of academic outputs were distributed across five OA routes: Green, Gold, Diamond, Hybrid, and Bronze. Additionally, 32.45% (n=31,647) were categorized

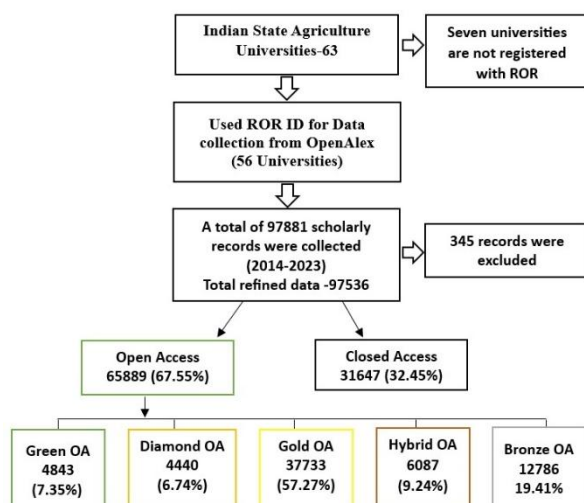


Fig. 1 — Flowchart of research workflow

as Closed Access. The following REST APIs were employed for analyzing authors, country collaborations, keywords, and journal details:

- https://api.openalex.org/works?page=1&filter=authorships.institutions.lineage:i12419238|i3131536999|i3130939756|i35839044|i2800696116|i20632288|i2800089517|i271267010|i34750443|i152185767|i3133099055|i24927338|i233492666|i377099284|i211055903|i205478545|i1306687154|i235110982|i199921877|i244504473|i61553790|i139046659|i102458738|i4210150675|i54021868|i221342038|i335685885|i4210156499|i290859477|i2799533726|i3130477807|i120386524|i167494164|i223781097|i13567498|i223471776|i899646|i253568910|i2801834944|i4210128267|i4210128752|i134900695|i82452031|i304343950|i3132430671|i4210098074|i4210092736|i252758333|i4210095517|i4210143625|i4210097692|i4210098184|i4210141180|i109963156|i75444546|i4210116187,publication_year:2014-2023,open_access.is_oa:true&apc_sum=false&cit_ed_by_count_sum=false
- "<https://api.openalex.org/sources/>" + value

2.3 Data Visualizations

After data analysis, the research utilized ArcGIS version 10.8 and MS Excel for data visualization.

3. Data Analysis

3.1 Growth of OA Publications

The experiments highlighted the growth of yearly OA publications, as shown in Figure 2. The numbers of OA publications and average citations were presented. Over the last ten years (2014-2023), a total of 65,889 OA academic research outputs were distributed by fifty-six state universities across five OA routes. Gold OA was the most productive, with 57.27% of records shared in this route, yielding an average citation per paper of 5.21. This was followed by Bronze OA (19.41%) with an average citation per paper of 3.7, Hybrid OA (9.24%) with 5.64, Green OA (7.35%) with 6.32, and Diamond OA (6.74%) with 4.93. Publication growth steadily increased from 2017, reaching a total of 11,535 during the study period. In 2023, there were 11,535 OA academic outputs, followed by 10,513 in 2020. The figure shows that in 2015, the highest average citations per paper (24.02) were attributed to Green OA academic outputs. Citations for Green OA and Gold OA documents outpaced those of the other three OA routes, likely due to the authors' shelf archiving

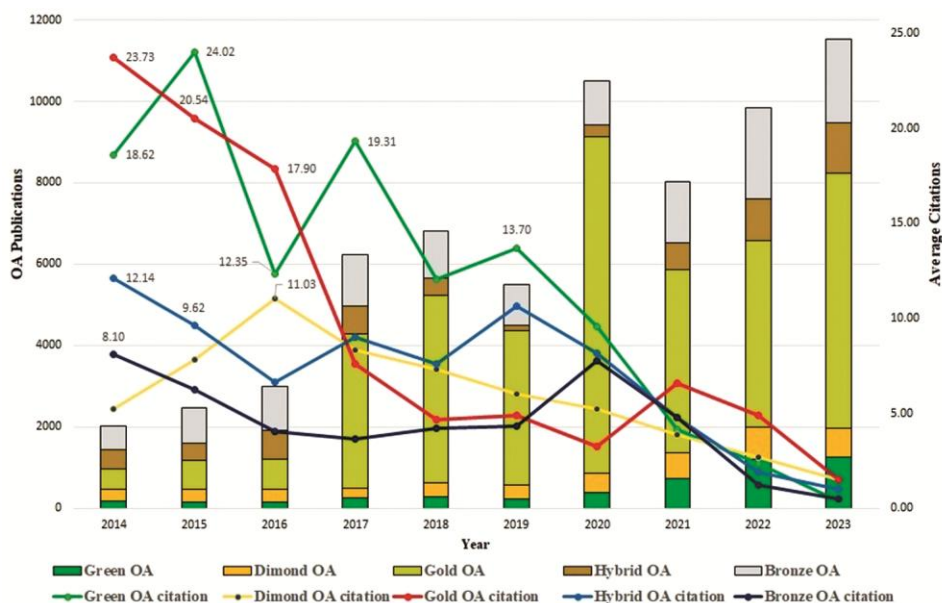


Fig. 2 — OA Publications Growth in 2014-2023

policy, which offers more citation advantages for Green OAs. Over the last ten years, only Green OA documents maintained an average citation per document above 11.65.

3.2 OA Status of State Agriculture Universities

Table 1 summarizes the OA outputs, OA types, and citation counts of the 56 State Agricultural Universities based on their OA publishing activities. It lists the names of 27 universities that have shared over a thousand OA outputs. Tamil Nadu Agricultural University is the highest-producing institution, having published 5,709 academic outputs (8.66% of the total OA), comprising 322 Green OA, 3,094 Gold OA, 383 Diamond OA, 802 Hybrid OA, and 1,108 Bronze OA, with a total of 22,392 citations (6.77% of total citations).

Punjab Agricultural University (OA: 3,478; TC: 31,127), Chaudhary Charan Singh Haryana Agricultural University (OA: 2,967; TC: 13,939), G.B. Pant University of Agriculture & Technology (OA: 2,938; TC: 31,116), and Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar (OA: 2,503; TC: 22,240) each published over two thousand OA documents and ranked among the top five.

In OA categories, Tamil Nadu Agricultural University produced the highest number of Gold OA outputs (3,094), followed by Bronze OA (1,108), Hybrid OA (802), and Diamond OA (383). The highest number of Green OA publications (361) and citations (31,127) came from Punjab Agricultural University. Additionally, U.P. Pt. Deen Dayal

Upadhyaya Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go Anusandhan Sansthan, Mathura, published 456 OA papers and received 12,408 citations, with an average citation per paper of 27.21.

The state agricultural universities with fewer than a thousand OA outputs have been categorized into eight groups of 100 OA publications each, except for the last group. Overall, the 56 state agricultural universities have received a total of 330,794 citations, with an average citation per paper of 5.02. Among these universities, the highest average citation per paper (10.59) was found for G.B. Pant University of Agriculture and Technology, while the lowest average citation per paper (1.88) was found for Vasant Naik Marathwada Krishi Vidyapeeth, Parbhani.

3.3 Growth of OA Publications at the State Level

Figure 3 highlights the yearly growth of OA publications at the state level. The color gradient from yellow to deep brown indicates low to high volumes of OA publishing across the states and union territory of India. The 56 State Agricultural Universities of India are distributed across 20 states and one union territory. During the study period, the highest number of OA publications came from Tamil Nadu (7,624, 11.57% of total OA publications), followed by Karnataka (6,229, 9.45%) and Punjab (4,853, 7.37%). States such as Rajasthan, Jammu and Kashmir, Haryana, Gujarat, and Maharashtra produced between 5.23% to 5.87% of OA documents, while 4.15% to 4.79% of OA documents originated from Uttar Pradesh, Uttarakhand, Kerala,

Table 1 — OA Status of State Agriculture Universities during 2014-2023

| Institution Name | No. of OAs | OA Types (%) | | | | | TC | ACP |
|---|------------|--------------|-------|---------|--------|--------|-------|-------|
| | | Green | Gold | Diamond | Hybrid | Bronze | | |
| 1. Tamil Nadu Agricultural University | 5709 | 5.64 | 54.20 | 6.71 | 14.05 | 19.41 | 22392 | 3.92 |
| 2. Punjab Agricultural University | 3478 | 10.38 | 39.76 | 9.75 | 16.65 | 23.46 | 31127 | 8.95 |
| 3. Chaudhary Charan Singh Haryana Agricultural University, Hisar | 2967 | 5.86 | 54.94 | 8.70 | 11.46 | 19.04 | 13939 | 4.70 |
| 4. G.B. Pant University of Agriculture & Technology | 2938 | 8.71 | 51.46 | 8.61 | 12.70 | 18.52 | 31116 | 10.59 |
| 5. Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar | 2503 | 10.67 | 57.89 | 6.63 | 8.79 | 16.02 | 22240 | 8.89 |
| 6. Assam Agricultural University | 1948 | 7.34 | 55.80 | 6.47 | 6.26 | 24.13 | 6714 | 3.45 |
| 7. Orissa University of Agricultural & Technology, Bhubaneswar | 1944 | 6.84 | 59.62 | 5.92 | 8.85 | 18.78 | 8785 | 4.52 |
| 8. Professor Jayashankar Telangana State Agricultural University, Hyderabad | 1755 | 3.42 | 71.85 | 3.30 | 4.56 | 16.87 | 4892 | 2.79 |
| 9. University of Agricultural Sciences, Dharwad | 1753 | 4.79 | 58.13 | 3.59 | 5.53 | 27.95 | 7407 | 4.23 |
| 10. Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur | 1673 | 3.65 | 68.32 | 4.06 | 5.98 | 17.99 | 4464 | 2.67 |
| 11. University of Agricultural Sciences, Bangalore | 1583 | 6.95 | 61.78 | 3.98 | 8.02 | 19.27 | 10284 | 6.50 |
| 12. Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur | 1572 | 7.89 | 52.74 | 5.22 | 14.19 | 19.97 | 10286 | 6.54 |
| 13. Maharana Pratap University of Agriculture & Technology, Udaipur | 1557 | 4.88 | 55.68 | 5.46 | 7.06 | 26.91 | 7585 | 4.87 |
| 14. Tamil Nadu Veterinary & Animal Sciences University, Chennai | 1544 | 10.30 | 57.45 | 8.74 | 8.61 | 14.90 | 8527 | 5.52 |
| 15. Acharya NG Ranga Agricultural University, Guntur | 1508 | 7.43 | 56.23 | 4.24 | 7.76 | 24.34 | 4169 | 2.76 |
| 16. Kerala Veterinary and Animal Sciences University, Pookode | 1466 | 10.16 | 55.87 | 6.82 | 9.00 | 18.14 | 6347 | 4.33 |
| 17. Anand Agricultural University, Anand | 1457 | 6.66 | 58.13 | 4.80 | 12.90 | 17.50 | 7583 | 5.20 |
| 18. Dr. Yaswant Singh Parmar University of Horticulture & Forestry, Solan | 1418 | 5.71 | 55.71 | 7.76 | 10.30 | 20.52 | 7201 | 5.08 |
| 19. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana | 1375 | 12.58 | 46.33 | 16.36 | 8.44 | 16.29 | 9607 | 6.99 |
| 20. Swami Keshwanand Rajasthan Agricultural University, Bikaner | 1291 | 3.41 | 57.47 | 7.75 | 6.43 | 24.94 | 3832 | 2.97 |
| 21. Kerala Agricultural University, Thrissur | 1241 | 9.35 | 56.00 | 7.09 | 8.54 | 19.02 | 4261 | 3.43 |
| 22. Sher-e-Kashmir University of Agricultural Science & Technology, Jammu | 1230 | 6.91 | 59.43 | 10.33 | 7.15 | 16.18 | 9776 | 7.95 |
| 23. Navsari Agricultural University, Navsari | 1188 | 3.37 | 57.74 | 6.14 | 10.77 | 21.97 | 3729 | 3.14 |
| 24. Indira Gandhi Krishi Viswa Vidyalaya, Raipur | 1141 | 2.72 | 72.13 | 2.89 | 5.43 | 16.83 | 3376 | 2.96 |
| 25. University of Agricultural Sciences, Raichur | 1131 | 5.13 | 70.03 | 1.95 | 9.20 | 13.70 | 3249 | 2.87 |
| 26. Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani | 1098 | 3.73 | 61.66 | 1.91 | 3.83 | 28.87 | 2067 | 1.88 |
| 27. Ch. Sarwan Kumar Himachal Pradesh Krishi Viswavidyalaya, Palampur | 1000 | 11.20 | 49.70 | 9.70 | 10.50 | 18.90 | 4459 | 4.46 |

Table 1 — OA Status of State Agriculture Universities during 2014-2023

| Institution Name | No. of OAs | OA Types (%) | | | | | TC | ACP |
|--|------------|--------------|-------|---------|--------|--------|--------|----------|
| | | Green | Gold | Diamond | Hybrid | Bronze | | |
| 3 institutions' publications 900-999 OAs | 2846 | 3.44 | 68.55 | 3.72 | 8.12 | 16.16 | 8120 | 2.85 |
| 2 institutions publications 800-899 OAs | 1714 | 0.04 | 64.70 | 5.13 | 5.02 | 20.95 | 4839 | 2.82 |
| 3 institutions publications 700-799 OAs | 2234 | 0.10 | 54.16 | 9.67 | 6.45 | 19.70 | 11493 | 5.14 |
| | | | | | | | | (Contd.) |
| 4 institutions publications 600-699 OAs | 2627 | 0.08 | 63.30 | 6.47 | 6.13 | 16.41 | 9085 | 3.46 |
| 4 institutions publications 500-599 OAs | 2252 | 0.07 | 61.63 | 6.57 | 6.75 | 17.94 | 7506 | 3.33 |
| 4 institutions publications 400-499 OAs | 1875 | 0.13 | 56.59 | 9.17 | 7.04 | 13.97 | 17895 | 9.54 |
| 7 institutions publications 300-399 OAs | 2520 | 0.14 | 48.93 | 7.94 | 10.44 | 18.65 | 9641 | 3.83 |
| 2 institutions publications 158-299 OAs | 353 | 0.05 | 66.86 | 4.53 | 6.52 | 17.56 | 2801 | 7.93 |
| Total of 56 Agriculture Universities OA Publications | 65889 | 7.35 | 57.27 | 6.74 | 9.24 | 19.41 | 330794 | 5.02 |

TC=Time Citation, ACP=Average Citations per Paper

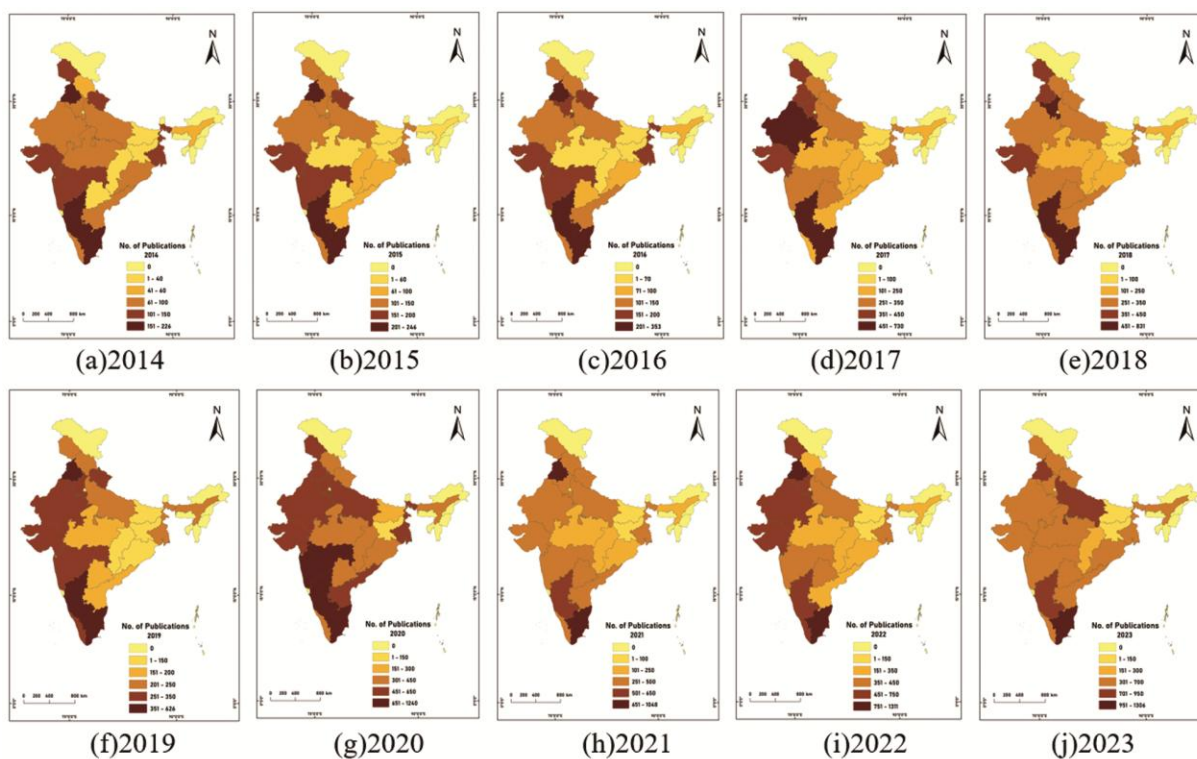


Fig. 3 — Growth of OA Publications at the State Level

West Bengal, and Andhra Pradesh. Similarly, 0.56% to 3.77% of OA documents appeared from states like Telangana, Himachal Pradesh, Madhya Pradesh, Assam, Odisha, Chhattisgarh, Bihar, and Jharkhand. Notably, the highest number of OA documents published in a single year was 226 from Punjab in 2014 (Figure 3a). In the years 2017, 2018, and 2019, Karnataka's State Agricultural Universities shared the highest OA document counts (730, 831, and 626, respectively) (Figures 3d, 3e, and 3f). In the remaining six years (2015, 2016, 2020, 2021, 2022,

and 2023), the highest OA publications were attributed to Tamil Nadu-based State Agricultural Universities (Figures 3c, 3g, 3h, 3i, and 3j).

3.4 Productive Sources

3.4.1 Domestic Sources

The 65,889 OA academic outputs were distributed across six primary source categories: Journal Articles (61,508, 93.35%), Articles in Repositories (4.55%), E-Books (0.34%), Book Series (0.13%), Conference Proceedings (0.09%), and Others (1.53%). Table 2 shows that among the 61,508 OA journal articles,

Table 2 — Domestic Sources / Journals from India

| Rank | Journal Name | OA Status | ACP | h-index | Q |
|------|--|-----------|-------|---------|----|
| 1 | International Journal of Current Microbiology and Applied Sciences | 13458 | 2.22 | 41 | NL |
| 2 | International Journal of Chemical Studies | 2675 | 0.76 | 25 | NL |
| 3 | International Journal of Environment and Climate Change | 2581 | 0.40 | 10 | NL |
| 4 | International Journal of Plant and Soil Science | 1929 | 0.47 | 20 | NL |
| 5 | Journal of Applied and Natural Science | 1426 | 3.19 | 29 | 4 |
| 6 | Indian Journal of Agricultural Sciences | 1139 | 1.57 | 30 | 4 |
| 7 | Indian Journal of Animal Sciences | 1115 | 1.30 | 23 | 3 |
| 8 | Current Journal of Applied Science and Technology | 1076 | 1.04 | 17 | NL |
| 9 | Asian Journal of Agricultural Extension, Economics and Sociology | 920 | 0.32 | 16 | NL |
| 10 | Indian Journal of Animal Research | 804 | 1.03 | 17 | 3 |
| 11 | Legume Research | 751 | 1.58 | 21 | 3 |
| 12 | Pharma Innovation | 703 | 0.63 | 10 | NL |
| 13 | Electronic Journal of Plant Breeding | 546 | 2.06 | 20 | 3 |
| 14 | Veterinary World | 546 | 13.61 | 57 | 2 |
| | 9 journals publishing 300-499 papers each | 3677 | | | |
| | 15 journals publishing 200-299 papers each | 3727 | | | |
| | 28 journals publishing 100-199 papers each | 4110 | | | |
| | 39 journals publishing 50-99 papers each | 2616 | | | |
| | 34 journals publishing 30-49 papers each | 1303 | | | |
| | 26 journals publishing 20-29 papers each | 620 | | | |
| | 71 journals publishing 10-19 papers each | 930 | | | |
| | 92 journals publishing 5-9 papers each | 594 | | | |
| | 47 journals publishing 4 papers each | 188 | | | |
| | 79 journals publishing 3 papers each | 237 | | | |
| | 103 journals publishing 2 papers each | 206 | | | |
| | 307 journals publishing 1 paper each | 307 | | | |
| | Total | 48184 | | | |

78.34% were published by 864 domestic journals. The top journals publishing more than 500 OA documents are highlighted in Table 2, which includes metrics such as average citations, h-index, and journal quartile. The highest number of OA documents (13,458) was published by the International Journal of Current Microbiology and Applied Sciences from Excellent Publisher. Among the top 14 journals, Veterinary World had the highest average citations per paper (13.61) and also received the highest h-index (57), and is placed in Quartile 2. Of the top 14 journals, 50% (n=7) are not listed in Scopus. However, among the seven Scopus-listed journals, two—namely the Journal of Applied and Natural Science and the Indian Journal of Agricultural Sciences—are in Quartile 4, four are in Quartile 3, and one is in Quartile 2.

3.4.2 Foreign Sources

Table 3 shows the names of the top fourteen foreign journals that published over a hundred articles each. Of the 61,508 OA journal articles, 21.66% (n=13,324) were published by 2,776 foreign journals from 83

countries. The top three countries are the United States (611 journals), the United Kingdom (451 journals), and the Netherlands (271 journals). Frontiers in Plant Science is the most productive journal for OA academic output from State Agricultural Universities in India, publishing 396 articles with an average citation per paper (ACP) of 29.32. Among the top fourteen journals, six are published in Switzerland, two in the United Kingdom, and six from other countries. The highest ACP (48.36) is found for the journal Frontiers in Microbiology, which is listed in Quartile 1. Of the top journals, nine are listed in Quartile 1, two in Quartile 2, one in Quartile 3, one in Quartile 4, and one is not listed in Scopus. The highest overall h-index (513) is found for the journal PLOS One, which is published in the USA.

3.5 Country Collaborations

Table 4 shows the names of the top twenty collaborative countries with OA colors, total citations, and average citations per paper. The State Agricultural Universities of India collaborated on OA papers with 159 countries. The highest number of OA

documents (2,080), comprising 256 Green, 110 Diamond, 1,107 Gold, 199 Hybrid, and 408 Bronze articles, was in collaboration with the USA, which received the highest number of citations (33,751).

This was followed by China (882), Saudi Arabia (753), the UK (637), Australia (558), and the Czech

Table 3 — Foreign Sources/ Journals with Foreign Origin

| Rank | Journal Name & Affiliated Country | OA Status | ACP | h-index | Q |
|------|---|-----------|-------|---------|----|
| 1 | Frontiers in Plant Science-Switzerland | 396 | 29.32 | 249 | 1 |
| 2 | Scientific Reports-United Kingdom | 337 | 24.93 | 362 | 1 |
| 3 | PLOS One-United States | 280 | 27.47 | 513 | 1 |
| 4 | 3 Biotech-Switzerland | 223 | 28.20 | 89 | 2 |
| 5 | Sustainability- Switzerland | 221 | 21.60 | 211 | 1 |
| 6 | Agronomy- Switzerland | 217 | 18.40 | 112 | 1 |
| 7 | Journal of Food Processing and Preservation- UK | 179 | 9.21 | 78 | 2 |
| 8 | Bangladesh Journal of Botany- Bangladesh | 176 | 2.96 | 24 | 4 |
| 9 | African Journal of Agricultural Research- Nigeria | 133 | 9.18 | 62 | NL |
| 10 | Frontiers in Microbiology- Switzerland | 132 | 48.36 | 272 | 1 |
| 11 | Plants- Switzerland | 125 | 14.33 | 111 | 1 |
| 12 | Egyptian Journal of Biological Pest Control-Egypt | 120 | 8.98 | 32 | 1 |
| 13 | Buffalo Bulletin- Thailand | 104 | 0.16 | 13 | 3 |
| 14 | Heliyon- Netherlands | 104 | 10.49 | 113 | 1 |
| | 17 journals publishing 50-99 papers each | 1087 | | | |
| | 34 journals publishing 30-49 papers each | 1255 | | | |
| | 176 journals publishing 10-29 papers each | 2927 | | | |
| | 261 journals publishing 5-9 papers each | 1693 | | | |
| | 134 journals publishing 4 papers each | 536 | | | |
| | 230 journals publishing 3 papers each | 690 | | | |
| | 479 journals publishing 2 papers each | 958 | | | |
| | 1431 journals publishing 1 paper each | 1431 | | | |
| | Total | 13324 | | | |

Table 4 — Collaborative Countries

| SL | Country Name | OA Status | | | | | Total OA | Time Citations | ACP |
|----|--------------|-----------|---------|------|--------|--------|----------|----------------|-------|
| | | Green | Diamond | Gold | Hybrid | Bronze | | | |
| 1 | USA | 256 | 110 | 1107 | 199 | 408 | 2080 | 33751 | 16.23 |
| 2 | China | 84 | 31 | 552 | 83 | 132 | 882 | 14437 | 16.37 |
| 3 | Saudi Arabia | 61 | 14 | 539 | 44 | 95 | 753 | 13436 | 17.84 |
| 4 | UK | 98 | 17 | 354 | 82 | 86 | 637 | 14519 | 22.79 |
| 5 | Australia | 80 | 12 | 309 | 104 | 53 | 558 | 16199 | 29.03 |
| 6 | Czech | 28 | 20 | 370 | 47 | 77 | 542 | 5593 | 10.32 |
| 7 | Russia | 21 | 11 | 331 | 39 | 70 | 472 | 5871 | 12.44 |
| 8 | Japan | 47 | 11 | 220 | 61 | 88 | 427 | 6781 | 15.88 |
| 9 | Egypt | 31 | 17 | 232 | 22 | 89 | 391 | 8345 | 21.34 |
| 10 | Poland | 12 | 9 | 242 | 41 | 45 | 349 | 4052 | 11.61 |
| 11 | Germany | 40 | 8 | 174 | 64 | 28 | 314 | 7359 | 23.44 |
| 12 | Korea | 24 | 14 | 175 | 49 | 42 | 304 | 9024 | 29.68 |
| 13 | Pakistan | 39 | 7 | 173 | 22 | 60 | 301 | 5897 | 19.59 |
| 14 | Italy | 46 | 10 | 118 | 46 | 77 | 297 | 3246 | 10.93 |
| 15 | Hungary | 7 | 20 | 212 | 11 | 27 | 277 | 2376 | 8.58 |
| 16 | Spain | 55 | 15 | 138 | 35 | 29 | 272 | 5073 | 18.65 |
| 17 | Bangladesh | 16 | 5 | 177 | 28 | 24 | 250 | 6313 | 25.25 |
| 18 | Canada | 36 | 7 | 134 | 26 | 38 | 241 | 4902 | 20.34 |
| 19 | France | 46 | 21 | 113 | 26 | 31 | 237 | 4606 | 19.43 |
| 20 | Sweden | 12 | 7 | 83 | 13 | 63 | 178 | 2802 | 15.74 |
| | Total | 1039 | 366 | 5753 | 1042 | 1562 | 9762 | 174582 | |



CSIR
भारत का नवाचार इंजन
The Innovation Engine of India

| Authors | Green | Diamond | Gold | Hybrid | Bronze | Total OA | Time Citations | ACP |
|-------------------|-------|---------|------|--------|--------|----------|----------------|-------|
| Kuldeep Dhama | 22 | 10 | 119 | 15 | 49 | 211 | 12018 | 55.9 |
| M. Raveendran | 15 | 25 | 93 | 13 | 12 | 158 | 1451 | 9.18 |
| Ruchi Tiwari | 12 | 5 | 76 | 12 | 34 | 139 | 10406 | 74.86 |
| Chaitanya G Joshi | 19 | 2 | 72 | 15 | 5 | 113 | 1438 | 12.73 |
| Y. S. Malik | 17 | 10 | 51 | 9 | 24 | 111 | 4934 | 44.45 |
| R. K. Varshney | 30 | 2 | 55 | 12 | 3 | 102 | 3620 | 35.49 |
| S. Hussain Wani | 17 | 1 | 59 | 5 | 13 | 95 | 3301 | 34.75 |
| V. Geethalakshmi | 4 | 10 | 56 | 15 | 7 | 92 | 145 | 1.58 |
| N. Senthil | 1 | 9 | 62 | 11 | 7 | 90 | 782 | 8.69 |
| Z. A. Dar | 4 | -- | 65 | 7 | 12 | 88 | 1139 | 12.94 |

Republic (542); these six countries collaborated with Indian researchers on over five hundred papers each. The USA leads in all OA types in terms of collaboration with State Agricultural Universities of India. The USA, China, Saudi Arabia, the UK, and Australia are the top five countries that have received more than 10,000 citations in collaborative papers. Among the top twenty countries, Korea (29.68) and Australia (29.03) have the highest average citations per paper, while Hungary has the lowest average citations per paper at 8.58. Out of the twenty countries, seven—namely the UK, Australia, Egypt, Germany, Korea, Bangladesh, and Canada—have received an average citations per paper over 20 in collaborative publications.

3.6 Prolific Authors

A total of 315,254 authors collaborated on 65,889 OA scholarly works. Table 5 presents the top ten productive authors in OA research from State Agricultural Universities of India, displaying OA types, citations, and average citations per paper (ACP). Kuldeep Dhama is the most productive author, affiliated with U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go Anusandhan Sansthan in Mathura, with 211 OA publications (Green 22, Diamond 10, Gold 119, Hybrid 15, and Bronze 49). He received 12,018 citations, resulting in an ACP of 55.9. Analysis of Table 5 shows that Gold OA publications are the top priority for each author. Despite having high OA publication counts, some authors have comparatively fewer citations and lower ACPs. The highest ACP (74.86) is found for Ruchi Tiwari, who has more than ten thousand citations. In contrast, author V. Geethalaxmi published 92 OA papers with the fewest citations (145) and the lowest ACP of 1.58.

3.7 Growth of OA Colours at the State Level

Figure 4 highlights the growth of five OA colors at the state level. During the study period, the highest number of Green OA documents was distributed from Tamil Nadu (541, 11.17% of total Green OA), which has three state agricultural universities, followed by Punjab (534 Green OA) and Karnataka (380 Green OA). Among Diamond OA publications, Punjab produced the highest number (564, 12.48%), followed by Tamil Nadu (554 Diamond OA documents). Gold OA documents are predominantly produced by authors, with Tamil Nadu achieving the top position by publishing 4,153 Gold OA documents, followed by Karnataka (3,947 Gold OA). Other states, such as Rajasthan, Uttar Pradesh, Maharashtra, Punjab, Gujarat, Haryana, and Jammu & Kashmir, have also made significant contributions to Gold OA. Hybrid OA publications were primarily published in Tamil Nadu (973, 15.98%), followed by Punjab (695), Karnataka (436), and Gujarat (436). The olive color map displays the distribution of Bronze OA documents, where Tamil Nadu ranks first with 1,403 Bronze OA documents, followed by Karnataka (1,204) and Punjab (1,040).

3.8 Funding Status and Impact of Research

Table 6 presents the top ten funded universities and their scholarly impacts. A total of 2,124 OA documents (3.22% of total OA documents) have received funding support from two hundred national and international agencies. The top ten funding agencies are the Indian Council of Agricultural Research (311), the Department of Biotechnology, Ministry of Science and Technology, India (252), the Science and Engineering Research Board (151), the Department of Science and Technology, Ministry of Science and Technology, India (114), King Saud University (85), the Bill and Melinda Gates Foundation (76), the University Grants Commission, New Delhi (71), the National Natural Science

Table 6 — Top Ten Funded Universities with Scholarly Impact Data

| Name of Universities | With Funding | | | Without Funding | | |
|--|--------------|-------|-------|-----------------|--------|-------|
| | Papers (%) | TC | ACP | Papers | TC | ACP |
| Punjab Agricultural University, Ludhiana | 214 (10.08) | 5076 | 23.72 | 3264 | 26051 | 7.98 |
| Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar | 158 (7.44) | 3315 | 20.98 | 2345 | 18925 | 8.07 |
| Tamil Nadu Agricultural University, Coimbatore | 155 (7.3) | 3559 | 22.96 | 5554 | 18833 | 3.39 |
| G.B. Pant University of Agriculture & Technology, Pantnagar | 107 (5.04) | 2568 | 24.00 | 2831 | 28548 | 10.08 |
| University of Agricultural Sciences, Bangalore | 96 (4.52) | 2408 | 25.08 | 1487 | 7876 | 5.30 |
| Kerala Veterinary and Animal Sciences University, Kerala | 80 (3.77) | 1330 | 16.63 | 1386 | 5017 | 3.62 |
| Tamil Nadu Veterinary & Animal Sciences University, Chennai | 75 (3.53) | 1650 | 22.00 | 1469 | 6877 | 4.68 |
| Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana | 71 (3.34) | 1486 | 20.93 | 1304 | 8121 | 6.23 |
| Chaudhary Charan Singh Haryana Agricultural University, Hisar | 68 (3.20) | 1414 | 20.79 | 2899 | 12525 | 4.32 |
| Assam Agricultural University, Jorhat | 68 (3.20) | 856 | 12.59 | 1880 | 5858 | 3.12 |
| Kerala University of Fisheries and Ocean Studies, Kochi | 58 (2.73) | 901 | 15.53 | 299 | 2313 | 7.74 |
| West Bengal University of Animal & Fishery Sciences, Kolkata | 58 (2.73) | 907 | 15.64 | 659 | 3982 | 6.04 |
| Others 44 universities | 916 (43.13) | 17863 | 19.50 | 38388 | 142535 | 3.71 |
| Total | 2124 (100) | 43333 | 20.40 | 63765 | 287461 | 4.51 |

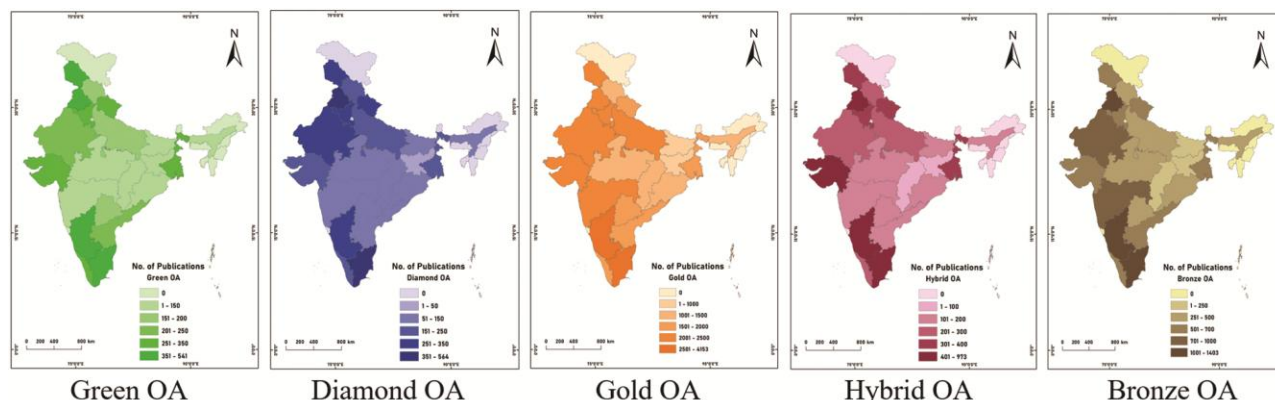


Fig. 4 — Growth of OA Colors at the State Level

Foundation of China (59), the Council of Scientific and Industrial Research, India (47), and the National Research Foundation of Korea (45). OA publications from Punjab Agricultural University received the highest funding support (214, 10.08% of the 2,124 papers) among the 56 State Agricultural Universities in India. Table 6 lists the impact of funded records alongside non-funded papers. OA publications with funding received an average of 20 citations per paper, while non-funded OA publications received an average of 4.51 citations per paper. In summary, 3.22% of OA publications with funding account for 13.09% of citations, while 96.78% of OA publications without funding account for 86.91% of citations. It is evident from Figure 5 that the impact of funded OA publications is more than three times their

share of publications, while non-funded OA publications have an impact that is less than their share. Furthermore, the University of Agricultural Sciences, Bangalore received the highest average citations per paper, at 25.08. The 2,124 OA publications with funding were published in 635 journals, with the top five being PLOS ONE (83), Frontiers in Plant Science (77), Scientific Reports (77), 3 Biotech (55), and Heliyon (36).

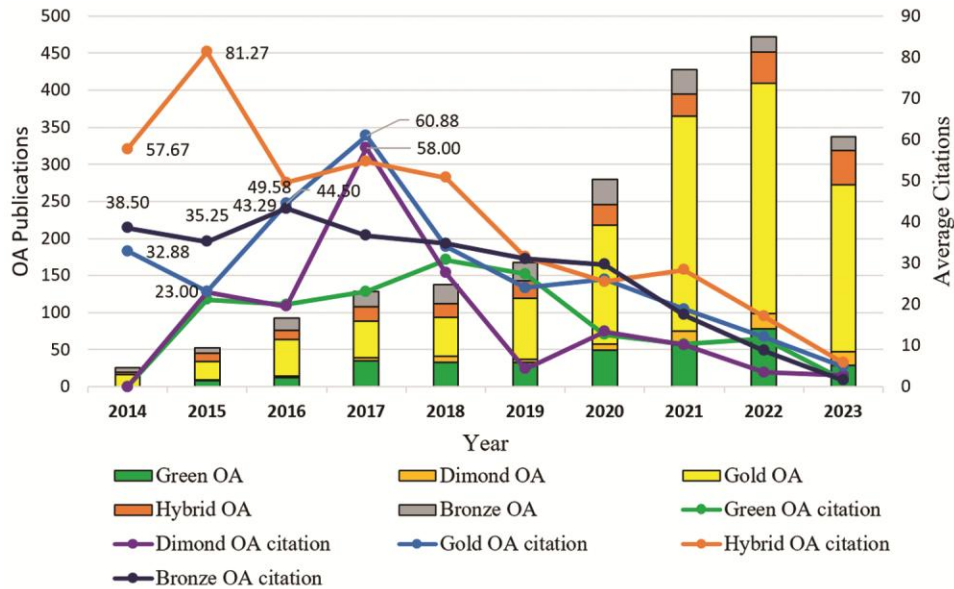


Fig. 6 — Year-wise Growth of Funded Research and Its Scholarly Impact

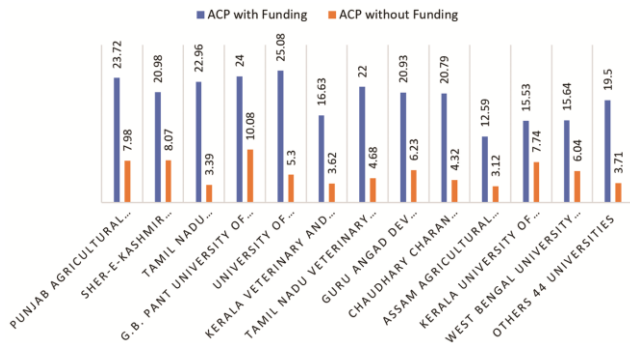


Fig. 5 — Impact of Funding on ACP

Figure 6 illustrates the year-wise distribution of OA colors for funded publications and their citation impacts. Of the total Green OA publications (4,843), the share of funded Green OA publications is 6.9%, accounting for 334 publications. Similarly, Hybrid OA represents 3.84% of funded publications, followed by Gold OA at 3.34%, Diamond OA at 1.91%, and Bronze OA at 1.63%. Despite having a 3.34% share of funded OA publications, Gold OA has the highest number of funded OA publications compared to other OA routes. In 2014, there were 26 funded OA publications (17 Gold OA, 3 Hybrid OA, and 6 Bronze OA), which increased to 337 funded publications by 2023 (29 Green OA, 18 Diamond OA, 226 Gold OA, 46 Hybrid OA, and 18 Bronze OA). During the study period, the highest number of funded OA publications (472) was recorded in 2022. In terms of average citations, Hybrid OA publications had the highest average citation (81.27) in

2015. Figure 6 clearly shows that the average citation for OA types was highest for Hybrid OA during the study period, followed by Gold OA.

3.9 Use of Article Processing Charges and Their Scholarly Impact

Table 7 presents a comparative overview of the top ten universities that utilize Article Processing Charges (APC), along with their citation counts, Average Citation Per Publication (ACP), and APC charges in USD. Punjab Agricultural University, Ludhiana, has paid a total of \$2,191,455 for 869 OA publications, representing 9% of the total APC publications, which is the highest amount among all state agricultural universities. Its ACP is 23.02, with a total of 20,005 citations. Among the top ten listed state agricultural universities, the highest ACP (34.57) is attributed to G.B. Pant University of Agriculture & Technology, Pantnagar, based on 606 OA papers.

The higher citation counts for OA publications published with APC correspond to a higher ACP, while OA publications without APC exhibit comparatively lower citation counts and ACP. The state agricultural universities in India have published more OA publications without APC, but those with APC have garnered higher citation counts. On average, APC-based OA publications have an ACP of 20.68, while OA publications without APC have an average of 2.33 citations per paper.

Figure 7 illustrates the trend in the use of Article Processing Charges (APC) in OA publications during

the study period. A total of 14.66% of OA publications (9,658 out of 65,889) incurred APC charges. Diamond OA publications are published without APC fees, while 25.83% of Green OA, 18.08% of Gold OA, 9.54% of Hybrid OA, and 7.9% of Bronze OA publications paid APC charges. In 2014, 531 OA publications (122 Green OA, 314 Gold OA, 41 Hybrid OA, and 54 Bronze OA) incurred

APC charges, and this number increased steadily, reaching over 1,500 OA papers in 2021, 2022, and 2023. Interestingly, the average citation per paper exceeded 10 for all OA types from 2014 to 2022, but it declined for all OA types in 2023. Hybrid OA publications had a comparatively higher citation per paper ratio than any other OA types.

3.10 Most Frequent Keywords

Table 7 — Top Ten Universities with APC based OA Publications & Scholarly Impact

| University Name | With APC | | | Without APC | | | |
|--|---------------|--------|-------|-------------|--------|--------|------|
| | Papers (%) | TC | ACP | USD | Papers | TC | ACP |
| Punjab Agricultural University, Ludhiana | 869 (9%) | 20005 | 23.02 | 2191455 | 2609 | 11122 | 4.26 |
| Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar | 633 (6.55%) | 15455 | 24.42 | 1448086 | 1870 | 6785 | 3.63 |
| G.B. Pant University of Agriculture & Technology, Pantnagar | 606 (6.27%) | 20949 | 34.57 | 1301773 | 2332 | 10167 | 4.36 |
| Tamil Nadu Agricultural University, Coimbatore | 590 (6.11%) | 11974 | 20.29 | 1319423 | 5119 | 10418 | 2.04 |
| Kerala Veterinary and Animal Sciences University, Kerala | 444 (4.6%) | 3923 | 8.84 | 511145 | 1022 | 2424 | 2.37 |
| Chaudhary Charan Singh Haryana Agricultural University, Hisar | 389 (4.03%) | 7707 | 19.81 | 887812 | 2578 | 6232 | 2.42 |
| Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana | 366 (3.79%) | 6865 | 18.76 | 760134 | 1009 | 2742 | 2.72 |
| Orissa University of Agricultural & Technology, Bhubaneswar | 285 (2.95%) | 4857 | 17.04 | 585450 | 1659 | 3928 | 2.37 |
| Tamil Nadu Veterinary & Animal Sciences University, Chennai | 282 (2.92%) | 5782 | 20.50 | 589095 | 1262 | 2745 | 2.18 |
| University of Agricultural Sciences, Bangalore | 261 (2.7%) | 6620 | 25.36 | 653483 | 1322 | 3664 | 2.77 |
| Bidhan Chandra Krishi Viswa Vidhyalaya, Mohanpur | 261 (2.7%) | 6507 | 24.93 | 603822 | 1311 | 3779 | 2.88 |
| Other 45 state universities | 4672 (48.37%) | 89098 | 19.07 | 9650642 | 34138 | 67046 | 1.96 |
| Total | 9658 (100%) | 199742 | 20.68 | 20502320 | 56231 | 131052 | 2.33 |

TC=Time Citation, ACP=Average Citation per Paper, USD=US Dollar

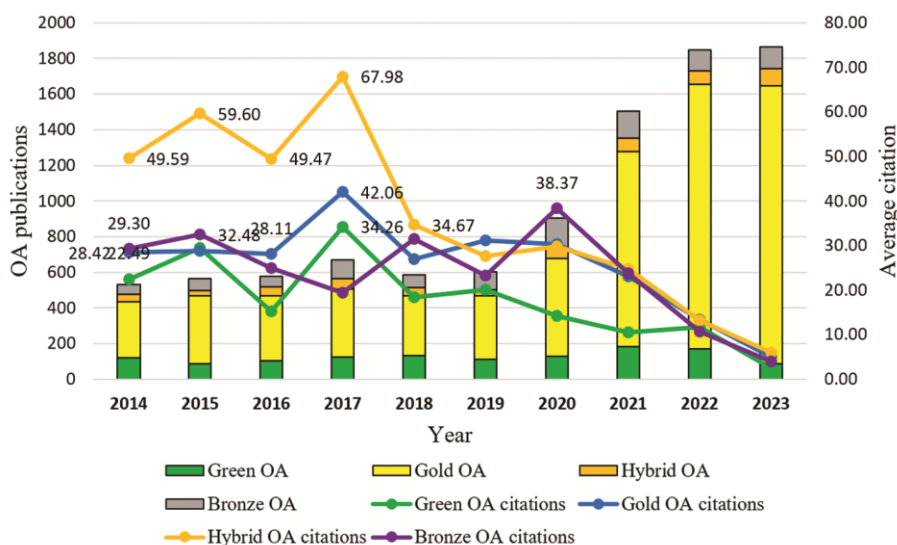


Fig. 7 — Year-wise Growth of APC based Publications and Its Scholarly Impact

Figure 8 displays the top twenty keywords that occur more than five hundred times. The most frequently used keyword is “crop productivity,” followed by “soil fertility,” “grain yield,” “plant growth,” and “maize yield,” among others. It was observed that all twenty keywords are related to various fields of agriculture,

with no indication of diversion to other fields.

3.11 Domain and Topic

Figures 9a and 9b display the domains related to OA publications and their average citations, respectively. Among the total OA publications, the majority (74.09%, or 48,817 out of 65,889) are related

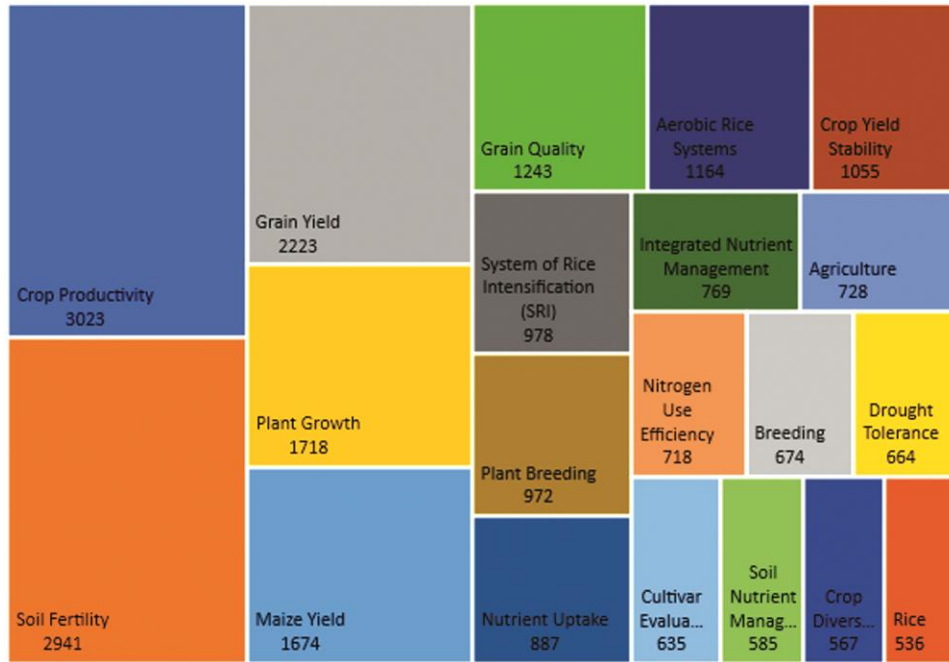


Fig. 8 — Top Keywords in the Agriculture Domain

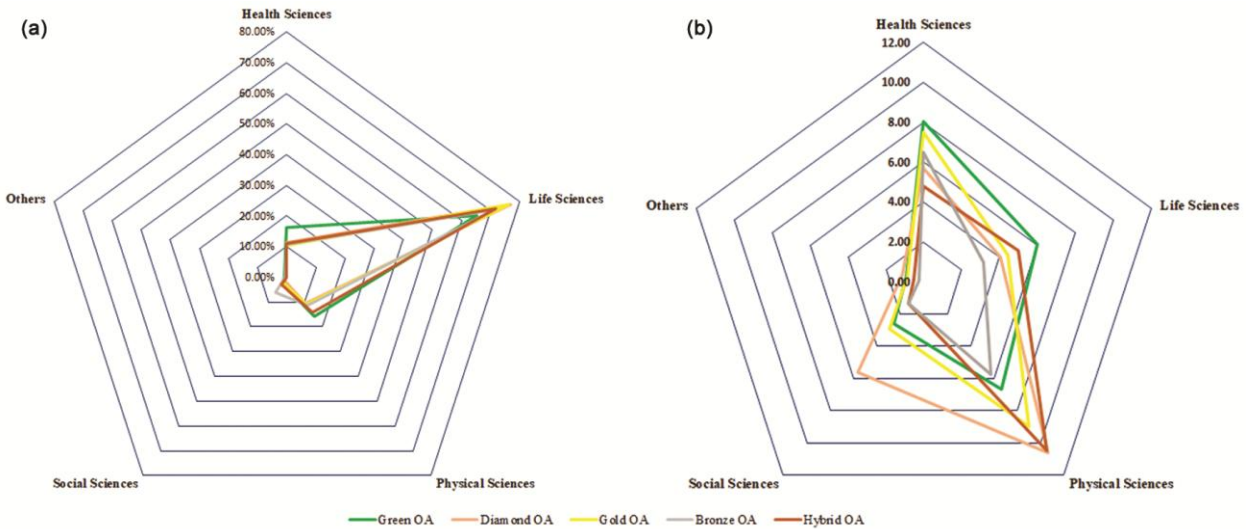


Fig. 9 — OA papers coverage with domain and Average citation

to the Life Sciences domain, followed by 11.77% in Physical Sciences, 10.92% in Health Sciences, 3% in Social Sciences, and 0.22% in other domains. Interestingly, the five OA types also follow a similar trend across different domains. Moreover, the study observed the citation trends of OA types and found that the highest average citations come from the Health Sciences domain (4-8 ACP) and the Physical Sciences domain (5-10 ACP). Surprisingly, Green OA and Hybrid OA publications have average citations of 6.01 and 5.00, respectively. In contrast, Diamond OA

publications received an average of 5.62 citations per paper in the Social Sciences domain.

Table 8 presents twenty-one topics along with their total publications, total citations, and average citations per paper. A total of 2,171 topics were identified, and among them, five hundred papers related to these topics are displayed in Table 8. The highest number of OA publications (3,881) belongs to “Agricultural Development and Policy in South Asia,” followed by “Rice Water Management and Productivity Enhancement” (2,556) and “Management of Soil

Table 8 — Trending Topic in the Agriculture Domain

| SL | Topic Name | TP | TC | ACP |
|----|--|-------|--------|-------|
| 1 | Agricultural Development and Policy in South Asia | 3881 | 3638 | 0.94 |
| 2 | Rice Water Management and Productivity Enhancement | 2556 | 9663 | 3.78 |
| 3 | Management of Soil Fertility and Crop Productivity | 1996 | 3063 | 1.53 |
| 4 | Genetics and Breeding of Cowpea | 1488 | 2933 | 1.97 |
| 5 | Factors Affecting Maize Yield and Lodging Resistance | 1469 | 2847 | 1.94 |
| 6 | Cultivar Evaluation and Mega-Environment Investigation | 1338 | 4564 | 3.41 |
| 7 | Genetic Diversity and Breeding of Okra | 1224 | 1752 | 1.43 |
| 8 | Physiology and Management of Fruit Trees | 1077 | 1918 | 1.78 |
| 9 | Livestock Farming and Rural Development Practices | 1013 | 1028 | 1.01 |
| 10 | Genomics and Breeding of Legume Crops | 833 | 5265 | 6.32 |
| 11 | Intercropping in Agricultural Systems | 826 | 2283 | 2.76 |
| 12 | Diversity and Evolution of Fungal Pathogens | 754 | 1823 | 2.42 |
| 13 | Deficit Irrigation for Agricultural Water Management | 678 | 1321 | 1.95 |
| 14 | Biofortification of Staple Crops for Human Nutrition | 676 | 6138 | 9.08 |
| 15 | Mechanism of Plant Growth Regulation | 665 | 832 | 1.25 |
| 16 | Mechanisms of Plant Immune Response | 560 | 6967 | 12.44 |
| 17 | Elicitor Signal Transduction for Metabolite Production | 554 | 2153 | 3.89 |
| 18 | Health Benefits of Wheatgrass Consumption | 547 | 1147 | 2.10 |
| 19 | Viral RNA Silencing and Plant Immunity | 544 | 3827 | 7.03 |
| 20 | Reproductive Health in Dairy Cattle | 534 | 998 | 1.87 |
| 21 | Genomic Selection in Plant and Animal Breeding | 532 | 1773 | 3.33 |
| | Others 2150 topics | 42144 | 264861 | 6.28 |
| | Total topics 2171 | 65889 | 330794 | 5.02 |

Fertility and Crop Productivity” (1,996). The topic “Rice Water Management and Productivity Enhancement” has received the highest number of citations (9,663), while “Mechanisms of Plant Immune Response” has the highest average citation per paper (12.44) among all the topics.

4. Findings and Discussion

This comprehensive analysis provides valuable insights into the OA research landscape of state agricultural universities in India. The results reveal key insights into OA publications, including publication trends, the most productive states, prolific institutions, top authors, leading journals, funding support, and the use of article processing charges (APCs).

The increasing trends in OA publishing over the last ten years convey a positive message. Authors are actively engaging with OA publishing routes, and the contributions of highly active institutions, authors, and states offer a comprehensive overview of research on sustainability in agriculture. Tamil Nadu Agricultural University in Coimbatore is a leading institution in publishing research through open-access routes, an achievement made possible by the collaborative efforts of authors and institutions. The rankings of three authors—M. Raveendran (158 publications), V. Geethalakshmi (92 publications), and N. Senthil (90

publications)—demonstrate this collaborative success.

Following Tamil Nadu Agricultural University, other notable contributors include Punjab Agricultural University, Chaudhary Charan Singh Haryana Agricultural University in Hisar, G.B. Pant University of Agriculture & Technology, and Sher-e-Kashmir University of Agricultural Science & Technology in Srinagar. The collaborative efforts of Tamil Nadu Agricultural University (5,709 publications), Tamil Nadu Veterinary and Animal Sciences University in Chennai (1,544 publications), and Tamil Nadu Dr. J. Jayalalithaa Fisheries University in Nagapattinam (371 publications) have positioned Tamil Nadu as the most productive state in India regarding OA documents.

Based on the analysis of OA percentages, the study classified five categories of OA: Green OA (7.35%), Diamond OA (6.74%), Gold OA (57.27%), Hybrid OA (9.24%), and Bronze OA (19.41%). The percentage of OA publications from Indian State Agricultural Universities (67.55%) is notably high compared to non-profit organizations³² (57.74%), Central Universities³⁸ (28.43%), and State Universities³⁶ (24.57%).

The research reveals a significant disparity between the ratios of domestic and foreign journal publications, as well as their average citations¹⁵. Notably, three Indian journals—International Journal of Current

Microbiology and Applied Sciences, International Journal of Chemical Studies, and International Journal of Environment and Climate Change—play an important role in OA publications. Authors often collaborate with U.S. institutions and publish their papers in American journals^{17,23,40}.

The analysis of funding status highlights a lack of support for agricultural research, with only 3.22% (n=2,124) of OA papers published with funding support. The Government of India ranks seventh in terms of research development funding, while the Department of Science and Technology's Funding for Improvement of Science and Technology (DST-FIST) provides only 4% of funding for agricultural research⁴¹.

Lastly, trending topics underscore recent developments in agricultural research in India. Given that global warming directly influences climate change worldwide, scholars are increasingly focusing on agricultural development policies, rice water management, soil fertility management, and crop productivity.

5. Conclusion

This study provides a comprehensive overview of open-access publishing trends, international collaborations, authorship patterns, and funding status at Indian State Agricultural Universities. It highlights opportunities for institutions, state governments, and funding agencies to prioritize open-access publishing to promote sustainable agricultural research. Additionally, researchers are encouraged to develop new indicators to measure research transparency.

References

- Gulati A & Juneja R, Transforming Indian Agriculture, In: Chand R, Joshi P, Khadka S, (eds) *Indian Agriculture Towards 2030, India Studies in Business and Economics* (Springer; Singapore),2022, p. 9–37. https://doi.org/10.1007/978-981-19-0763-0_2
- Pathak H, Mishra J P and Mohapatra T, Indian agriculture after independence (Indian Council of Agricultural Research; New Delhi), 2022, p. 426.
- Goswami B, Bezbaruah M P and Mandal R, Indian Agriculture after the Green Revolution: Changes and challenges, (Routledge; USA), 2017.
- Balasubramanian P and Ravanan C, Scientometric analysis of agriculture literature: A global perspective, *Library Progress (International)*, 31(1) (2011) 1–18.
- Nayak S N and Bankapur V M, Modelling the growth of global agricultural literature: A scientometric study based on CAB-Abstracts, *International Journal of Library and Information Studies*, 7(3) (2017) 99–111.
- Sagar A, Kademani B and Bhanumurthy K, Research trends in agricultural science: A global perspective, *Journal of Scientometric Research*, 2(3) (2013) 185–185.
- Chisenga J and Simumba D, Open Access publishing: Views of researchers in public agricultural research institutions in Zambia, *Agricultural information worldwide*, 2 (2009) 113–119.
- Das R K, Das S, Rahman R and Mondal P, Mapping of agriculture research in Bangladesh: A scientometric analysis, *Journal of Advanced Research in Library & Information Science*, 6(2) (2019) 7–15.
- Garg K C, Kumar S, Bhatia V K, Ramasubramanian V, Kumar A and Kumari J, Plant genetics and breeding research: Scientometric profile of selected countries with special reference to India, *Annals of Library and Information Studies*, 58 (2011) 184–197.
- Kasa M G, Ibrahim U and Momoh K A, Bibliometric analysis of publication output patterns of faculty members of agriculture and veterinary complex of a Nigerian University, *Information Manager (The)*, 14(1-2) (2014) 21–28.
- Nasir S, Ahmed J, Qadir J & Gilani A H, Mapping of plant science research productivity in Pakistan, *Pakistan Journal of Botany*, 51(4) (2019) 1531–1538.
- Pouris A, A scientometric assessment of agricultural research in South Africa, *Scientometrics*, 17(5-6) (1989) 401–413. <https://doi.org/10.1007/bf02017461>
- Vellaichamy A, Scientometric analysis of food and nutrition research in India and China: a comparative study, *Journal of Library and Information Science*, 6(1) (2016) 122–133.
- Behera M, Meher D and Panda N, Research publications of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar during 1966–2022: A bibliometric analysis, *Pearl: A Journal of Library and Information Science*, 16(3) (2022) 157–172.
- Garg K C, Kumar S and Lal K, Scientometric profile of Indian agricultural research as seen through Science Citation Index Expanded, *Scientometrics*, 68(1) (2006) 151–166. <https://doi.org/10.1007/s11192-006-0088-y>
- Kadam S D and Bhusawar S C, Research productivity of agricultural faculty members with special reference to Maharashtra, India: A scientometric study, *Library Philosophy and Practice*, (2021) 5907. <https://digitalcommons.unl.edu/libphilprac/5907>
- Nidhisha P K and Sarangapani R, Research trends of ICAR-IARI scientists: A scientometric analysis, *Library Philosophy and Practice*, (2021) 5296. <https://digitalcommons.unl.edu/libphilprac/5296>
- Ramanan S, S Arunachalam A and Rajawat B S, A scientometric assessment of research publications from ICAR-Central Agroforestry Research Institute, *Indian Journal of Agroforestry*, 23(2) (2021) 134–140.
- Sankar M and Prema C, Research productivity of Tamil Nadu Agricultural University as reflected in Scopus database: A scientometric dimension, *Asian Journal of Agricultural Extension, Economics and Sociology*, 40(10) (2022) 852–860.
- Sarkhel J K and Raychoudhury N, Contributions of Bidhan Chandra Krishi Viswavidyalaya to agricultural research: A

- bibliometric study, *Annals of Library and Information Studies*, 57 (4) (2010) 348–355.
- 21 Sharma R M, Research publication trend among scientists of Central Potato Research Institute: A bibliometric study, *Annals of Library and Information Studies*, 56 (2009) 29–34.
 - 22 Tekale K U, Veer D K and Kadam S D, Mapping of research productivity of agriculture faculty of Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani: A study based in Indian Citation Index, *International Journal of Library and Information Studies*, 7(4) (2017) 47–53.
 - 23 Tripathi H K, Raj H and Kumar S, Mapping of research output of animal science division in ICAR, *Library Herald*, 51(1) (2013) 50–65.
 - 24 Uma K and Das K A, *Introduction to Open Access*, (UNESCO Publishing; France), 2015.
 - 25 Gargouri Y, Larivière V, Gingras Y, Carr L and Harnad S, Green and Gold Open Access percentages and growth by discipline, *arXiv.org*, (2012). <https://arxiv.org/abs/1206.3664v1>.
 - 26 Fuchs C and Sandoval M, The diamond model of open access publishing: Why policy makers, scholars, universities, libraries, labour unions and the publishing world need to take non-commercial, non-profit open access seriously, *TripleC: Communication, Capitalism & Critique*, 11(2) (2013) 428–443.
 - 27 Archambault É, Amyot D, Deschamps P, Nicol A, Provencher F, Rebout L and Roberge G, Proportion of Open Access papers published in peer-reviewed journals at the European and world levels—1996–2013, *Copyright, Fair Use, Scholarly Communication, etc.* (2014).
 - 28 Piwowar H, Priem J, Larivière V, Alperin J P, Matthias L, Norlander B, Farley A, West J and Haustein S, The state of OA: A large-scale analysis of the prevalence and impact of Open Access articles, *PeerJ*, 6 (2018) e4375. <https://peerj.com/articles/4375/>
 - 29 Björk B-C, The hybrid model for open access publication of scholarly articles: A failed experiment?, *Journal of the American Society for Information Science and Technology*, 63(8) (2012) 1496–1504. <https://doi.org/10.1002/asi.22709>
 - 30 Laakso M and Björk B-C, Delayed open access: An overlooked high-impact category of openly available scientific literature, *Journal of the American Society for Information Science and Technology*, 64(7) (2013) 1323–1329. <https://doi.org/10.1002/asi.22856>
 - 31 Priem J, Piwowar H. and Orr R, OpenAlex: A fully-open index of scholarly works, authors, venues, institutions, and concepts, *arXiv.org*, (2022). <https://arxiv.org/abs/2205.01833v2>.
 - 32 Hazarika R, Roy A and Sudhler K G, Mapping the open access publications of Indian non-profit organizations over the last 20 years based on OpenAlex insights, *Global Knowledge, Memory and Communication*, (2024). <https://doi.org/10.1108/GKMC-02-2024-0106>
 - 33 Robinson-Garcia N, Costas R. and Leeuwen T N van, Open Access uptake by universities worldwide, *PeerJ*, 8 (2020) e9410. <http://doi.org/10.7717/peerj.9410>
 - 34 Nazim M, Analysing Open Access uptake by academic and research institutions in India, *DESIDOC Journal of Library & Information Technology*, 41(2) (2021) 108–115. <http://doi.org/10.14429/djlit.41.2.16324>
 - 35 Mukhopadhyay P, How green is my valley? Measuring open access friendliness of Indian Institutes of Technology (IITs) through data carpentry, In A Biswas & M Das Biswas (Eds.), *Panorama of open access: Progress, practices & prospects*, (Ess Ess) 2022 (1st ed., pp. 67–89). <https://doi.org/10.5281/zenodo.6511080>.
 - 36 Roy A and Mukhopadhyay P, Measuring the open access friendliness of the state universities in India through data carpentry, *Annals of Library and Information Studies*, 69(3) (2022) 225–237. <https://doi.org/10.56042/alis.v69i3.63837>
 - 37 Roy A and Mukhopadhyay P, Assessing Open Access Friendliness of National Institutes of Technology (NITs): A data carpentry approach, *DESIDOC Journal of Library & Information Technology*, 42(5) (2022) 331–338. <https://doi.org/10.14429/djlit.42.5.18263>
 - 38 Roy A and Mukhopadhyay P, Measuring Open Access Friendliness of Indian central universities through data carpentry, *Journal of Information and Knowledge*, 59(3) (2022) 131–139. <https://doi.org/10.17821/srels/2022/v59i3/170100>.
 - 39 Roy A and Shukla A, Unveiling the status of Open Access Dairy research in India through data carpentry, *Journal of Data Science, Informetrics, and Citation Studies*, 3(1) (2024) 1–10. <https://doi.org/10.5530/jcitation.3.1.1>
 - 40 Tripathi H K and Garg K C, Scientometrics of Indian crop science research as reflected by the coverage in Scopus, CABI and ISA databases during 2008–2010, *Annals of Library and Information Studies*, 61(1) (2014) 41–48.
 - 41 Srinivasiah R, Renuka S D and Prasad U K, Impact of DST-FIST funding on research publications in India (2000–2020): A bibliometric investigation, *Journal of Scientometric Research*, 10(2) (2021) 135–147. <https://doi.org/10.5530/jscires.10.2.28>