Scholarly Communication Pattern and Research Output of Tamilnadu, India during 2009 to 2018: A Case Study

Mohamed Idhris¹ and Manuelraj Peter*²

¹Assistant Professor, Deanship of Library Affairs, Imam Abdulrahman Bin Faisal University, Saudi Arabia
²Assistant Professor & Head of Library Systems, Deanship of Library Affairs, Imam Abdulrahman Bin Faisal University, Saudi Arabia

*Corresponding author: Manuelraj Peter, Assistant Professor & Head of Library Systems, Deanship of Library Affairs, Imam Abdulrahman Bin Faisal University, Saudi Arabia

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Abstract

Purpose: This paper provides a bibliometric study of the research performance of Tamil Nadu, India, over the 10-year period between 2009 and 2018. Tamil Nadu has published 1,87,817 articles over a period of 10 years, of which they have been published in authoritative journals indexed by SCOPUS.

Methods: On November 9, 2019, data were collected from the Scopus. We carried out a qualitative and quantitative study using bibliometric methods of publishing inputs, papers, writers, organizations, countries, keywords and terms. Using bibliometric analysis, the data are analyzed using the excel. The analysis also aims to analyze yearly wise circulation, author wise distribution, origin wise distribution of research papers, keyword distribution, organization partnership, subject area and geographic distribution.

Results: From 2009 to 2018, we found 18,7817 publications in Tamil Nadu. I found an improvement in the annual publishing rate over time. Over the past decades, 2018 has the largest number of publications. Mr. Mohan, Viswanathan Krishna, who works at the Madras Diabetes Research Foundation, Chennai has the largest number of research findings over the periods of analysis. Research India Publications ‘ International Journal of Applied Engineering Research journal is the largest number of literatures. The USA is India’s most active collaborating country with India, the Indian Institute of Technology Madras was the most active institution, keyword analysis showed that human, controlled study, nonhuman and others were the hot spots of these research studies.

Conclusion: This bibliometric study revealed that publication research output from Tamil Nadu growing well from all fields. As per the comparison of Tamil Nadu population growth [1] and publication growth, the publication growth rate is 2% lower than population growth so we need to increase the publication growth.

Introduction

Tamil Nadu is one of India’s 28 states. Chennai (formerly known as Madras) is its capital and largest city. Located in the southernmost part of the Indian subcontinent, Tamil Nadu is bordered by the union territories of Puducherry and Kerala, Karnataka, and Andhra Pradesh, South Indian states. It is bordered on the north by the Western Ghats, the Nilgiri Mountains, the Meghamalai Hills, and on the west by Kerala, on the east by the Bay of Bengal, on the southeast by the Gulf of Mannar, and on the south by the Indian Ocean. The state shares a sea border with the Sri Lankan government. In Tamil Nadu, there are 22 state universities and 29 Deemed Universities operating, which include the disciplines of arts and science, engineering, agriculture and medicine. [2]. University Grant Commission (UGC) is the major funding sponsor in Tamil Nadu publications UGC and other statutory regulatory bodies are...
responsible for the organization and maintenance of standards in universities and colleges in Tamil Nadu.

Indian Institute of Technology Madras (IITM) got third rank and Anna University got thirteen rank in all over the India during the year of 2019 [3] and National Institute Ranking Framework [4] (NIRF) ranking, the Indian Institute of Technology Madras bagged the 1st ranks and Anna University got 13th rank among the overall institutions in India during the year of 2019 The first university was established in 1857 at Chennai (Madras) University of Madras, followed in 1929 by Annamalai University Annamalai Nagar. These two universities are our nation’s pre-independence universities[5]. In India, one of the most highly ranked institution available state was tamilnadu, by holding IITs, IIMs and leading medical and technical universities. Analyzing the scholarly research output of this Indian state will give an overview of the Indian research growth, further, to identify the gap in the research in different disciplines and research growth this study will give a greater benefit to all the researchers.

**Review of Literature**

Manuelraj Peter, Spurgeon Anandraj, Mohamed Idhris, Abdurahiman Pattukuthu and Arun Vijay Subbarayalu [6] analyzed Bibliometric study in Health Care Professionals in Saudi Arabia the journal “PLoS One” was the most effective journal published in 2014-18, with 680 of its publishing followed by the Saudi medical journal.

Mohamed Idhris,Manuelraj Peter,Abdurahiman Pattukuthu and Spurgeon Anandraj Samuel [7], the study reveals a gradual increase in work on LJUPS between 2010 and 2017. Highest number of publications related to the year 2016. During 2010-2017, the United States is the top contributor: PETRI M is the lead author with 394 papers comprising 1,017% of the overall publications. Siwach AK et al. [8] research explores Maharshi Dayanand University, Rohtak’s research contributions in terms of publishing output over the period 2000-2013 as reflected in the Scopus database. The research evaluates the year - to-year efficacy of research, its effects on citations, national and international partnerships, top collaborative institutions, subject-matter distribution of articles, journals used for correspondence, most popular journals for publishing, most prolific authors, number of citations earned and top-quoted University papers during the study period.

N Geetha et al.[9] analyzed that her paper on Research Output of Anna University: A Bibliometric Study Based on Scopus Database stated her study shows that there is substantial research output and a steady increase in publications among Anna University academics and the dominance of collaborative work between Anna University. Venkatakrishnan CJ[10] Analysis of the growth trend was carried out and predictions are presented. Prosthodontist exhibited a tendency to publish case reports in general dental journals in international newspapers. Poomini S, etal.[11] analyzed that Most of the 33 papers have been published in the Indian Journal of Dental Research and 25 in the Conservative Dentistry Review. Of these papers, 66 are based on the authors’ original research. Kumaragurupari R, et al.[12] revealed that research quality, as reflected in both the number of publications in peer-reviewed journals and those journals’ qualitative indicators, improved during the duration of this study.

**Methodology**

The chosen data were downloaded from Scopus database. The following search terms have been used to retrieve the records from database “AFFILCITY (Tamilnadu) OR AFFILCITY(Tamilnadu) OR AFFILCITYChennai) OR AFFILCITY(Vellore) OR AFFILCITY(Tiruvannamalai) OR AFFILCITY(Cuddalore) OR AFFILCITY(Villuppuram) OR AFFILCITY(Kancheepuram) OR AFFILCITY(Tiruvarur) OR AFFILCITY(Kalakurich) OR AFFILCITY(Chengalpettu) OR AFFILCITY(Tirupattur) OR AFFILCITY(Ranipettai) OR AFFILCITY(Coimbatore) OR AFFILCITY(Nilgiris) OR AFFILCITY(Salem AND india) OR AFFILCITY(Dharmapuri) OR AFFILCITY(Erode) OR AFFILCITY(Dindigul) OR AFFILCITY(Karur) OR AFFILCITY(Namakkal) OR AFFILCITY(Krishnagiri) OR AFFILCITY(Tirupur) OR AFFILCITY(Thanjavur) OR AFFILCITY(Tiruchirappalli) OR AFFILCITY(Trichy) OR AFFILCITY(Pudukottai) OR AFFILCITY(Nagapattinam) OR AFFILCITY(Tiruvur) OR AFFILCITY(Perambalur) OR AFFILCITY(Ariyalur) OR AFFILCITY(Kanyakumari) OR AFFILCITY(Madurai) OR AFFILCITY(Ramanathapuram) OR AFFILCITY(Tirunelveli) OR AFFILCITY(Virudhunagar) OR AFFILCITY(Sivagangai) OR AFFILCITY(Thoothukudi) OR AFFILCITY(Theni) OR AFFILCITY(Tenkasi)” from 2009 to 2018. No journal or types of article restrictions have been established. All the publications that were displayed were taken into the analysis. In Excel, a data sheet was prepared to record the information and then the data was entered from the paper itself manually.

**Results**

Table 1: Year wise Productivity of Publications.

| Year | Count | Percent |
|------|-------|---------|
| 2009 | 8188  | 4.36    |
| 2010 | 9903  | 5.27    |
| 2011 | 12967 | 6.9     |
| 2012 | 15632 | 8.32    |
| 2013 | 17405 | 9.27    |
| 2014 | 22464 | 11.96   |
| 2015 | 25899 | 13.79   |
| 2016 | 24754 | 13.18   |
| 2017 | 23658 | 12.6    |
| 2018 | 26947 | 14.35   |
| Total| 187817| 100%    |

Table 1 shows the yearly publication of articles published by Tamil Nadu State based on Scopus results. When reviewing the last ten years of publishing results, it is observed that (14.35%) of articles n=26947 published in 2018 and the remaining 85 percent of articles published over a 9-year period. While 2015 has the second highest number of articles n=25899, (13.79 %), the lowest number of articles published in 2009 was n=8188 (4.36%). On an average, n=18781 articles were published per year. After 2014 research publication increased very rapid, and last five years contributed
68.88% of the research output. From Figure 1, we can see an upward trend in Tamil Nadu’s research output regarding the number of publications from the Scopus list (Tables 1 & 2) (Figure 1) [13,14].

Table 2: Ranking List of Top 15 Authors.

| Author Name          | Author Last Organization                                      | Count | Doc. By Author | Citation | h-index |
|----------------------|---------------------------------------------------------------|-------|----------------|----------|---------|
| Mohan, Viswanathan Krishna | Madras Diabetes Research Foundation, Chennai                   | 440   | 830            | 35654    | 82      |
| Vaidyanathan, Sundarapandian | Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai | 379   | 499            | 20063    | 100     |
| Ramasamy, Jegadeesh D | Shri Sathya Sai Medical College and Research Institute, Kanchipuram | 293   | 314            | 430      | 9       |
| Ignacimuthu, Savarimuthu J. | Loyola College, Chennai, Chennai | 291   | 418            | 9851     | 47      |
| Soman, K. P          | Amrita School of Engineering, Coimbatore, Coimbatore          | 288   | 448            | 1836     | 16      |
| Mukherjee, Amitava   | Vellore Institute of Technology, Vellore, Vellore             | 263   | 321            | 6491     | 40      |
| Shrivastava, Prateek Saurabh | Shri Sathya Sai Medical College and Research Institute, Chennai | 262   | 322            | 458      | 9       |
| Pradeep, Thalappil   | Indian Institute of Technology Madras, Chennai                 | 261   | 470            | 18011    | 63      |
| Kang, Gagandeep      | Christian Medical College, Vellore, Vellore, India            | 257   | 379            | 9067     | 48      |
| Mandal, Asit Baran   | CSIR-CLRI, Chennai                                             | 256   | 323            | 6399     | 43      |
| Chandrasekaran, Natarajan | Vellore Institute of Technology, Vellore, Vellore           | 247   | 285            | 5503     | 38      |
| Velmurugan, Devadasan | University of Madras, Chennai                                 | 242   | 557            | 2679     | 23      |
| Jayavel, Ramasamy    | Anna University, Chennai, India                                | 232   | 418            | 6172     | 41      |
| Perumal, P.T.        | Central Leather Research Institute India, Chennai              | 222   | 399            | 9096     | 51      |

Figure 1: Year wise productivity of publications.

Table 2 indicates ranking of authors by number of publications. Mr. Mohan, Viswanathan Krishna, working at the Madras Diabetes Research Foundation, Chennai, got the first rank with 440 publications and also highest citation score among the top 15 authors; Mr. Vaidyanathan, Underspending, he is working in VelTech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology Chennai, ranked second with 379 publications, and he got highest h-index (n=100). Mr. Ramasamy Jegadeesh working in Shri Sathya Sai Medical College and Research Institute, Kanchipuram, ranked third with 293 publications. Most of authors are working in the Private institutions. Out of the 15 authors nine authors are working in the Chennai based institutions. The top 15 authors analysis also found that only Medical and Engineering subjects’ group were produced more scholarly research than the other subject disciples (Table 3).
Table 3: Ranking List of Journals Top 20 Journals.

| Source Title                                      | Publisher                                | Doc | Cite Score | 2018 Citations | 2015-17 Doc | % Cited | SNIP | SJR  |
|---------------------------------------------------|------------------------------------------|-----|------------|----------------|--------------|---------|------|------|
| International Journal of Applied Engineering Research | Research India Publications                | 5949 | N.A        | N.A            | N.A          | N.A     | 0.354 | 0.122 |
| Indian Journal of Science and Technology          | Indian Society for Education and Environment | 2155 | N.A        | N.A            | N.A          | N.A     | 0.717 | 0.143 |
| International Journal of ChemTech Research        | Sphinx Knowledge House                   | 1540 | N.A        | N.A            | N.A          | N.A     | 0.632 | 0.136 |
| ARPN Journal of Engineering and Applied Sciences  | Asian Research Publishing Network (ARPN)  | 1474 | 0.5        | 2564           | 5138         | 26      | 0.483 | 0.224 |
| Research Journal of Pharmaceutical, Biological and Chemical Sciences | RJPBCS                                   | 1470 | N.A        | N.A            | N.A          | N.A     | 0.369 | 0.127 |
| Advances in Intelligent Systems and Computing      | Springer Nature                          | 1298 | 0.54       | 7162           | 13364        | 30      | 0.434 | 0.174 |
| International Journal of Pharmacy and Technology  | International Journal of Pharmacy and Technology (IJPT) | 1281 | N.A        | N.A            | N.A          | N.A     | 0.318 | 0.113 |
| Acta Crystallographica Section E: Structure Reports Online | International Union of Crystallography      | 1243 | N.A        | N.A            | N.A          | N.A     | 0.2   | 0.136 |
| Asian Journal of Pharmaceutical and Clinical Research | Asian Journal of Pharmaceutical and Clinical Research | 1213 | N.A        | N.A            | N.A          | N.A     | 0.655 | 0.167 |
| AIP Conference Proceedings                        | American Institute of Physics            | 1128 | 0.37       | 10085          | 27335        | 23      | 0.385 | 0.182 |
| RSC Advances                                      | Royal Society of Chemistry               | 1119 | 3.16       | 103974         | 32913        | 83      | 0.785 | 0.807 |
| Indian Veterinary Journal                         | Indian Veterinary Association             | 1115 | 0.07       | 80             | 1198         | 4       | 0.092 | 0.197 |
| International Journal of Pharmacy and Pharmaceutical Sciences | International Journal of Pharmacy and Pharmaceutical Sciences | 1097 | N.A        | N.A            | N.A          | N.A     | 2.029 | 0.232 |
| European Journal of Scientific Research           | European Journals Inc.                   | 1072 | N.A        | N.A            | N.A          | N.A     | N.A   | N.A  |
| Journal of Clinical and Diagnostic Research       | JCDR Research and Publications (Pvt) Limited | 1053 | N.A        | N.A            | N.A          | N.A     | 0.695 | 0.348 |

Table 3 shows the list of journals ranked. The most productive journal is the International Journal of Applied Engineering Research with n=5949 articles, followed by n=2155 articles by the Indian Journal of Science and Technology, some of the journals cite score and citations data are not available in the Scopus database. The Journal of Clinical and Diagnostic Research published by (JCDR Research and Publications (Pvt) Limited) n=1053 got least number of publications among top 15 journals list (Table 4) (Figure 2). Another research we performed was to determine the top 15 keywords used in this Tamil Nadu publication. During the last decades from the n=187817 documents found. The top 15 keywords with high frequency of occurrence are “human” utilized n=26525 (14.12%) items, followed by “Controlled Study” n=17223 (9.17%) and “Nonhuman” n=15693(8.36%) items. It was identified that the top listed keywords are mostly from medical and Science background (Table 5) (Figure 3) [15].

![Keywords ranking](image-url)
Table 4: Top 15 Keywords used in publications.

| Sl.No | Keyword          | Document | Out of 187817 |
|-------|-----------------|----------|---------------|
| 1.    | Human           | 26525    | 14.12         |
| 2.    | Controlled Study| 17223    | 9.17          |
| 3.    | Nonhuman        | 15693    | 8.36          |
| 4.    | Humans          | 14569    | 7.76          |
| 5.    | Male            | 14029    | 7.47          |
| 6.    | Female          | 12709    | 6.77          |
| 7.    | Priority Journal| 11165    | 5.94          |
| 8.    | Unclassified Drug| 10813 | 5.76          |
| 9.    | Adult           | 10791    | 5.75          |
| 10.   | India           | 9449     | 5.03          |
| 11.   | X Ray Diffraction| 7171 | 3.82          |
| 12.   | Scanning Electron Microscopy | 6651 | 3.54          |
| 13.   | Chemistry       | 6071     | 3.23          |
| 14.   | Animals         | 5456     | 2.90          |
| 15.   | Major Clinical Study | 4773 | 2.54          |

Table 5: Highly Productive Institutes.

| Sl.No | Institution                                      | Affiliation             | Count | Out of 187817 |
|-------|--------------------------------------------------|-------------------------|-------|---------------|
| 1.    | Indian Institute of Technology Madras            | Autonomous institute    | 16463 | 8.77          |
| 2.    | Anna University                                  | State university        | 15752 | 8.39          |
| 3.    | Vellore Institute of Technology, Vellore         | Deemed University       | 15527 | 8.27          |
| 4.    | Sathyabama Institute of Science and Technology   | Deemed University       | 6200  | 3.30          |
| 5.    | SASTRA Deemed University                         | Deemed University       | 5914  | 3.15          |
| 6.    | Bharathiar University                            | State university        | 5850  | 3.11          |
| 7.    | National Institute of Technology, Trichirappalli | Autonomous institute    | 5178  | 2.76          |
| 8.    | University of Madras                             | State university        | 4751  | 2.53          |
| 9.    | Christian Medical College, Vellore               | private, minority       | 4707  | 2.51          |
| 10.   | Bhanthidasan University                          | State university        | 3405  | 1.81          |
| 11.   | SRM Institute of Science and Technology, Ramapuram Campus | Deemed University   | 3245  | 1.73          |
| 12.   | Bharath Institute of Higher Education and Research | Deemed University      | 3162  | 1.68          |
| 13.   | PSG College of Technology                        | Autonomous              | 3128  | 1.67          |
| 14.   | Madurai Kamaraj University                       | State university        | 2967  | 1.58          |
| 15.   | SRM Institute of Science and Technology          | Deemed University       | 2844  | 1.51          |

The fifteen highly productive Institutes get the highest publishing level in Tamil Nadu in Table 5. With n = 16463 (8.77%) papers, the Indian Institute of Technology Madras is in first place, followed by Anna University, in second position with n = 15752 (8.39%) documents, and Vellore Institute of Technology, Vellore in third position with n = 15527 (8.27%). In positions four are the Sathyabama Institute of Science and Technology with n = 6200 (3.30%), Finally SRM Institute of Science and Technology has n = 2844 (1.51%). Increasing publications and ranking affiliations could be related to collaboration among authors. Most of the institutions are based on engineering and autonomous body (Table 6) (Figure 4). The number of publications was acquired from
the Scopus database by each thematic field. The major thematic areas are represented by the distribution (Table 6). This figure shows that the area with the highest percentage of documents was Engineering n=60871 (32.41) followed by Computer Science n=38094 (20.28%), Materials Science n=28027 (14.92%) and Medicine n=24914 (13.27%). Engineering and engineering related subject Categories are occupied one third of top 15 major subjects. This shows the need of improvement in the medical science research productivity (Table 7) (Figure 5) [16].

Figure 4: Subject of categories.

Figure 5.
Table 6: Top 15 Subject Categories.

| Subject Categories                        | Count  | Out of 187817 |
|-------------------------------------------|--------|---------------|
| 1. Engineering                            | 60871  | 32.41         |
| 2. Computer Science                       | 38094  | 20.28         |
| 3. Materials Science                      | 28027  | 14.92         |
| 4. Medicine                               | 24914  | 13.27         |
| 5. Physics and Astronomy                  | 24469  | 13.03         |
| 6. Chemistry                              | 23191  | 12.35         |
| 7. Biochemistry, Genetics and Molecular Biology | 21084  | 11.23         |
| 8. Pharmacology, Toxicology and Pharmaceutics | 18155  | 9.67          |
| 9. Mathematics                            | 16163  | 8.61          |
| 10. Chemical Engineering                  | 14713  | 7.83          |
| 11. Agricultural and Biological Sciences  | 11010  | 5.86          |
| 12. Environmental Science                 | 10970  | 5.84          |
| 13. Energy                                | 8481   | 4.52          |
| 14. Multidisciplinary                     | 5424   | 2.89          |
| 15. Earth and Planetary Sciences          | 5121   | 2.73          |

Table 7: Geographical Distribution / Countries Collaborated.

| Sl.No | Country     | Continent | Count | Percent |
|-------|-------------|-----------|-------|---------|
| 1.    | India       | Asia      | 187723| 99.96   |
| 2.    | United States| N.America| 6901  | 3.67    |
| 3.    | South Korea | Asia      | 3378  | 1.80    |
| 4.    | United Kingdom| Europe  | 2487  | 1.32    |
| 5.    | Japan       | Asia      | 1924  | 1.02    |
| 6.    | Malaysia    | Asia      | 1894  | 1.01    |
| 7.    | Saudi Arabia| Asia      | 1829  | 0.97    |
| 8.    | China       | Asia      | 1816  | 0.97    |
| 9.    | Germany     | Europe    | 1775  | 0.95    |
| 10.   | Australia   | Oceania   | 1667  | 0.89    |
| 11.   | Canada      | N.America| 1465  | 0.78    |
| 12.   | Taiwan      | Asia      | 1430  | 0.76    |
| 13.   | France      | Europe    | 1238  | 0.66    |
| 14.   | Italy       | Europe    | 1182  | 0.63    |
| 15.   | Singapore   | Asia      | 958   | 0.51    |

Number of publications ranked the top 15 countries / territories, including the number and percentage of single country articles and internationally collaborative articles (Table 7) Eight Asian countries, two North American countries, four European countries, and one country in Oceania are ranked among the top 15 of the publications. In the top 15 competitive countries, there are still no African or South American countries. The seven major industrial nations (G7: Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) have placed the top fifteen in the world. In addition, G7 had high productivity in independent papers, which included all independent papers n=16972 (9.03%). United states have contributed n=6901 (3.67%) articles and stood first rank in the ranking of Country Collaborated with India followed by South Korea n=3378 (1.80%) articles has received second highest position. However, United Kingdom contributed n=2487 (1.32%) followed by Japan n=1924 (1.02%) [17-20].

Conspicuous

a) It is clear from the finding that n=26947 (14.35%) maximum number of publications were published in the year 2018.

b) It indicates that Mr. Mohan, Viswanathan Krishna, working at the Madras Diabetes Research Foundation, Chennai, got the first rank with 440 publications and also highest citation score n=35654.

c) It is cleared that the most productive journal is the International Journal of Applied Engineering Research with n=5949 articles.

d) It is clear from the study that the keyword “Human” n=26525 (14.12%) is the most dominated keywords in this study.

e) It revealed that Indian Institute of Technology Madras has dominated the Top ranked Institute list by contributing n=16463 (8.77%) articles alone.

f) It is clear from the study that the Subject Categories Engineering n=60871 (32.41%) is the is the most dominated Subject Categories in this study.

g) United states have contributed n=6901 (3.67%) articles and stood first rank in the ranking of Country Collaborated with India.

Conclusion

The study was conducted based on Scopus database during 2009-2018 of Tamil Nadu. Publication growth in Tamil Nadu is expanding rapidly in recent years. UGC is the major funding sponsor in Tamil Nadu publications and UGC funded publication count is increased year by year nevertheless after between 2015 to 2018 publication count is decreased it shows that lack of publication awareness among the researchers. The Scopus database covered only standard publications that is one of the reasons for it. Most of the top-ranking authors are working in the non-governmental organizations. Publication count has increased to force Non-governmental organization authors to work under them. In recent years, the number of publication count is increased year by year.

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