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Research Article

From Teenage Inventor to Scientist: Scientometric Profiling of an Indian-American Scientist, Dr. Shiva Ayyadurai's Research Output

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ABSTRACT

Background: This study presents a comprehensive bibliometric analysis of the scholarly contributions of Dr. Shiva Ayyadurai, an Indian-American scientist best known for his pioneering work in the development of the electronic mail system. At the age of just 14, in 1978, Dr. Ayyadurai developed an early version of email while working at the University of Medicine and Dentistry of New Jersey. His system, named "EMAIL," digitally replicated the structure of the interoffice paper-based communication system, incorporating features such as Inbox, Outbox, Memo, and Attachments-laying the groundwork for the modern email systems used today. **Aim:** The objective of this study is to provide a quantitative overview and construct a scientific profile of Dr. Ayyadurai's academic output from 1980 to 2025. A total of 54 publications were analysed, including 26 journal articles, 4 conference papers, 11 books, 12 patents, and 1 technical report. **Methodology:** Data was sourced primarily from Google Scholar and Wikipedia, with supplementary information from both online and offline repositories. The dataset was organized using MS Excel and Word, and standard bibliometric indicators were applied for analysis. **Findings:** Key findings show that Dr. Ayyadurai's publication trajectory spans 45 years, with a balanced mix of 18 non-collaborative and 36 collaborative works. His research is notably multidisciplinary, covering systems biology, computational modelling, biological engineering, and information technology. The Degree of Collaboration (DC) ranged from 0.34 to 1.00 annually, with an overall DC of 0.67. Additional metrics include a Productivity Coefficient of 0.78 and an Average Yearly Contribution of 1.17. His most productive period was between 2020-2024, during which he published 14 papers. Dr. Ayyadurai is listed as the first author in 22 publications, reflecting his leadership in research. His most frequent collaborator is P. Deonikar, with 25 joint publications over 13 years. The majority of his papers were published in the American Journal of Plant Sciences; and Health and Environmental Research Online (HERO). A country-wise distribution reveals that the USA accounts for 61.11% of his total publications. This study also examines whether this data set validates Bradford's and Lotka's Laws or not. **Conclusion:** This bibliometric study offers valuable insights into Dr. Ayyadurai's research legacy and serves as a resource for future scholars and information scientists.

Keywords: Bibliometric, Electronic mail, E-mail, Scientometric, Shiva Ayyadurai, Statistical analysis, Teenage inventor, V. A. Shiva Ayyadurai, VAS Ayyadurai, Vellayappa Ayyadurai Shiva.

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INTRODUCTION

Blessing of science, scientific inventions have made human life more beautiful and sophisticated. E-mail is one of the blessings and important quick communication service over the world. E-mail, short for *Electronic mail*, is a method of exchanging digital messages over the internet that has transformed global communication since its broader adoption in the 1970s and 1980s. In 1971, *Raymond Samuel Tomlinson*, an American computer scientist, developed the first networked email system on *ARPANET*, the precursor to the modern internet. His application enabled users to send messages between computers, marking a major milestone in digital communication (Wikipedia, 2025). Meanwhile, in 1978, *Shiva Ayyadurai*, an Indian-American scientist, developed a software program called *"EMAIL"* at the age of 14. Written in FORTRAN, the program replicated the interoffice mail system used at the University of Medicine and Dentistry of New Jersey (UMDNJ). Ayyadurai later received a *U.S. copyright* for the program, and he controversially claims

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to be the inventor of email (The Washington Post, 2012). The invention of email has been the subject of ongoing debate. While Tomlinson is widely credited with creating the first *networked email system*, Ayyadurai argues that he developed the first *full-featured electronic mail system* for office use. The controversy largely hinges on how "invention" is defined-whether it refers to the technical first instance of sending messages over a network, or the creation of a structured email system resembling modern platforms. This episode begins by exploring Dr. Shiva Ayyadurai's multifaceted scholarly contributions, which intersect the fields of systems biology, computational modeling, biological engineering, and information technology, along with notable endeavors in innovation and entrepreneurship.

Early Life and Education

Dr. Shiva Ayyadurai, an Indian-American engineer, entrepreneur, and anti-vaccine activist, was born on December 2, 1963, in Bombay (now Mumbai), India. His birth name is Vellayappa Ayyadurai Shiva. He spent his early childhood in Muhavur village, located in Rajapalayam, Tamil Nadu, in southern India. His family, of Indian Tamil heritage, immigrated to the United States when he was just seven years old, in 1970 (Sanjeevi, 2013; Wikipedia, 2025). Ayyadurai's father is Vellayappa Ayyadurai, and his mother is Deepa Ayyadurai. While attending Livingston High School in New Jersey, he volunteered at the University of Medicine and Dentistry of New Jersey (UMDNJ), where his mother was employed. In 1978, at the age of 14, Ayyadurai participated in a summer program at the Courant Institute of Mathematical Sciences at New York University (NYU) to study computer programming (Wikipedia, 2025). He later attended the Massachusetts Institute of Technology (MIT), where he earned his Bachelor of Science in Electrical Engineering and Computer Science in 1986 (Trafton, 2007). This was followed by two master's degrees at MIT-one in Scientific Visualization (1987-1989) and another in Applied Mechanics (1988-1990). He went on to complete his Ph.D. in Systems Biology from MIT in 2007 (Sanjeevi, 2013; Wikipedia, 2025). That same year, he received a Fulbright U.S. Student Program grant to explore how Siddha-an ancient system of traditional medicine from South India-could be integrated with modern systems biology (Wikipedia, 2025). Dr. Shiva Ayyadurai, an Indian-American inventor and entrepreneur, married actress Fran Drescher on *September 6, 2014*, in an intimate ceremony at their beachfront home in Los Angeles. The couple had been dating for over a year before their wedding. Drescher was known for her role in the TV show *The Nanny* (Olya, 2014). The couple separated in *September 2016*. Ayyadurai later clarified that their 2014 ceremony was not a formal wedding but a spiritual celebration of their friendship with close friends and family (Wikipedia, 2025).

Research Carrier and Discovery

Dr. Shiva Ayyadurai is an Indian-American scientist and entrepreneur known for his controversial claim of inventing email. In 1978, at the age of 14, he developed a program named "EMAIL" while working as a research fellow at the University of Medicine and Dentistry of New Jersey (UMDNJ). This program replicated the interoffice mail system, featuring components like Inbox, Outbox, Folders, and Address Book. In 1982, Ayyadurai was awarded the first U.S. copyright for this software, which he argues legally recognized him as the inventor of email (GODS, 2025). However, this claim has been widely disputed by experts. Prior to Ayyadurai's work, electronic messaging systems had been in use since the 1960s, with Ray Tomlinson's 1971 implementation on ARPANET being a notable example. Critics argue that Ayyadurai's system was a localized version for internal communication, not a groundbreaking innovation in the broader context of email development (Reddit.com, 2020). Beyond his work on email, Ayyadurai has pursued various ventures in science and technology. He holds four degrees from the Massachusetts Institute of Technology (MIT), including a Ph.D. in Biological Engineering. His doctoral research led to the development of CytoSolve®, a computational platform for modeling complex biological systems without animal testing (GODS, 2025). Additionally, he founded EchoMail, a company specializing in email management software, which served clients like Kmart and American Express (Wikipedia, 2025). Ayyadurai's career has been marked by both innovation and controversy, particularly regarding his claims about the invention of email. While his contributions to technology and science are notable, the debate over his role in the history of email continues to be a subject of discussion.

Implementation of Discovery

In 1978, as a 14-year-old high school student, Dr. Shiva Ayyadurai developed a software program called *"EMAIL"* while volunteering at the University of Medicine and Dentistry of New Jersey (UMDNJ). This program was designed to replicate the traditional interoffice mail system digitally. It included features such as an Inbox, Outbox, Folders, and an Address Book, allowing users within the same organization to send, receive, and manage messages electronically. The system was written in *FORTRAN* and implemented on a *mainframe computer* used by the university. Ayyadurai was awarded the first U.S. *copyright* for the EMAIL software in 1982, which he argues formalizes his role as the creator of the email system as understood in the office environment (The Washington Post, 2012). The program served as a digital alternative to paper-based interoffice memos, streamlining communication within the university.

Dr. Shiva Ayyadurai's Involvements

Dr. V. A. Shiva Ayyadurai's involvements in following aspects may include (Wikipedia, 2025; Indian Frontliners (IFL) Kuwait, 2020; Duda, 2021).

Millennium Cybernetics / EchoMail

- In 1994, Shiva Ayyadurai founded a company called *Millennium Cybernetics*.
- The company developed emailmanagement / customerrelationship software originally called *Xiva*, later *EchoMail*. The tool analyzes incoming emails for an organization and either replies automatically or routes them to the appropriate department.
- By ~2001, EchoMail's clients reportedly included Kmart, American Express, and Calvin Klein, and it was used by over thirty U.S. Senators for handling constituent emails.

CSIR India (Council of Scientific and Industrial Research)

- In *2009*, Ayyadurai was recruited by CSIR under its director-general (Samir K. Brahmachari) to help establish *CSIRTech*, a publicprivate partnership to commercialize / spin off technologies developed in CSIR's labs.
- His role was reportedly that of "Outstanding Scientist and Technologist of Indian Origin" and as an Additional Secretary in the Indian government.
- Ayyadurai prepared a critical "Path Forward" report for CSIR ("CSIRTech Path Forward") in which he criticized structural, governance, and operational issues at CSIR.
- According to reports, after delivering or publishing that critical report, he was dismissed by CSIR, allegedly on grounds of "unprofessional conduct," though Ayyadurai claims the dismissal was retaliation for his criticism.

Genetically Modified Food / GMO Safety Claims

- Around *2015*, Ayyadurai published / presented papers that use computational systems biology (modeling) to argue that certain GM soybeans ("RoundupReady Soy" etc.) are *not* "substantially equivalent" to nonGM counterparts. He claimed disruptions in biochemical pathways, specifically: lower antioxidant glutathione, higher formaldehyde accumulation, and disturbance in formaldehyde detoxification / other metabolic systems (C1 metabolism, etc.).
- He has publicly challenged GM food safety assessments and asked for stricter or more transparent standards. He offered a sort of bet / challenge to Monsanto (a major company in GM seeds), offering a building or money if they could disprove his claims.
- However, these claims have been critiqued by regulatory bodies. For example, the *European Food Safety Authority (EFSA)* evaluated one of Ayyadurai's lines of argument and criticized it for lacking sufficient data, lacking model validation, and not providing measurements of actual soybeans to show elevated formaldehyde.

Politics

Political Affiliation: Independent; formerly aligned with the Republican Party.

U.S. Senate Runs:

- 2018: Ran as an Independent in Massachusetts; lost.
- 2020: Ran in the Republican primary in Massachusetts; claimed election fraud after losing the primary.
- 2024: Announced candidacy for U.S. President as an Independent.

Election Misinformation

- After losing the 2020 Republican primary, Ayyadurai claimed the election was rigged, despite no credible evidence.
- Alleged that mail-in ballots and electronic voting machines were manipulated.
- Promoted conspiracy theories related to Dominion Voting Systems and ballot deletion.
- His claims were widely debunked by election officials and fact-checkers.
- Was banned from Twitter (now X) in 2021 for spreading COVID-19 and election misinformation, though later reinstated.

Key Claims/Misinformation

Patent claims

Ayyadurai claimed that COVID19 was patented by the Pirbright Institute. However, the patent he referenced was for an avian coronavirus (which infects birds), not SARSCoV2 (the virus responsible for COVID19).

Immune system/vitamin C treatment

He described COVID19 as "an overactive dysfunctional immune system that overreacts and that's what causes damage to the body," and suggested that things like vitamin C could treat it.

Deep-state/Anthony Fauci allegations

He has alleged that the pandemic is being used by elements of a "deep state," and has accused Dr. Anthony Fauci of being a "Deep State Plant," calling for Fauci's removal.

Skepticism about vaccines/mandatory vaccinations

He has expressed skepticism of COVID19 vaccines, questioned their necessity, and opposed mandates.

Opposition to measures like lockdowns

He published an open letter to President Trump in which he argued that a national lockdown was unnecessary, and instead promoted preventive alloflife measures and large doses of vitamins.

Literature Review

Over the years, bibliometric and scientometric studies have emerged as essential tools for evaluating the academic contributions of prominent individuals across diverse fields. Typically led by librarians and information scientists, these discipline-specific analyses underscore the sustained interest in assessing scholarly influence through quantitative research indicators. The trend was notably initiated by Srimurugan and Nattar (2008), who assessed the research productivity of Dr. K. Veluthambi, a renowned plant biologist. In 2010, Hazarika, Sarma, and Sen examined the scientific output of Dr. Nayana Nanda Borthakur, an eminent biometeorologist, while Sangam and Savanur conducted a bibliometric study on Eugene Garfield, the pioneering figure behind the fields of bibliometrics and scientometrics. Building upon these efforts, Mukherjee (2013) evaluated the work of Prof. Lalit Singh, followed by a comprehensive bibliometric and biographical study on Nobel Laureate Sir C. V. Raman by Manjunath and Ramesha (2015). A significant contribution came from Mondal, Raychoudhury, and Sarkhel (2018), who profiled Prof. P. C. Mahalanobis, a key figure in Indian statistics and the founder of the Indian Statistical Institute. In 2019, Dutta explored the scholarly legacy of Prof. B. K. Sen, a trailblazer in library science and scientometrics. The field further diversified with Teli and Maity's (2021) analysis of the scientific contributions of Stephen William Hawking, the world-renowned theoretical physicist. More recently (Huded et al., 2023), focused on the ecological scholarship of Prof. Madhav Gadgil. Between 2023 and 2024, Koley extended bibliometric profiling to the domains of medicine, law, mathematics, and computer science, covering influential figures such as Prof. Dilip Mahalanobis (a pioneer in oral rehydration therapy), Justice Fali Sam Nariman (India's first Additional Solicitor General), Dr. Raj Chandra Bose (co-discoverer of counterexamples to Euler's conjecture), and Dr. Alan Turing, whose foundational work shaped modern Artificial Intelligence. In 2024, Behera and Meher analyzed the academic contributions of Dr. Raghuram Rajan, a noted economist and former Governor of the Reserve Bank of India. The most recent studies include Koley's (2025) bio-bibliographic work on Emeritus Professor Dr. Ian Hector Frazer, the Pioneer of HPV Vaccine against Cervical Cancer in Women and the examination by Madhu, Kannappanavar, and Sab (2025) of Dr. Gautam Radhakrishna Desiraju, one of India's foremost chemists. These contributions reflect an expanding and interdisciplinary interest in scientometric research.

However, despite the growing and diverse corpus of such studies, no bibliometric or scientometric analysis has yet been conducted on Dr. Shiva Ayyadurai, the Indian-American engineer credited with inventing E-mail. This notable gap offers a timely and original opportunity to undertake the first comprehensive scientometric assessment of Dr. Ayyadurai's academic output and scholarly impact.

Objectives

The primary aim of this bibliometric study is to conduct a comprehensive analysis of the scholarly contributions of Dr. Shiva Ayyadurai. The specific objectives are as follows:

- To analyses the annual and age-wise distribution of his publications, identifying trends over the course of his academic career.
- To examine his authorship pattern, focusing on his role as lead author versus co-author.
- To calculate the Degree of Collaboration (DC) among his co-authored works.
- To assess author productivity, using standard bibliometric models and metrics.
- To identify recurring research collaborators, forming a profile of his research team and co-authorship network.
- To determine the preferred publication channels, including journals, conference proceedings, and books.
- To compute bibliometric indicators such as Collaboration Index (CI), Collaboration Coefficient (CC), and Modified Collaboration Coefficient (MCC) for his authorship pattern.
- To locate geographical distribution of his publications
- To examine Lotka's and Bradford's Law

METHODOLOGY

This study examines a total of 54 publications attributed to Dr. Shiva Ayyadurai, covering the time span from 1980 to 2025. His scholarly output reflects a multidisciplinary approach, encompassing systems biology, computational modeling, biological engineering, and information technology, along with significant contributions to innovation and entrepreneurship. The primary data sources for this analysis were Google Scholar

(GS) and Wikipedia. The publication dataset consists of 26 journal articles, 4 conference papers, 11 books, 12 patents, and 1 technical report, disseminated across diverse platforms.

To ensure the completeness and accuracy of the dataset, additional information was retrieved from both online and offline repositories. The collected data was systematically compiled and organized using Microsoft Excel and MS Word, allowing for structured categorization in line with the study's objectives. Standard bibliometric and scientometric indicators were applied to the dataset, and the results are presented and discussed in detail in the subsequent sections.

Statistical Analysis

Bibliometric or informetric analysis can be defined as a type of statistical analysis applied to scholarly information. It involves the application of mathematical and statistical techniques to scholarly publications such as books and journals, magazines, as well as related data, and other information sources such as Web-documents, mass media, social media, etc. in order to systematically analyze and interpret the findings.

RESULTS

Based on the data collected on Dr. Shiva Ayyadurai from 1980 to 2025, the following results have been presented through tabulation using bibliometric indicators to develop a scientometric profile of the scientist.

Year and Age-wise Publications

Table 1 presents year-age-wise publications including yearly participation of co-authors. The publication trajectory of Dr. Shiva Ayyadurai spans 45 years (1980-2025), with a total of 54 publications distributed across various stages of his academic and professional life.

Productivity Coefficient

Significantly, 50% of her total publications (i.e., 27 papers) were completed by the beginning of 2015, at which point her productive academic age was 36 years, considering her publishing journey began at age 27. Using this data, his *Productivity Coefficient* (Sen and Gan, 1990) is calculated as 36/46 = 0.78:

$$\text{Productivity Coefficient} = \frac{\text{50th Percentile Productive Age}}{\text{Total Productive Age}} = \frac{36}{46} = 0.78$$

Average Yearly Contribution

Additionally, her average annual output (Sen and Gan, 1990) stands at:

$$\text{Average Yearly Contribution} = \frac{\text{Total Publications}}{\text{Total Productive Years}} = \frac{54}{46} = 1.17 \text{ papers per year}$$

Quinquennium wise Paper Publications

The quinquennial (five-yearly) analysis of paper publications, as detailed in Table 2, reveals a clear trend in research activity over time and Figure 1 has drawn line diagram showing age wise peak productivity. Period during 1970-2025.

Authorship Pattern

Table 3 presents the *authorship pattern over time*, differentiating between *non-collaborative* (single-author) and collaborative (multi-author) papers. The data offers insights into evolving trends in academic collaboration from *1980 to 2025.*

Collaboration Index (CI), Collaboration Co-efficient (CC) and Modified Collaboration Coefficient (MCC)

Using standard formulas (Yadav, Singh, and Verma, 2019; Ravichandra and Rajendra, 2024) value of Collaboration Index (CI), Collaboration Co-efficient (CC) and Modified Collaboration Coefficient (MCC) are calculated and listed in Table 4 and a graphical representation has been drawn in Figure 2. From the observed data set of the table, the following bibliometric indicators are obtained with examples.

Collaboration Index (CI)

Collaborative Index (CI) is the average number of authors per article in a given set of publications. It serves as a basic indicator of collaborative activity in research.

CI for a Year = [(single-authored × number of single-authored paper) + (two authored × number of two authored papers) + (Three authored × number of three authored papers) + so on] ÷ Grand total number of papers.

For example,

CI for 1989 = [1 x 1 + 6 x 1] ÷ 2

= 7 ÷ 2 = 3.5 and so on.

[Note that, first 1 for single- authored paper, 6 for six authored papers, next 1 for number of particular authored paper, etc.]

Collaboration Co-efficient (CC)

It quantifies the proportion of multi-authored papers in relation to the total number of papers published, helping to assess the extent of collaborative research within a given data set or discipline.

CC for a Year =1 - {$\sum$(1÷ *authorship pattern* × *total number of papers for specific authorship pattern*) / *Grand total number of papers for the year}. For example,*

CC for 1989 = 1- {[(1/1 x 1) + (1/6 x 1)] ÷ 2}

= 1- {[(1 + 1 /6] ÷ 2}

= 1- {[1 + 0.17] ÷ 2}

Table 1: Year and age wise distribution of Publications, 1980-2025.

Year	APC	CAPC	A's Age	PP Age	SAP	MAP	Authorship Position (S)						CoA	DC
							S1	S2	S4	S5	S9	S7		
1980	1	1	17	1	1									-
1985	1	2	22	6		1			1				4	1.00
1988	1	3	25	9		1		1					4	1.00
1989	2	5	26	10	1	1	1						5	0.50
1990	1	6	27	11	1									-
1993	1	7	30	14		1				1			4	1.00
1996	1	8	33	17	1									-
1997	1	9	34	18	1									-
2003	1	10	40	24	1									-
2004	2	12	41	25	2									-
2007	3	15	44	28	2	1	1						1	0.34
2008	1	16	45	29		1							2	1.00
2010	1	17	47	31	1									
2011	3	20	48	32	1	2	1		1				5	0.67
2012	2	22	49	33	2									
2013	3	25	50	34	1	2	1			1			8	0.68
2014	1	26	51	35	1									
2015	8	34	52	36	1	7	3			3	1		33	0.88
2016	2	37	53	37		2	1	1					5	1.00
2017	1	38	54	38	1									
2021	3	41	58	42		3	2					1	19	1.00
2022	4	45	59	43		4	4						7	1.00
2023	5	50	60	44		5	3	2					8	1.00
2024	2	52	61	45		2	2						2	1.00
2025	3	55	62	46		3	3						6	1.00
Total	54				18	36	22	4	2	5	1	1	113	0.67

= 1- {1.17 ÷ 2} =1- 0.59 = 0.41 and so on.

This metric is often used in bibliometric studies to understand collaboration trends across authors, institutions, or countries.

Modified Collaboration Coefficient (MCC)

The MCC is a bibliometric indicator used to measure the degree of collaboration in scientific research. It's a refinement of the original Collaboration Coefficient (CC), which quantifies the extent of co-authorship in scholarly publications.

MCC for a Year = [N ÷ (N - 1)] × [CC for the specific year].

For example,

MCC for 1989 = [2 ÷ (2-1)] × 0.41 =2 × 0.41 = 0.82 and so on.

Status in Byline of Authors

Table 5 illustrates the authorship byline positions of an individual named *Shiva* across 36 collaborative publications, offering insight into their role and prominence in joint research work. Shiva appears most frequently as the *first author in 22 papers*, indicating a leading role in the majority of collaborations, particularly in two-authored and three-authored works.

Main Author and Co-authors

Table 6 presents a chronological overview of publications highlighting the names of *first authors and their co-authors* from *1985 to 2025*, showcasing the collaborative nature of research over time and the recurring presence of *VAS (or S) Ayyadurai* in various roles.

Core Research Associates

Table 7 highlights the core research associates of Shiva Ayyadurai from 1980 to 2025, based on frequency and consistency of collaboration. It includes papers with Ayyadurai, the span of associateship, papers per year, and collaborators arranged from the highest to the lowest number of papers coauthored with the scientist.

Core Publishing Platforms

An analysis of Table 8 reveals a diverse range of core publishing platform or *communication channels* used by Shiva Ayyadurai for disseminating his research between 1980 and 2025, spanning *journals, conference proceedings*, *books*, *patents*, and *technical reports*. Figure 3 graphically represents the types of source of publications.

Prominent Scholarly Channels and Bradford's Law

Bradford's Law of Scattering states that if journals (or publication sources) are arranged in order of decreasing productivity (number of articles), they can be divided into *three zones* (Hertzel, n.d.):

Each zone contributes *approximately one-third of the total articles.*

The *number of sources* in each zone increases *geometrically* (e.g., $1 : n : n^2$).

To *validate Bradford's Law* using Table 7, it must analyze that how the *distribution of articles* is spread across different *publication sources* (i.e., journals, conferences, books, patents, etc.). According to the data in Table 7, validation test can start step by step.

Step 1: Total Publications (TP) = 54,

Step 2: Total Sources = 47 (numbered 1-47 in the table), and

Step 3: Sources by Productivity (Descending Order) from Table 7 i.e.

3 articles each in 2 sources = 6 articles.

2 articles each in 3 sources = 6 articles.

1 article each in 42 sources = 42 articles.

So,

No. of Articles	No. of Sources	Total Articles
3	2	6
2	3	6
1	42	42
Total	47	54

Step 4: Division into Bradford's Zones (1/3 of Total Articles = 18 per zone)

According to the Bradford's Law, the 54 articles should be distributed into 3 zones of approx. 1/3 of total articles i.e. 18 articles each. Details are given below.

Zone	Articles	No of sources	Remarks
Zone I	18	11	2 sources with 3 articles each = 6 3 sources with 2 articles each = 6 6 sources with 1 article each = 6 So, 2 +3 + 6= 11 sources, and 6 + 6 + 6 = 18 articles.
Zone II	18	18	18 sources with 1 paper each
Zone III	18	18	18 sources with 1 paper each

Step 5: Bradford Multiplier

According to Bradford's Law, if the core (Zone 1) has **k** journals, the zones should follow a geometric progression: $k : kn : kn^2$

Here, Zone I = 11 sources

So:

Zone II should be $11 \times n$

Zone III should be $11\times n^2$

and

Zone II = 18, multiplier $n = 18 \div 11 = 1.64$

Predicted / expected Zone III = $11 \times (1.64)^2 = 29.59$ or 30

Actual Zone III = 18 (observed), that is much *lower than expected.*

The above results are interpreting that

Zone I (11 sources) accounts for one-third of the output - this aligns well with Bradford's Law.

Zone II (18 sources) also aligns numerically.

Zone III (18 sources), however, is **much smaller** than the expected 29-30 sources.

This indicates a *partial conformity* to Bradford's Law:

The *core-periphery structure* is visible.

But the *geometric progression of source counts* is not strictly followed.

DISCUSSION

On the basis of the findings presented above, the discussion brings together the key factors that influence the study outcomes. By integrating these factors, the discussion aims to provide a coherent interpretation of the results and to underscore their relevance and implications.

Table 2: Quinquennium wise paper publication.

Quinquennium	ABA	Papers	P/Y	%
1980-1984	17-21	1	0.2	1.85
1985-1989	22-26	4	0.8	7.41
1990-1994	27-31	2	0.4	3.7
1995-1999	32-36	2	0.4	3.7
2000-2004	37-41	3	0.6	5.56
2005-2009	42-46	4	0.8	7.42
2010-2014	47-51	10	2	18.5
2015-2019	52-56	11	2.2	20.37
2020-2024	57-61	14	2.8	25.93
2025-2029	62-66	3	0.6	5.56
Total		54		100

Table 3: Authorship pattern with time span.

Number of authors	Sa	2a	3a	4a	5a	6a	7a	9a	18a	Total
Non-collaborative papers	18									18
Collaborative papers		12	8	3	8	1	1	2	1	36
Time span (Total)	37	18	17	9	30	1	1	1	1	
Duration	1980-2017	2007-2025	2008-2025	2016-2025	1985-2015	1989	2013	2015	2021	

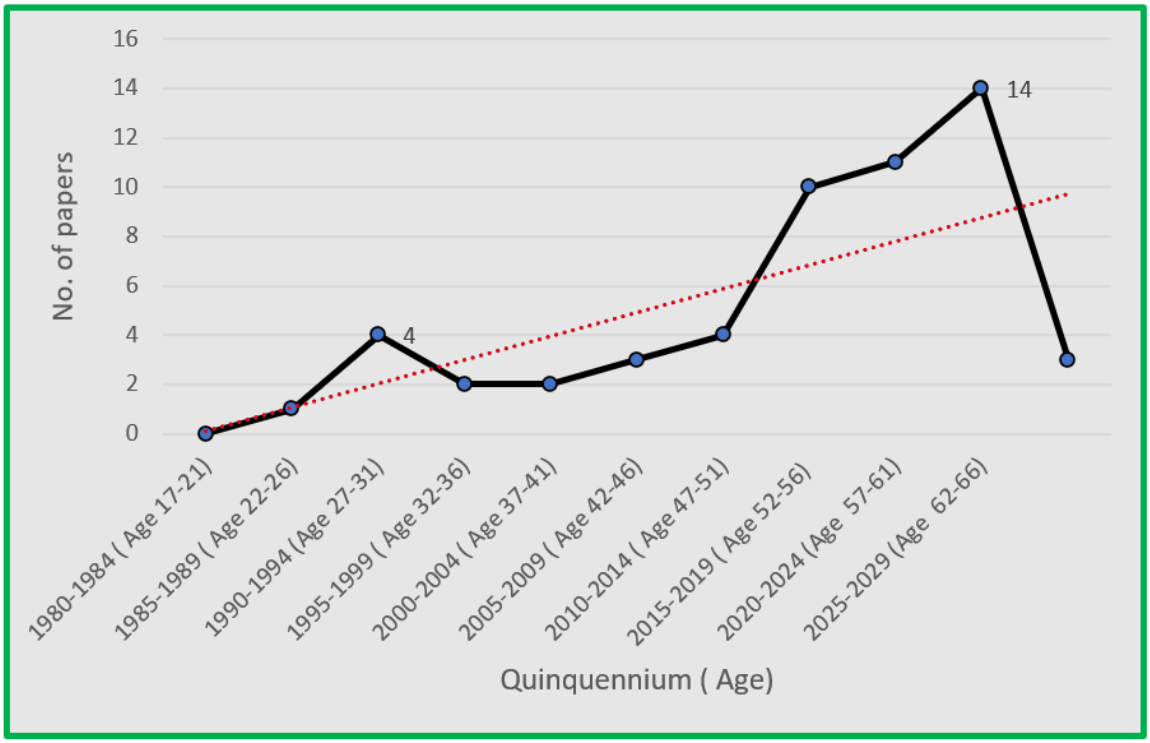

Figure 1: Quinquennium and age-wise peak productivity.

Table 4: Calculation for CC, CI and MCC.

Year	Total	Authorship Pattern									Bibliometric Indicators		
		I	II	III	IV	V	VI	VII	IX	XVIII	CC	CI	MCC
1980	1	1									0.00	1.00	0.00
1985	1					1					0.80	5.00	0.00
1988	1					1					0.80	5.00	0.00
1989	2	1					1				0.41	3.50	0.82
1990	1	1									0.00	1.00	0.00
1993	1					1					0.80	5.00	0.00
1996	1	1									0.00	1.00	0.00
1997	1	1									0.00	1.00	0.00
2003	1	1									0.00	1.00	0.00
2004	2	2									0.00	1.00	0.82
2007	3	2	1								0.16	1.34	0.24
2008	1			1							0.66	3.00	0.00
2010	1	1									0.00	1.00	0.00
2011	3	1	1			1					0.43	1.00	0.65
2012	2	2									0.00	1.00	0.00
2013	3	1		1				1			0.51	3.67	0.77
2014	1	1									0.00	1.00	0.00
2015	8	1	1			4			2		0.84	5.13	0.96
2016	2			1	1						0.43	3.50	0.86
2017	1	1									0.00	1.00	0.00
2021	3		2							1	0.65	7.34	0.98
2022	4		2	1	1						0.61	2.75	0.81
2023	5		2	3							0.60	2.60	0.75
2024	2		2								0.50	2.00	1.00
2025	3		1	1	1						0.39	3.00	0.59
Total	54	18	12	8	3	8	1	1	2	1	0.45	3.09	0.46

Chronological Publications, Role of authorship and Degree of Collaboration

According to the chronological list of publications, his first publication appeared at the age of 17 in 1980, marking an early entry into scholarly work. Publication frequency remained modest through the 1980s and 1990s, with a noticeable increase post-2007, peaking in 2015 with 8 publications. The cumulative growth shows a steady rise, especially after 2010, reflecting increased research productivity and collaboration.

A total of *113 co-authorships* were documented across Dr. Shiva Ayyadurai's publication record, with a significant number reflecting his leadership in research. He served as the sole author in 18 instances (S1) and as the first author in 36 publications (S2), underscoring his prominent individual and lead contributions. In contrast, mid and secondary authorship roles (S4, S5, S7, S9) became more frequent in later years, indicating a shift toward increased collaboration in multi-authored works.

Among these collaborative efforts, the Degree of Collaboration (DC) varied annually between *1.00 and 0.34*, with an *overall DC value of 0.66*, signifying a moderate level of co-authorship throughout his career. The highest number of co-authors engaged in a single year was *33 in 2015*, followed by *19 in 2021*, reflecting peak periods of collaborative productivity. Notably, Dr. Ayyadurai maintained an active publication profile well into his 60s, demonstrating both sustained scholarly engagement and adaptability. The data reflects a clear evolution in his research approach-from independently authored early works to more interdisciplinary and collaborative endeavors in his later career.

Quinquennium's Potential Output

A *noticeable increase* begins in the 2000-2004 period, where the number of papers starts to climb modestly. However, the most significant growth occurs in the 2010-2024 span. During 2010-2014, publications jumped to *10 papers* (18.5%), and this

Table 5: Status of Shiva in byline of authors.

Publications	Status in byline of authors							Total
	1st	2nd	3rd	4th	5th	7th	9th	
Two-authored	12							12
Three-authored	4	4						8
Four-authored	3							3
Five-authored	2			2	4			8
Six-authored			1					1
Seven-authored					1			1
Nine-authored	1						1	2
Eighteen-authored						1		1
Total	22	4	1	2	5	1	1	36

upward trend continued, peaking in 2020-2024 with 14 papers, accounting for 25.93% of the total. This marked increase may reflect factors such as enhanced institutional support for research, increased academic capacity, or improved access to publishing platforms.

The period *2015-2019* also saw a strong output (11 papers, 20.37%), indicating sustained momentum. The high values for both *papers per year* and *percentage share* during this 15-year window point to a period of prolific research productivity.

Interestingly, the current quinquennium (2025-2029) shows a drop to only *3 papers* so far (up to 2025), which is *5.56%* of the total. However, since this period is still ongoing, this lower figure may not be representative of the full quinquennium's potential output.

In summary, the data highlights a slow start, followed by gradual and then accelerated growth in research output, with the period from 2010 to 2024 emerging as the most productive era. The early years reflect foundational or formative stages, while the recent years suggest maturation and consolidation of research activities. The dip in the current quinquennium should be interpreted cautiously, as it may change by the end of the period

Authorship Pattern

From 1980 to 2017, a total of 18 non-collaborative (single-author) papers were published, reflecting an early trend of individual research efforts. However, starting from 2007, a significant shift towards collaborative authorship is observed. Two-author papers became the most common form of collaboration (12 papers from 2007-2025), followed by three-author (8 papers, 2008-2025) and five-author papers (8 papers, 1985-2015). Less frequent but notable are publications with larger groups-4, 6, 7, 9, and even 18 authors-indicating occasional involvement in more complex or interdisciplinary research projects, especially in the recent decade. The presence of a paper with 18 authors in 2021 particularly highlights participation in large-scale collaborations. Overall, the data reflects a transition from solitary research toward teamwork and collective scholarship, aligning with broader academic and scientific trends over the last few decades.

CC, CI and MCC

The year-wise calculation of the Collaborative Coefficient (CC), Collaboration Index (CI), and Modified Collaborative Coefficient (MCC) based on authorship patterns. Overall, the data indicate a clear predominance of collaborative research, as reflected by the total CC value of 0.45 and MCC of 0.46, suggesting a moderate level of collaboration over the study period. Single-authored papers were more common in the earlier years, resulting in low or zero CC and MCC values. However, from 2011 onward, there is a noticeable increase in multi-authored publications, with higher CC, CI, and MCC values, particularly during 2015, 2021, and 2024, indicating stronger collaborative trends. The overall CI value of 3.09 further confirms the growing tendency toward multi-authored research, highlighting an increasing emphasis on collaborative work over time.

Position in By line of authors

Findings of Table 5 suggests that Shiva was often the primary contributor or coordinator in these studies. Additionally, Shiva is listed as the *second author in 4 papers* and as the *third author once*, reflecting a significant yet supporting role in a few instances. In more extensive collaborations, such as five-authored papers, Shiva appears in *fourth, and fifth positions*, showing flexibility and teamwork in multi-author projects. Notably, Shiva is also credited as the *seventh author in one eighteen-author paper*, and as the *ninth author in a nine-author paper*, indicating participation in large-scale, possibly interdisciplinary efforts where authorship order may reflect specific contributions rather than leadership. Overall, the data reflects Shiva's consistent involvement in research, often in a leading capacity, but also as a collaborative team member in larger projects.

Name and Year-wise First Authors and Co-authors

Initially, in the 1980s and early 1990s, Ayyadurai appears as either *a co-author or first author* in collaborative works with researchers like *GV Novakovic, LE Freed, RS Langer*, and others, indicating early involvement in research networks. From *2007 onward*, Ayyadurai increasingly emerges as *a lead or co-lead author*, marking a transition into a more prominent authorship role. Notably, Ayyadurai is listed as a *first author (sole or shared)* in nearly every year between *2007 and 2025*, often collaborating with recurring names such as *P Deonikar, CF Dewey*, and others, suggesting ongoing research partnerships. The 2021 publication stands out with an extensive list of co-authors, indicating involvement in a large-scale, likely interdisciplinary or institutional project. Across the timeline, *P Deonikar* appears most frequently as a co-author, reflecting a strong, sustained research collaboration. Overall, the data highlights Ayyadurai's evolution from a team contributor to a central research figure, consistently leading or co-leading studies in recent decades while maintaining long-term collaborative relationships.

Research Team of Shiva Ayyadurai

At the top of the list (Table 7) is *P. Deonikar*, the most prominent collaborator, with 25 papers over 13 years (2013-2025), averaging nearly 2 papers per year, indicating a sustained and productive research partnership. In second place are M. Mohan and *S. Kothandaram*, each with 6 papers published in 2015 alone, suggesting an intensive collaboration during that specific year. *C. Forbes Dewey* ranks third with 5 papers over 7 years, reflecting a long-term, though less frequent, partnership. Other notable collaborators include V. *Venugopal, Beracah Yankama, DA Nordsletten*, and *Brian Carey*, each contributing multiple times across different time spans. The remaining co-authors, many of whom i.e. 43 appear only once, likely represent short-term, project-specific collaborations or participation in larger research consortia. Overall, the data points to a core group of consistent collaborators, especially *Deonikar to Dewey*, who have played significant roles in Ayyadurai's research trajectory, supported by a broader network of occasional contributors.

Author Productivity and Lotka's Law Validation Test

An analysis of the co-authorship data reveals that out of 60 individual collaborators, 43 co-authors (71.67%) have contributed to only one publication, 12 co-authors (20%) have authored two papers, and 1 co-author (1.67%) has contributed to 25 papers. According to Lotka's Law, the number of authors publishing n papers is approximately $1/n^2$ of those publishing a single paper. Based on this, if 43 authors published one paper, then around 11 authors should have published two papers ($43/2^2 = 10.75$), and approximately 1.72 authors should have published four papers ($43/4^2 = 2.69$), and so on (Hertzel, n.d.).

Table 6: List of year wise names of First authors and Co-authors.

Year	1st authors' Name	Co-authors' Name
1985	S Laxminarayan	O Mills, L Rajaram, S Ayyadurai, L P.Michelson
1988	S Ayyadurai	GV Novakovic, LE Freed, RS Langer, CL Cooney
1989	G. V. Novakovic	L. E. Freed, S. Ayyadurai, H. Bernstein, Robert S. Langer and C. L. Cooney
1993	Amar Gupta	M. V. Nagendraprasad', A. Liu, P. S. P. Wangt and S. Ayyadurai
2007	S Ayyadurai	CF Dewey
2008	E Sciacca	VAS Ayyadurai, CF Dewey
2011	VAS Ayyadurai, DA Nordsletten	CF Dewey Jr, B Yankama, R Umeton, VAS Ayyadurai, CF Dewey
2013	VAS Ayyadurai, Andrew Koo	P Deonikar, P Stashenko, David Nordsletten, Renato Umeton, Beracah Yankama, Shiva Ayyadurai, Guillermo García-Cardeña, C Forbes Dewey
2015	VAS Ayyadurai, M Mohan, S Kothandaram, P Deonikar	P Deonikar, S Kothandaram, M Mohan, V Venugopal, Cori Kollin, Phoebe Konecky, Rachael Olovyanniko, Zachary Zamore, VAS Ayyadurai, Brian Carey
2016	VAS Ayyadurai, MD Sweeney	M Hansen, J Fagan, P Deonikar, S Ayyadurai, BV Zlokovic
2021	VAS Ayyadurai, Hellen A Oketch-Rabah	P Deonikar, Mary L Hardy, Allison P Patton, Mei Chung, Nandakumara D Sarma, Charlie Yoe, VA Shiva Ayyadurai, Mary A Fox, Scott A Jordan, Mkaya Mwamburi, Diane R Mould, Robert E Osterberg, Corey Hilmas, Ram Tiwari, Luis Valerio Jr, Donnamaria Jones, Patricia A Deuster, Gabriel I Giancaspro
2022	VAS Ayyadurai	P Deonikar, RR Bannuru, KG McLure, KM Sakamoto
2023	VAS Ayyadurai, GJ Ramey	P Deonikar, C Fields, VAS Ayyadura
2024	VAS Ayyadurai	P Deonikar
2025	VAS Ayyadurai	P Deonikar, RD Kamm, V Radhakrishnan, A Keating

Table 7: Leading Co-authors with Shiva Ayyadurai, 1980-2025.

Serials	PW	Collaborators	FYP	LYP	YT	Paper/Year	Rank
1	25	P Deonikar	2013	2025	13	1.92	I
2	6	M Mohan	2015	2015	1	6	II
3	6	S Kothandaram,	2015	2015	1	6	II
4	5	C Forbes Dewey	2007	2013	7	0.71	III
5	4	V Venugopal	2015	2015	1	4	III
6	2	Beracah Yankama,	2011	2013	3	0.67	IV
7	2	Brian Carey	2015	2015	1	2	IV
8	2	DA Nordsletten,	2011	2013	3	0.67	IV
9	2	GJ Ramey,	2013	2023	11	0.18	IV
10	2	GV Novakovic,	1988	1989	2	1	IV
11	2	LE Freed,	1988	1989	2	1	IV
12	2	Zachary Zamore,	2015	2015	1	2	IV
13	2	CL Cooney	1988	1989	2	1	IV
14	2	Cori Kollin,	2015	2015	1	2	IV
15	2	Phoebe Konecky	2015	2015	1	2	IV
16	2	Renato Umeton	2011	2013	3	0.67	IV
17	2	Robert S. Langer	1988	1989	2	1	IV
18	1 each	A Keating, A. LIU, Allison P Patton, Amar Gupta, Andrew Koo, C Fields, Charlie Yoe, Corey Hilmas, Diane R Mould, Donnamaria Jones, E Sciacca, Gabriel I Giancaspro, Guillermo García-Cardeña, H. Bernstein, Hellen A Oketch-Rabah, J Fagan, KG McLure, KM Sakamoto, LP Michelson, L Rajaram, Luis Valerio Jr, M Hansen, MV Nagendraprasad, Mary A Fox, Mary L Hardy, Mei Chung, Mkaya Mwamburi, Nandakumara D Sarma, O Mills, P Stashenko, PSP Wangt, Patricia A Deuster, R Olovyanniko, Rachael Olovyanniko, Ram Tiwari, RD Kamm, Robert E Osterberg,, RR Bannuru, S Laxminarayan, Scott A Jordan, V Radhakrishnan, BV Zlokovic, MD Sweeney [43]			1 year each	1 per year	V

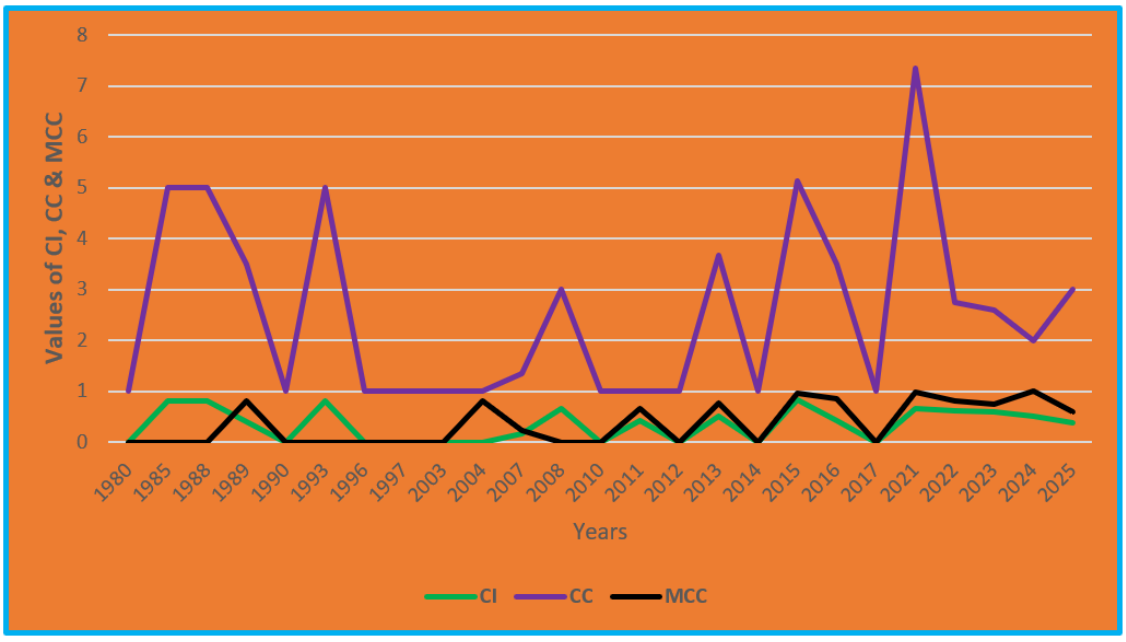

Figure 2: Graphical representation of CI, CC and MCC.

Table 8: List of dominant channels of Knowledge Dissemination.

Rank	Communication Channels	TP	%-age	Cum-%	YFP	YLP	Country
Group A	**JOURNAL ARRTICLES (26, 48.20%)**						
1	American Journal of Plant Sciences	3	5.57	5.57	2015	2016	USA
2	Health and Environmental Research Online (HERO)	3	5.57		2015	2015	USA
3	Agricultural Sciences	2	3.72		2015	2015	USA
4	Clinical Nutrition ESPEN	2	3.72		2021	2022	Frace
5	Nutrients	2	3.72		2023	2023	Switzerland
6	Applied Sciences	1	1.85		2022	2022	Switzerland
7	Biophysical Journal	1	1.85		2013	2013	USA
8	Cancers	1	1.85		2022	2022	Switzerland
9	Cellular and Molecular Bioengineering	1	1.85		2011	2011	Germany
10	Dissertation Abstracts International	1	1.85	31.55	2007	2007	USA
11	IEEE transactions on biomedical engineering	1	1.85		2011	2011	USA
12	International Journal of Pattern Recognition and Artificial Intelligence	1	1.85		1993	1993	Singapore
13	International Journal of System of Systems Engineering	1	1.85		2014	2014	UK
14	JADA Foundational Science	1	1.85		2013	2013	USA
15	Journal of Dietary Supplements	1	1.85		2021	2021	UK
16	Mathematics Teacher	1	1.85		1980	1980	USA
17	Nature Neuroscience	1	1.85		2016	2016	UK
18	NPJ Systems Biology and Applications	1	1.85		2025	2025	UK
19	Stem Cells	1	1.85	48.20	2025	2025	USA
Group B	**CONFERENCE PAPERS (4, 7.40%)**	`					
20	12th international research symposium on service excellence in management	1	1.85	50.05	2011	2011	India
21	8th IEEE International Conference on Bio-informatics and Bio-engineering	1	1.85		2008	2008	Greece
22	Proceedings of the Annual International Conference of the IEEE Engineering	1	1.85		1988	1988	USA
23	Proceedings of the International Conference on Medical and Biological…	1	1.85	55.60	1985	1985	Japan
Group C	**BOOKS (11, 20.35%)**						
24	Arts and the Internet: A Guide to the Revolution, Allworth Press	1	1.85	57.45	1996	1996	USA
25	Future Visions on Biomedicine and Bioinformatics 1: A Liber Amicorum in Memory of Swamy Laxminarayan	1	1.85		2010	2010	Germay
26	The email revolution: How to build brands and create real connections. All Aboard, Inc,	1	1.85		2012	2012	USA
27	The Email Revolution: Unleashing the Power to Connect, Allworth Press, New York	1	1.85		2013	2013	USA
28	Scalable computational architecture for integrating biological pathway models, Massachusetts Institute of Technology	1	1.85		2007	2007	UK

Rank	Communication Channels	TP	%-age	Cum-%	YFP	YLP	Country
29	Computational wave propagation in isotropic and anisotropic media using the generalized mass-spring lattice model, Massachusetts Institute of Technology, Department of Mechanical Engineering	1	1.85		1990	1990	UK
30	Visualization of wave propagation in elastic solids using a mass-spring lattice model, Massachusetts Institute of Technology, Dept. of Architecture	1	1.85		1989	1989	UK
31	The Myth of Substantial Equivalence and Safety Evaluations of Genetically Engineered Crops: A Cyto Solve Systems Biology Analysis, Synthetic Pesticide Use in Africa, 209-247	1	1.85		2021	2021	USA
32	Fluid Dynamic Study of the Enzymatic Fluidized Bed Reactor for Blood Deheparinization, Fluidization V (Publisher)	1	1.85		1989	1989	Un-known
33	The Internet Publicity Guide: How to Maximize Your Marketing and Promotion in Cyberspace. New York: Allworth Press	1	1.85		1997	1997	USA
34	All-American Indian: This Fight Is Your Fight-The Battle to Save America from the Elites Who Think They Know Better. General Interactive, LLC.	1	1.85	75.96	2017	2017	Unknown
Group D	**US PATENTS (6, 11.10%)**						
35	US Patent 6,718,368	1	1.85	77.80	2004	2004	USA
36	US Patent 6,718,367	1	1.85		2004	2004	USA
37	US Patent 6,668,281	1	1.85		2003	2003	USA
38	US Patent 11,642,360	1	1.85		2023	2023	USA
39	US Patent 12,342,841	1	1.85		2025	2025	USA
40	US Patent 12,167,997	1	1.85	87.05	2024	2024	USA
Group E	**US PATENTS APP (6, 11.10%)**						
41	US Patent App. 18/474,019	1	1.85	88.90	2024	2024	USA
42	US Patent App. 18/123,128	1	1.85		2023	2023	USA
43	US Patent App. 18/120,659	1	1.85		2023	2023	USA
44	US Patent App. 17/606,247	1	1.85		2022	2022	USA
45	US Patent App. 14/120,114	1	1.85		2015	2015	USA
46	US Patent App. 13/271,319	1	1.85	98.15	2012	2012	USA
Group F	**TECHNICAL REPORT (1, 1.58%)**						
47	Computation and Systems Biology (CSB).	1	1.85	100	2007	2007	USA

In this data set:

The count of authors with *two publications* (12) *is very close* to the expected value (= 11), aligning well with Lotka's prediction.

However, there is *only one author* with *a very high number of papers* (25), which significantly exceeds the expected frequency for that level ($43/25^2 \approx 0.07$), indicating *an outlier or highly prolific collaborator.*

Moreover, the absence of authors with intermediate publication counts (e.g., 3, 4, 5 papers) in the proportions expected by Lotka's Law weakens the overall fit.

Therefore, while the data shows *partial alignment with Lotka's Law*-particularly for authors with one or two publications-the overall distribution *does not fully conform* to the inverse-square pattern. The presence of a *single, highly prolific co-author and a lack of gradual decline* in author counts with increasing publications suggests that the dataset *deviates from Lotka's Law*, especially in *the upper tail of productivity*.

Leading Publication Channels

The *largest share* of publications (Table 8) falls under *Group A - Journal Articles*, accounting for over 48% of the total, indicating

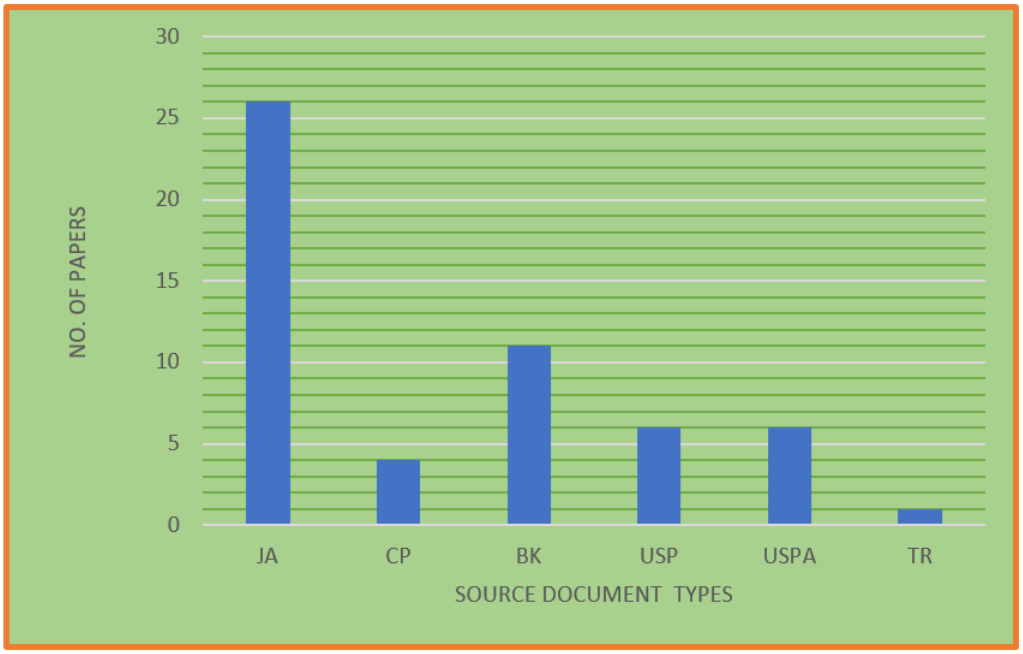

Figure 3: Bar diagram showing types source documents and number of papers published.

a strong preference for *peer-reviewed scholarly dissemination*. Leading journals include the *American Journal of Plant Sciences* and Health and Environmental Research Online (HERO), each with three publications, reflecting consistent engagement in plant and health sciences. *Group B*, comprising *conference papers,* accounts for a smaller portion but highlights early participation in international scientific forums, particularly during the 1980s and 2000s.

Ayyadurai has also published extensively in *Group C - Books*, covering both technical and public-facing topics such as *email, bioinformatics, marketing, and genetic engineering,* suggesting an effort to reach both academic and general audiences. This group represents roughly *18.5%* of the total, underlining his multidisciplinary communication style. *Groups D and E*, comprising *U.S. Patents and Patent Applications*, together form a significant component, illustrating a strong focus on *innovation and applied research*, particularly between 2003 and 2025. With *11 entries in total*, these legal-technical documents show a clear emphasis on translating research into protected intellectual property. Finally, *Group F includes a technical report,* reflecting occasional use of grey literature for specialized audiences.

Overall, the distribution of publication types showcases a *broad and strategic approach to knowledge dissemination*, blending *academic rigor, technological innovation, and public engagement.* The spread across *different media and decades* indicates not only a *sustained research output* but also a *deliberate effort to communicate with multiple stakeholders*-scientists, practitioners, policy-makers, and the public.

Bradford's Law Validation Test

The publication data from scholarly channels shows a *moderate fit with Bradford's Law*. While the distribution of articles does support the concept of a *core set of sources producing a significant portion* of publications, the expected geometric increase in the number of sources per zone is *not strictly observed* - especially in Zone 3. Therefore, the data set shows partial validation of Bradford's Law, with a clear core group of productive sources but a deviation from the idealized distribution in the outer zones.

Country wise Paper Publication

This study obtains distribution of Shiva's 54 publications by country, showing a strong dominance of the *USA*, which accounts for *61.11%* (33 publications). This overwhelming share suggests a significant alignment with American academic or publishing platforms, likely reflecting either institutional affiliations, target audiences, or the concentration of publishers in the USA. The *UK* follows at 1*2.95%*, and *Switzerland* at *7.41%*, both indicating moderate European engagement. Other countries-*Germany and France* (each 3.71%), and *Greece, India, Japan, and Singapore* (each 1.85%)-represent minimal contributions, suggesting limited reach or focus in those regions. The *2 publications listed as 'Unknown'* (3.71%) highlight either incomplete metadata or less formal publishing routes. Overall, the data reflects a *Western-centric publication profile*, with the USA as the dominant hub, and limited diversification across other global regions. This pattern could influence both the visibility and regional impact of Shiva's scholarly work.

CONCLUSION

Shiva Ayyadurai, an Indian-American scientist, has made notable contributions to the fields of science and technology. His work, particularly in systems biology and email technology, reflects his innovative spirit and dedication to advancing knowledge. Despite controversies surrounding his claims, his career continues to inspire meaningful discussions on innovation, intellectual property, and the evolution of digital communication. In today's world, email is an essential tool used by billions of people every day, yet very few know the name of the man who played a pivotal role in its invention-Dr. Shiva Ayyadurai, an Indian-origin scientist. At the remarkable age of just 14, he developed an electronic mail system while working at the University of Medicine and Dentistry of New Jersey, which he named "EMAIL." His system replicated the interoffice paper mail system in digital form, including features like Inbox, Outbox, Memo, Attachments, and more, laying the foundation for what we recognize today as email. This study is a heartfelt tribute to Dr. Shiva Ayyadurai for his groundbreaking discovery and his lasting impact on the way the world communicates. His journey is not only a testament to youthful genius but also an inspiration for aspiring scientists across the globe, especially from underrepresented backgrounds.

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ABBREVIATIONS

CoA: Co-author; **R/DC:** Correlation Coefficient/ Degree of Collaboration; **S1/Sa/SAP:** Single-authored; **S2/2a:** Two-authored; **YFP:** Year of First Publication; **YLP:** Year of Last Publication; **APC:** Annual Paper Count; **CAPC:** Cumulative Annual Paper Count; **A-Age/ABA:** Author's Biological Age; **Y/T:** Year Taken; **Cum-%:** Cumulative Percentage; **P/Y:** Paper per Year; **TP:** Total Paper; **PW:** Paper with Shiva; **PP Age:** Paper Productive Age; **MAP:** Multi-authored Paper.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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AUTHOR CONTRIBUTIONS

Dr. Koley conceived and planned the study, contributed to drafting the introduction, revised and enhanced the manuscript, and finalized the conclusions. Ms. Goswami handled data collection, organization, and tabulation, and drafted the initial manuscript under Dr. Koley's supervision.

SUMMARY

This study provides a comprehensive bibliometric analysis of Dr. Shiva Ayyadurai, an Indian-American scientist recognized for developing an early version of the email system at the age of 14 in 1978. The analysis covers 54 of his publications from 1980 to 2025, including journal articles, books, patents, and conference papers, sourced mainly from Google Scholar and Wikipedia. Dr. Ayyadurai's research spans 45 years and reflects a strong multidisciplinary approach across systems biology, computational modelling, biological engineering, and information technology. Of his works, 36 are collaborative and 18 are solo-authored, with a total of 113 co-authorships. His Degree of Collaboration (DC) averaged 0.67, with a Productivity Coefficient of 0.78 and an Average Yearly Contribution of 1.17. The most productive period was 2020-2024, with 14 publications. He is the first author in 22 papers, indicating a leadership role, especially in small-team research. P. Deonikar was his most frequent collaborator, co-authoring 25 papers over 13 years. Most of his works appeared in the American Journal of Plant Sciences and Health and Environmental Research Online (HERO). Geographical analysis shows 61.11% of his publications originated in the USA. The study also confirms the relevance of Bradford's and Lotka's Laws in analyzing his publication pattern. Overall, the study offers valuable insights into Dr. Ayyadurai's scholarly contributions and serves as a useful reference for future researchers and information scientists.

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