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Research Article

Bio-bibliometric Study of Gali Madhavi Latha, A Pioneering Female Geotechnical Engineer behind the World's Highest Railway Bridge at Chenab

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ABSTRACT

This study aims to evaluate the scholarly impact of Dr. Gali Madhavi Latha, a prominent Indian female geotechnical engineer, through a technometric and bibliometric assessment. The objectives are to quantify her research productivity, collaboration patterns, and influence on geotechnical engineering. Publication data spanning 1998-2025 were sourced from Google Scholar and ResearchGate, validated, and analysed using standard scientometric indicators. The dataset comprises 200 publications, including 12 single-authored and 188 co-authored, with journal articles representing 56% of her output. A significant concentration of her work appears in *Geotextiles and Geomembranes, Indian Geotechnical Journal*, and *International Journal of Geosynthetics and Ground Engineering* (together 40 papers). Peak productivity occurred between 2022 and 2025, averaging 7.14 papers per year, with a Productivity Coefficient of 0.68. She has collaborated extensively with T.G. Sitharam (23 joint publications). Her most cited work (1999) has 431 citations. Key metrics, including DC (0.94), CC (2.32), and MCC (0.47), highlight her collaborative and scholarly influence. Validation of Lotka's and Bradford's laws further contextualizes her contributions. This study demonstrates Dr. Latha's sustained, high-impact research, bridging experimental, analytical, and applied geotechnical engineering, underscoring her prominence in both academic and practical engineering domains.

Keywords: Best Woman Geotechnical Researcher, Bibliometric, Chenab Railway Arch Bridge, Design-as-you-go method, Gali Madhavi Latha, Geotechnical engineering, Indian Institute of Science (IISc) Bangalore, Kashmir valley, Women geotechnical engineer, World's highest rail bridge.

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INTRODUCTION

Dr. Gali Madhavi Latha, also known as G. Latha or GM Latha, is a renowned woman academician and researcher in the field of geotechnical engineering. She is a professor in the Department of Civil Engineering at the Indian Institute of Science (IISc), Bengaluru, where she also serves as the Chair of the Centre for Sustainable Technologies. Her research interests include soil reinforcement, geosynthetics, and rock mechanics. Dr. Latha played a pivotal role in the geotechnical aspects of the Chenab Rail Arch Bridge-the world's highest rail bridge-for over 17 years, contributing to its successful construction. Her work has earned her notable accolades, including being named the Best Woman Geotechnical Researcher by the Indian Geotechnical Society in 2021, and inclusion in the Top 75 Women in STEAM in India in 2022 (Wikipedia, 2025). This episode explores her contributions and impact through a scientometric lens, shedding light on her influence within the academic and engineering communities. Her research results are combinedly called the "*Design-as-you-go*" method. Despite aspiring to become a doctor in her childhood, a lack of familial support led her to pursue a career in engineering instead (IISc, n.d.).

The scientometric profile of Prof. Madhavi Latha builds upon earlier bibliometric portraits of eminent Indian scientists such as C.N.R. Rao, A.P.J. Abdul Kalam, and R.A. Mashelkar, which have mapped research productivity, collaboration networks, and citation impact across different scientific disciplines (Balasubramani and Murugan, 2011; Jeevan and Gupta, 2002; Kademani *et al*., 2005; Koley and Sen, 2021). While those studies focused primarily on male figures in materials science, aerospace engineering, and chemical technology, Dr. Latha's profile adds a gendered dimension, highlighting the visibility and challenges of women scientists in engineering and rehabilitation research. Thus, this study contributes to both disciplinary scientometrics and the broader discourse on gender equity in Indian science.

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Geotechnical Engineering

Geotechnical engineering is a branch of civil engineering that focuses on the investigation, classification, and evaluation of earth materials such as soil and rock. It involves the analysis, design, and construction supervision of foundations, slopes, retaining structures, and other systems that interact with the ground. The primary objective is the stabilization and protection of structures through the proper application of soil mechanics and rock mechanics principles, ensuring the safety, durability, and sustainability of engineering projects. Effective implementation of geotechnical principles requires careful observation, documentation, and interpretation of subsurface conditions to provide a reliable foundation for design and construction (Coduto, 2016).

The Chenab Railway Arch Bridge

The Chenab Bridge, built at a cost of ₹1,486 crore, is a remarkable engineering feat and the tallest railway bridge in the world-35 M taller than the Eiffel Tower. Spanning 359 metres above the Chenab River, it enhances connectivity to the Kashmir Valley and is considered one of the most challenging civil-engineering projects in India's railway history (ET Online, 2025; Wikipedia, 2025; Shah, 2025).

Early life and Education

Dr. G. Latha was born on 9 February 1971[?] in Yedugundlapadu village, located in Prakasam district, Andhra Pradesh, India. She completed her primary education at ZPGH School in Kandukur and pursued her intermediate studies at TRR Government College, Kandukur, between approximately 1985 and 1987. Dr. Latha earned her B.Tech. degree in Civil Engineering from the College of Engineering, Kakinada, under Jawaharlal Nehru Technological University (JNTU), Andhra Pradesh, from 1988 to 1992. She went on to obtain an M.Tech. Degree from the National Institute of Technology (NIT), Warangal, where she was awarded a Gold Medal for academic excellence (Starsunfolded, 2025; AIT, 2019). Dr. Latha completed her Ph.D. in Geotechnical Engineering at the Indian Institute of Technology Madras between 1995 and 2000, and later undertook post-doctoral research in Rock Engineering at the Indian Institute of Science (IISc), Bangalore, from 2000 to 2003 (IISc, n.d.; Wikipedia, 2025).

Professional Affiliations

Dr. G. Madhavi Latha is currently serving as a Higher Administrative Grade (HAG) Professor in the Department of Civil Engineering at the Indian Institute of Science (IISc), Bangalore, Karnataka, a position she assumed in July 2024. She joined IISc in June 2003 as an Assistant Professor and held that position until May 2009. She was subsequently promoted to Associate Professor in June 2009 and continued in that role until May 2015. From June 2015 to July 2024, she served as a full Professor in the department (Starsunfolded, 2025; AIT, 2019; Wikipedia, 2025). Before joining IISc, Dr. Latha worked as an Assistant Professor at the Indian Institute of Technology (IIT) Guwahati from April 2000 to June 2003. During her postdoctoral tenure, she also contributed as a faculty member at IISc. In July 2021, she was appointed as the Chairperson of the Centre for Sustainable Technologies at IISc (Starsunfolded, 2025). Since 2010, Dr. Latha has been actively involved in international technical committees, serving as a member of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) Technical Committee on Soil-Structure Interaction and the International Geosynthetics Society's Technical Committee on Soil Reinforcement (AIT, 2019). Notably, she is also recognized as the *first woman to become a faculty member in* the Department of Civil Engineering at IISc (Wikipedia, 2025).

Research Career

Dr. G. Madhavi Latha specializes in several core areas of geotechnical engineering, including *ground improvement using geosynthetics, earthquake geotechnical engineering, rock engineering*, and *numerical modelling in geomechanics*. Throughout her academic career, she has guided numerous Ph.D., M.Sc. (Engineering), and M.E. students, and continues to supervise doctoral research (AIT, 2019; Wikipedia, 2025). Dr. Latha has published extensively in both national and international journals and conferences and has contributed to a number of research and consultancy projects. She currently serves as the *Associate Editor of the Indian Geotechnical Journal* and as an *Editorial Board Member for Geotextiles and Geomembranes* (AIT, 2019). Her academic and professional contributions have significantly advanced geotechnical engineering education and research in India. Her research focuses on understanding *soil behaviour* and methods to enhance ground stability using *reinforcement techniques*, particularly *geosynthetics*. She has demonstrated how soil interacts with reinforcement materials, with special attention to the *frictional behaviour at interfaces*. Utilizing *advanced imaging techniques*, she has analysed micro-level surface deformations and linked these to corresponding stress and displacement responses. Dr. Latha has also made significant contributions *to ground improvement using geocells*, assessing their performance under foundations, retaining walls, and slopes. She has investigated how reinforced roads perform under *cyclic loading*, such as traffic-induced stresses, and examined the behaviour of *retaining structures during seismic events*. In the domain of *rock engineering*, Dr. Latha's work includes *modelling fractured rock masses, slope stability analysis*, and *the design of safe rock slopes*. Her expertise extends to challenging terrains, including *foundation design for bridges in geologically risky regions* (Starsunfolded, 2025). One of her most impactful contributions has been as a *technical advisor for the Chenab Railway Bridge project* in the Himalayan region in association with Indian Railways and the company AFCONS. Leveraging findings from her research, she pioneered a practical engineering approach known as the

"*Design-as-you-go" methodology*, which allows for real-time adjustments to design and construction based on evolving ground and rock conditions (ET Online, 2025; Starsunfolded, 2025). This approach was crucial in navigating unforeseen geological challenges such as fractured rock, hidden cavities, and variable rock properties-factors not apparent in early site investigations. Her contributions culminated in the successful construction of the Chenab Railway Bridge, an engineering marvel that enhances connectivity in the Kashmir Valley, representing a meaningful translation of academic research into real-world infrastructure for societal benefit.

Role in Building Chenab Railway Bridge

In 2025, She has published a paper in the *Indian Geotechnical Journal's* women's special issue titled *"Design as You Go: The Case Study of Chenab Railway Bridge."* This paper provides an indepth look at the engineering philosophy behind the world's highest railway bridge-the Chenab Railway Bridge. Located 359 m above the Chenab riverbed, the project posed massive challenges due to its altitude, difficult terrain, steep slopes, and complex geological conditions. Environmental stresses like high winds, seismicity, and temperature extremes added to the complexity. To manage these dynamic constraints, the project team adopted the *"design as you go"* approach, meaning major elements such as the overall bridge location and type remained constant, while design aspects like pier dimensions, foundation types, structural details, and other components were flexibly adapted as new geological and geotechnical information emerged. The paper draws on the author's 17 years of first-hand involvement in planning, designing, and constructing the bridge (Latha, 2025).

Awards and Recognitions

Dr. Latha was awarded and recognised in many ways (Civil.iisc, n.d.; Indian Geotechnical Society, 2025; KABR, 2021):

- Dr. Latha is listed in the top 75 women in STEAM of India (2022),
- Editor-in-chief, Indian Geotechnical Journal, Springer (2016-2022),
- Member, Editorial Board, Geotextiles and Geomembranes, Elsevier,
- Vice-Chairman, Karnataka Geotechnical Centre, Bangalore Chapter of Indian Geotechnical Society (2009-2012),
- Convenor of TC: Technical Committee on Ground Improvement and Reinforcement, Indian Geotechnical Society (2015 onwards),
- Nominated member of TC: Technical Committee on Reinforcement, International Geosynthetics Society (2011 onwards),
- Received the Outstanding Paper Award from the International Society for Rock Mechanics for "*Prediction of Stress-Strain Response of Jointed Rocks Using Artificial Neural Networks*" presented at the ISRM International Symposium, 2010,
- Nominated member of TC207 (Soil-Structure Interaction & Retaining Walls), ISSMGE, since 2010,
- "Teacher Extraordinaire" award by Builders Association of India, Mysore Centre, 2007,
- Best paper award in *FIYGEC-2007* for the paper "Comparison of different failure criteria for modelling jointed rocks" (2007),
- Received the Best Paper Award by ISRMTT for *"Prediction of Stress-Strain Behaviour of Intact and Jointed Rocks in Triaxial Compression," Journal of Rock Mechanics and Tunneling Technology* (2002),
- Gold Medal in Civil Engineering in M.Tech. (1995),
- Best Paper Award for the paper *"Geocell supported Embankments"* in National Seminar on*Ground Improvement Methods*, NIT Warangal (1998),
- Best paper award for paper "*Study of Soil and industrial Waste Water Interaction behaviour"* during*Terzaghi-94*, Kakinada (1994).

REVIEW OF LITERATURE

Over the years, bibliometric and scientometric studies have become key tools for assessing the academic contributions of distinguished individuals across various disciplines. These subject-focused analyses, often led by librarians and information scientists, highlight the enduring interest in evaluating scholarly impact through quantitative research metrics. The trend began with Srimurugan and Nattar (2008), who analyzed the research productivity of Dr. K. Veluthambi, a noted plant biologist. In 2010, Hazarika, Sarma, and Sen conducted a scientometric study of Dr. Nayana Nanda Borthakur, an eminent bio-meteorologist. That same year, Sangam and Savanur performed a bibliometric analysis of Eugene Garfield, the pioneer credited with founding the fields of bibliometrics and scientometrics. Building on this foundation, Mukherjee (2013) evaluated the research output of Prof. Lalit Singh, followed by Manjunath and Ramesha (2015) who undertook a comprehensive bibliometric and biographical study of Nobel Laureate Sir C. V. Raman. A notable contribution came from Mondal *et al.* (2018), who profiled Prof. P. C. Mahalanobis, a prominent Indian statistician and founder of the Indian Statistical Institute. In 2019, Dutta explored the scholarly legacy of Prof. B. K. Sen, a leading figure in library science and scientometrics. The field broadened further with Teli and Maity (2021), who analysed the publications of Stephen William Hawking, the globally renowned theoretical physicist. In 2023,

Huded *et al*., examined the contributions of Prof. Madhav Gadgil**,** an ecologist and environmental scientist. During 2023 and 2024**,** Koley expanded the domain of bibliometric profiling into medicine, law, and mathematics-highlighting figures such as Prof. Dilip Mahalanobis (oral rehydration pioneer), Justice Fali Sam Nariman (India's first Additional Solicitor General), and Dr. Raj Chandra Bose, the Indian-American statistician and co-discoverer of counterexamples to Euler's conjecture. In 2024**,** Behera and Meher profiled Dr. Raghuram Rajan, a prominent economist and former RBI Governor. In the same year, Kavi and Singh carried out a study on Prof. Roddam Narasimha, a distinguished scientist in the field of Aerospace Engineering. Most recently, Koley (2025) produced a bio-bibliographic study on Dr. Suprabhat Mukherjee, a leading researcher in colon cancer, illustrating the growing interdisciplinary scope of scientometric research.

Despite the growing body of bibliometric and scientometric studies profiling eminent scientists across disciplines, there remains a notable gap in the documentation of women's contributions to science and engineering. While several studies have focused on male scholars-from Nobel laureates like Sir C. V. Raman to modern figures such as Dr. Raghuram Rajan-very few have systematically analysed the scholarly impact of women scientists, particularly in technical fields such as geotechnical engineering. This imbalance reflects a broader gender disparity in scientometric research, where female representation in citation analyses, productivity assessments, and research profiling remains disproportionately low.

The absence of a scientometric portrait of *Dr. Gali Madhavi Latha*, the first Indian woman geotechnical engineer to attain international recognition, underscores this gap. Her pioneering leadership in the design and construction of the *Chenab Bridge*, the world's highest railway bridge, stands as a landmark achievement in civil engineering and infrastructure development. Yet, despite her significant academic and professional contributions, no comprehensive bibliometric evaluation of her work has been conducted.

This study, therefore, seeks to fill this critical void by undertaking a *scientometric analysis of Dr. Latha's research productivity, collaboration patterns, and citation impact*. Beyond celebrating an individual scholar, the study aims to broaden the visibility of women's achievements in Science, Technology, Engineering, and Mathematics (STEM)-fields where they are often underrepresented both in participation and recognition. By constructing a data-driven portrait of Dr. Latha's scholarly influence, the research contributes to gender-inclusive scientometric literature and provides a framework for future analyses of women scientists in engineering and allied domains.

STUDY OBJECTIVES

The primary aim of this bibliometric study is to conduct a comprehensive analysis of the scholarly contributions of Dr. Gali Madhavi Latha, a pioneering geotechnical engineer. The specific objectives are as follows:

- To analyse the annual and age-wise distribution of her publications, identifying trends over the course of her academic career,
- To examine her authorship pattern, focusing on her role as lead author versus co-author,
- To calculate the Degree of Collaboration (DC) among her co-authored works,
- To assess author productivity, using standard bibliometric models and metrics,
- To identify recurring research collaborators, forming a profile of her research team and co-authorship network,
- To determine the preferred publication channels, including journals, conference proceedings, and book chapters,
- To compute bibliometric indicators such as Collaboration Index (CI), Collaboration Coefficient (CC), and Modified Collaboration Coefficient (MCC) for her authorship pattern,
- To evaluate the citation impact of her work through citation analysis and 'cited by' metrics,
- To identify her most cited publications, highlighting the scholarly works with the greatest academic influence.

METHODOLOGY

This study presents a comprehensive bibliometric and scientometric analysis of a total of *200 publications* in the field of Geotechnical Engineering, authored by Dr. Madhavi Latha Gali (also known in publications as *M. L. Gali* or *G. M. Latha*). The analysed works span a period of *1998 to 2025*. The publication data were primarily collected from ResearchGate (RG), Google Scholar (GS), the researcher's ORCID *profile*, and her *official institutional website*. Data collection was carried out during the period *June 10 to August 28, 2025*. To ensure consistency and reliability, citation counts for all the identified publications were taken exclusively from the Google Scholar (GS) database.

The complete publication corpus comprises *112 journal articles, 68 conference papers, 3 books, 11 book chapters, 2 dissertations/ Ph.D. theses, and 4 other types of publications* disseminated across various national and international platforms. In addition to online sources, supplementary details were obtained from both online and offline repositories to ensure the comprehensiveness and accuracy of the dataset.

After data collection, all records were compiled, verified, and systematically organized using *Microsoft Excel* and *Microsoft Word*. The data were then *tabulated and categorized* in accordance with the study's objectives, forming the basis for subsequent analytical stages. The analysis employed a range of established *bibliometric and scientometric indicators* to evaluate the research output and impact of Prof. Madhavi Latha Gali. These included: Productivity Coefficient, Authorship pattern and Degree of Collaboration, Co-authorship and collaborative patterns, Status in authorship byline (lead, corresponding, or co-author positions), Core communication channels (key journals and conferences), Validation of Lotka's Law and Bradford's Law, Comparison with the ideal Bradford distribution, Relative Citation Index, Citation Growth Rate, and Citation Doubling Time, Collaborative metrics, including Collaboration Index (CI), Collaboration Coefficient (CC), and Modified Collaboration Coefficient (MCC), Citation analysis and related performance indicators. The results and interpretations derived from these analyses are discussed in detail in the subsequent sections of this study.

RESULTS AND DISCUSSION

Year and Age wise Distribution of Publications

Table 1 presents a chronological and age-wise overview of Latha's publication record over a 28-year period, spanning from 1998 to 2025. It is important to note that there were no publications in 1995. During this time, she has authored a total of 200 publications, of which 188 are multi-authored and 12 are single-authored. Her collaborative research involved 264 different co-authors. Latha's publishing career began in 1998, when she was 27 years old. The highest number of publications in a single year was recorded in 2023, with 21 papers, followed by 19 papers in 2024, 14 papers each in 2014 and 2016, 11 in 2022, and 10 in both 2008 and 2025. Throughout this period, her Degree of Collaboration (DC) reached a maximum value of 1.0, with all other annual values ranging between 0.50 and 0.95. The overall DC across her career is 0.94, reflecting a strong inclination towards collaborative work. Latha has taken the position of first author in 52 publications. The highest number of first-author roles in a single year occurred in 2008 (6 papers), followed by 2010 (5 papers). She has also frequently been the second author, most notably in 2023 (15 papers), 2024 (11 papers), and 2014 and 2016 (10 papers each).

Significantly, 50% of her total publications (i.e., 100 papers) were completed by the beginning of 2016, at which point her productive academic age was 19 years, considering her publishing journey began at age 27. Using this data, her *Productivity Coefficient* (Sen & Gan, 1990)is calculated as:

$$\text{Productivity Coefficient} = \frac{\text{50th Percentile Productive Age}}{\text{Total Productive Age}} = \frac{19}{28} = 0.68.$$

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

$$\text{Average Yearly Contribution} = \frac{\text{Total Publications}}{\text{Total Productive Years}} = \frac{200}{28} = 7.14 \text{ papers per year.}$$

These findings highlight Prof. Madhavi Latha Gali's sustained and collaborative research productivity over nearly three decades, marked by consistent output and strong teamwork. Her high Degree of Collaboration (0.94) and Productivity Coefficient (0.68) demonstrate a steady and impactful contribution to geotechnical engineering, reflecting both research leadership and long-term scholarly influence.

Authorship Pattern with Analytic Assessment

Table 2 presents the authorship pattern of Latha's 200 publications spanning the years 1998 to 2025. A detailed breakdown of the co-authorship distribution reveals significant trends in her collaborative work.

The majority of publications i.e.124 papers (62%) were co-authored by two individuals**,** including Latha. These appeared consistently over a 21-year period, indicating a sustained and possibly strong bilateral collaboration trend.

The second most common pattern involves *three-author papers*, totalling 53 publications (26.5%), published over a 24-year span. This suggests broader but still closely-knit collaborative efforts throughout most of her career.

Single-authored papers account for 12 publications (6%), distributed over 25 years, indicating Latha's continued engagement in independent research, albeit at a much lower frequency.

There are 10 four-authored papers (5%), published over a 23-year period, which might reflect occasional larger research collaborations or interdisciplinary projects.

Only one publication involved five authors, marking it as an outlier in her authorship pattern. This suggests that large-scale collaborations were extremely rare in her publication history.

Analytic Notes

Dominance of Two-Authored Papers

The fact that over 60% of Latha's publications are co-authored with just one other person may indicate a few long-standing and productive research partnerships.

Limited Multi-Authorship Expansion

While there is a reasonable number of three- and four-authored papers, the sharp drop beyond that (only one five-authored paper) implies that Latha has primarily worked within small research teams, with minimal engagement in large consortia or institutional group collaborations.

Sustained Solo Contributions

Though limited in number, the presence of single-authored papers across 25 years shows that she consistently maintained

Table 1: Year and Age wise Distribution of Dr. Latha's Publications.

Year	TP	CTP	ABA	PPA	SA	MA	Authorship Position				CoA	DC
							1st	2nd	3rd	4th		
1998	1	1	27	1		1			1		2	1.00
1999	1	2	28	2		1			1		2	1.00
2000	5	7	29	3	1	4	3		1		8	0.80
2001	3	10	30	4		3	2		1		7	1.00
2002	4	14	31	5		4		4			4	1.00
2003	1	15	32	6		1			1		3	1.00
2004	4	19	33	7		4	4				5	1.00
2006	9	28	35	9	1	8	4	3	1		11	0.89
2007	9	37	36	10	1	8	3	4	1		9	0.89
2008	10	47	37	11		10	6	4			12	1.00
2009	8	55	38	12	1	7	4	3			8	0.88
2010	7	62	39	13		7	5	2			8	1.00
2011	2	64	40	14	1	1		1			1	0.50
2012	6	70	41	15		6	1	4	1		8	1.00
2013	5	75	42	16		5	1	4			7	1.00
2014	14	89	43	17	1	13	2	10		1	17	0.93
2015	7	96	44	18	1	6	3	2	1		7	0.83
2016	14	110	45	19		14	2	10	2		18	1.00
2017	6	116	46	20	1	5		4	1		9	0.83
2018	4	120	47	21		4	1		3		10	1.00
2019	5	125	48	22	1	4		3	1		6	0.80
2020	5	130	49	23		5		5			6	1.00
2021	9	139	50	24	1	8	3	1	4		14	0.89
2022	11	150	51	25		11	1	8	1	1	15	1.00
2023	21	171	52	26		21	2	15	4		26	1.00
2024	19	190	53	27	1	18	4	11	2	1	29	0.95
2025	10	200	54	28	1	9	1	8			12	0.90
	200				12	188	52	106	27	3	264	0.94

individual scholarly output, which is often seen as a marker of intellectual independence.

Temporal Spread of Authorship Types

The longer time spans for publishing single-, three-, and four-authored papers (23-25 years) suggest a diverse and ongoing collaboration style, where different authorship types were maintained throughout her career rather than confined to specific phases.

Collaborative Stability

The consistency in authorship patterns over long durations reflects a stable collaborative trajectory, indicating sustained research engagement and strong professional relationships.

The *thematic evolution* of Prof. Madhavi Latha Gali's research closely mirrors her *career progression*, showcasing a natural and strategic broadening of focus over time. As her experience and collaborations expanded, her research themes appear to have evolved toward *applied and interdisciplinary areas*, integrating *geosynthetics, ground improvement, retaining structures, and soil-structure interaction*. This shift suggests a progression from theoretical exploration to *practical, solution-oriented research*,

aligned with growing academic maturity and professional leadership roles.

In later years, her increased co-authorship patterns and collaborative metrics indicate a move toward *team-led, multi-institutional, and mentoring-based research*, reflecting her position as a senior academic guiding projects and students. Thus, her thematic evolution from foundational studies to complex, collaborative, and applied research-parallels her academic trajectory from an emerging researcher to an established authority and thought leader in geotechnical engineering.

Quinquennium wise Paper Publications

Table 3 summarizes Latha's publication productivity across six quinquennias spanning 28 years (1998-2025), highlighting the number of publications, percentage contributions, and yearly publication rate (PY) in each period. A total of 200 papers were published over the 28-year span.

Early Stage (1998-2002)

In her early stage of her productive career, Latha produced 14 papers (7%). Latha's publishing career began modestly, with an average of 2.8 papers per year in her first quinquennium. This period likely represents the foundation-building phase, characterized by initial collaborations and establishing a research presence.

Growth Phase (2003-2007)

The second quinquennium contains 23 publications that shows a significant 64% increase in output compared to the first i.e. 14 to 23 papers. With a rise in productivity to 4.6 papers per year, this phase marks the beginning of a growth trajectory, possibly due to expanding research networks and increased experience.

Acceleration Phase (2008-2012)

Productivity continues to rise sharply and this phase consists of 33 publications (16.50%), with a 43% increase in publications over the previous period. Latha reaches mid-career here, with likely access to more projects, grants, and collaborators, resulting in a higher publishing rate.

Peak Productivity Phase (2013-2017)

This quinquennium marks a peak in scholarly productivity, with nearly a quarter of her total output (i.e. 46, 23%) occurring during these five years. Publishing at an impressive rate of 9.2 papers per year, this suggests high research momentum and possibly leadership roles in collaborative projects.

Slight Decline but Sustained Output (2018-2022)

This period accounts for 34 publications, or 17% of the total. While there is a decline from the peak, output remains significantly higher than earlier periods, maintaining a robust average of 6.8 papers per year. This may reflect a strategic shift toward quality over quantity or changes in research focus.

Resurgence (2023-2027)

This phase yielded 50 papers, representing 25% of the total, with a yearly average of 10.0. Latha experiences a record-high productivity phase, contributing a full 25% of her career output in this final quinquennium. With nearly 10 papers per year, this could be attributed to enhanced collaborations, ongoing large-scale projects, or leadership in institutional research initiatives. Second time, productivity again peaked in this phase (Figure 1).

Table 2: Authorship Pattern with Time Span.

Pattern	SA	DB	TA	FR	FV	Total
Non-Collaborative	12					12
Collaborative		124	53	10	1	188
Year range	2000-2025	2004-2025	2000-2024	2001-2024	2024-2024	
Time Span	25	21	24	23	1	

Table 3: Quinquennium wise paper publication and peak period of Latha's productivity.

Quinquennium	PPA	Paper	%	PY
1998-2002	1-5	14	7.00	2.8
2003-2007	6-10	23	11.50	4.6
2008-2012	11-15	33	16.50	6.6
2013-2017	16-20	46	23.00	9.2
2018-2022	21-25	34	17.00	6.8
2023-2027	26-[30]	50	25.00	10.0
Total		200	100	

Table 4: Leading co-authors of M Latha during 1998-2025.

Rank	Name of Co-authors	TP	FYP	LYP	Time Span	Affiliation	Country
1	TG Sitharam	23	2002	2025	23	IISc Bangalore	India
2	Balaji Lakkimsetti	15	2021	2025	4	IISc Bangalore	India
3	A Murali Krishna	14	2006	2021	15	IISc Bangalore	India
4	Karpurapu Rajagopal	13	1998	2009	11	Andhra University College of Engineering, Visakhapatnam	India
5	Prashanth Vangla	13	2014	2022	8	IISc Bangalore	India
6	Prerana Krishnaraj	12	2022	2025	3	IISc Bangalore	India
7	G Tiwari	11	2014	2024	10	IISc Bangalore	India
8	NR Krishnaswamy	10	1998	2006	8	IIT Madras	India
9	Anjali G. Pillai	8	2020	2023	3	IIT Madras	India
10	Asha M Nair	8	2009	2016	7	IISc Bangalore	India
11	Arunakumari Garaga	9	2007	2012	5	IISc Bangalore	India
12	P Raghuveer Rao	4	2020	2021	1	IISc Bangalore	India
13	GL Sivakumar Babu	6	2015	2019	4	IISc Bangalore	India
14	Rizwan Khan	6	2023	2025	2	IISc Bangalore	India
15	Renjitha Mary Varghese	6	2013	2019	6	IISc Bangalore	India
16	GS Manju	6	2013	2023	10	IISc Bangalore	India
17	Aarya Krishna	5	2023	2025	2	IISc Bangalore	India
18	Hasthi Venkateswarlu	5	2023	2025	2	IISc Bangalore	India
19	KV Anusree	5	2022	2025	3	IISc Bangalore	India
20	MN Asha	5	2008	2014	6	CMR Institute of Technology, AECS Layout, Bangalore, Karnataka.	India
21	Nimisha Roy	5	2014	2022	8	National Institute of Technology, Jamshedpur	India
22	N Srilatha,	5	2012	2022	10	MSRIT, Bangalore	India
23	Bhardwaj Pandit	4	2017	2019	2	IISc Bangalore	India
24	CG Puttappa	4	2012	2017	5	MSRIT, Bangalore.	India
25	Sujit Kumar Dash	4	2001	2009	8	IISc Bangalore	India
26	Amit Somwanshi	3	2009	2013	4	IISc Bangalore	India
27	G Muralikrishna	3	2007	2009	2	CSIR-CFTRI, Mysore	India
28	Vidya S Murthy	3	2006	2007	1	IISc Bangalore	India
29	Vaishali Wayal	3	2021	2023	2	IISc Bangalore	India
30-40	11 co-authors with 2 papers each	22					
41-64	24 co-authors with 1 paper each	24					
Total	64 co-authors						

Some key observations may include

Continuous Growth: Each quinquennium shows growth in output until 2017, followed by a brief dip and then a remarkable resurgence.

Strong Late-Career Productivity: Contrary to typical trends, Latha's most productive phase occurs in the later stage of her career, indicating sustained engagement and possibly increased collaborative or supervisory roles.

Average Output: Across the 30 years, her average annual publication rate stands at 10 papers per year, with the highest annual rate in 2023-2027. Since the publications have been counted up to the year 2025, the actual annual average is 16.67.

Figure 1 shows a steady rise in Gali's publication output from early to mid-career, peaking during 2013-2017, followed by a brief dip and renewed growth in recent years. This pattern reflects consistent research productivity and a strong resurgence in later career stages, indicating sustained scholarly engagement and expanding research leadership.

Leading Co-authors

Table 4 presents the prolific collaborators of M. Latha in the production of 188 collaborative papers, involving a cumulative total of 264 authorships (counting all contributors across papers), and 64 unique individual co-authors. Her eight most frequent collaborators-*T.G. Sitharam* (23 papers over 23 years), *Balaji Lakkimsetti* (15 papers in 4 years), *A. Murali Krishna* (14 papers over 15 years), *Karpurapu Rajagopal* (13 papers in 11 years), *Prashanth Vangla* (13 papers in 8 years), *Prerana Krishnaraj* (12 papers in 3 years), *G. Tiwari* (11 papers in 10 years), and *N.R. Krishnaswamy* (10 papers in 8 years)-are considered her closest collaborators based on publication count and duration of collaboration from 1998 to 2025. Beyond this core group, a second tier of co-authors has contributed between 3 and 8 papers each, while 11 collaborators have co-authored two papers and another 24 have co-authored one paper each during the same period. The majority of her close collaborators are affiliated with her home institution, the Indian Institute of Science (IISc), Bengaluru, Karnataka. However, a few external collaborators are also notable: M.N. Asha from *CMR Institute of Technology, Bangalore*; N. Srilatha and C.G. Puttappa from *MSRIT, Bangalore*; and Nimisha Roy from *the National Institute of Technology, Jamshedpur*.

Prof. M. Latha Gali's collaboration network is anchored by a core group of long-term partners, primarily from IISc Bengaluru, reflecting strong institutional synergy and research continuity. The inclusion of collaborators from other Indian institutes indicates expanding academic outreach and knowledge exchange, demonstrating a balanced blend of deep institutional collaboration and selective external engagement that has strengthened her research impact.

Validation of Lotka's Law

An analysis of the co-authorship data reveals that out of 64 individual collaborators, 24 co-authors (37.5%) have contributed to only one publication, while 11 co-authors (17.08%) have authored two papers, and 4 co-authors (6.25%) have contributed to three papers. The frequency of authorship does not exhibit an inverse square relationship typically described by Lotka's Law, which states that the number of authors publishing n papers is about $1/n^2$ of those publishing a single paper. This distribution does not align with Lotka's Law, which suggests an inverse-square relationship between the number of authors and their productivity. Hence, the data set in Table 4 does not support Lotka's Law. This suggests a *non-uniform collaboration structure*, with a few highly consistent co-authors and many occasional contributors reflecting project-specific partnerships.

Preferred Forms of Publications

Table 5 reveals that among the 200 publications by M. Latha between 1998 and 2025, the dominant form of scholarly communication is journal articles (JA), comprising 114 papers or 56% of the total output, underscoring a strong emphasis on peer-reviewed scientific dissemination. This is followed by Conference Papers (CP) at 34%, which indicates active participation in academic forums and collaborative research discussions. Book chapters (5.5%), books (1.5%), theses/dissertations (1%), and a few

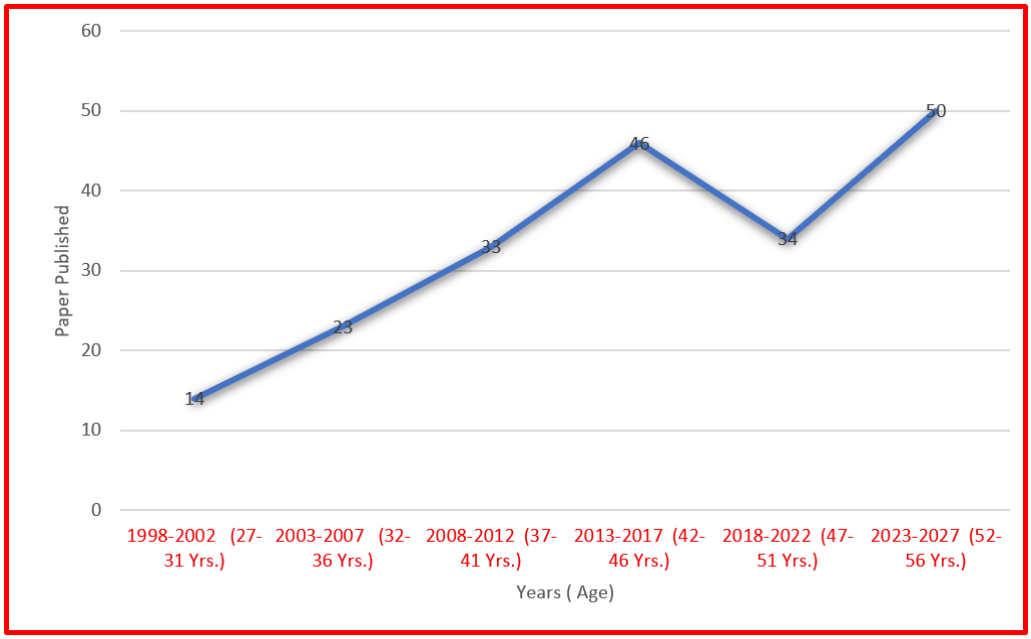

Figure 1: Peak period of productivity during 1998-2025.

uncategorized works (2%) make up the rest, reflecting diverse but less frequent modes of scholarly expression. Type of publication categories has been graphically represented in Figure 2. Notably, her top three preferred journals-Geotextiles and Geomembranes (IF 5.292, h-index 117), Indian Geotechnical Journal (IF 1.4, h-index 28), and International Journal of Geosynthetics and Ground Engineering (IF 2.3, h-index 35)-collectively account for 40 of her journal articles, suggesting a focused contribution to geosynthetics and geotechnical engineering. The selection of journals with high impact factors and h-index values highlights her strategic publishing in reputed platforms, enhancing the visibility and impact of her work within the global research community.

Dr Latha's publication profile demonstrates a clear focus on high-quality, peer-reviewed journal articles, particularly in geosynthetics and geotechnical engineering, reflecting both subject-matter expertise and strategic journal selection. Her strong presence in reputable journals and active participation in conferences highlights a balanced approach between scholarly visibility and academic networking, enhancing the global impact of her research.

Figure 2 graphically shows types of paper in different formats. The visual clearly shows that journal articles dominate Latha Gali's publication portfolio, followed by conference papers, together accounting for the vast majority of her output. This reflects a strong preference for *peer-reviewed scientific dissemination and active participation in academic forums*, underscoring both research rigor and scholarly engagement.

Country wise Publications

Table 6 and Figure 3 present the country-wise distribution of M. Latha's 200 publications, reflecting both national and international reach. A significant portion i.e. 57 papers or 28.5% originates from India, indicating strong engagement with domestic academic and research institutions. Among international contributions, the Netherlands leads with 28 publications (14%), likely due to recurring publications in *Geotextiles and Geomembranes*, a high-impact journal based there. The UK (11%), USA (10.5%), and Germany (8%) follow closely, suggesting robust international collaborations and visibility in top-tier Western research outlets. Other notable contributions come from Singapore and entries marked "un-known" (5% each), possibly representing international proceedings or unclassified sources. Countries like Austria (3.5%), Greece (2.5%), China and Louisiana (2% each), and Canada and France (1.5% each) further demonstrate the diverse geographical footprint of her work. Several countries, including Switzerland, Australia, Indonesia, Japan, Kazakhstan, Lisbon, South Korea, and Spain, have contributed to one paper each (0.5%), showing occasional yet wide-ranging global outreach. Overall, this distribution underlines M. Latha's active engagement in both national and international research networks across over 20 countries.

Dr. Gali's publications reflect a strong domestic research base complemented by selective international collaborations, highlighting both sustained engagement with Indian institutions and targeted partnerships with high-impact global journals. Collaborations are concentrated in India due to institutional ties, mentorship roles, and long-term project continuity, while thematic evolution from core geotechnical studies to applied and interdisciplinary research mirrors her progression from early-career scholar to globally recognized expert.

Communication Channels and Bradford's Law

Table 7 shows Bradford's Law that divides journals (or sources) into three zones:

Zone I: Fewest sources yielding the most productive core (about 1/3 of total articles).

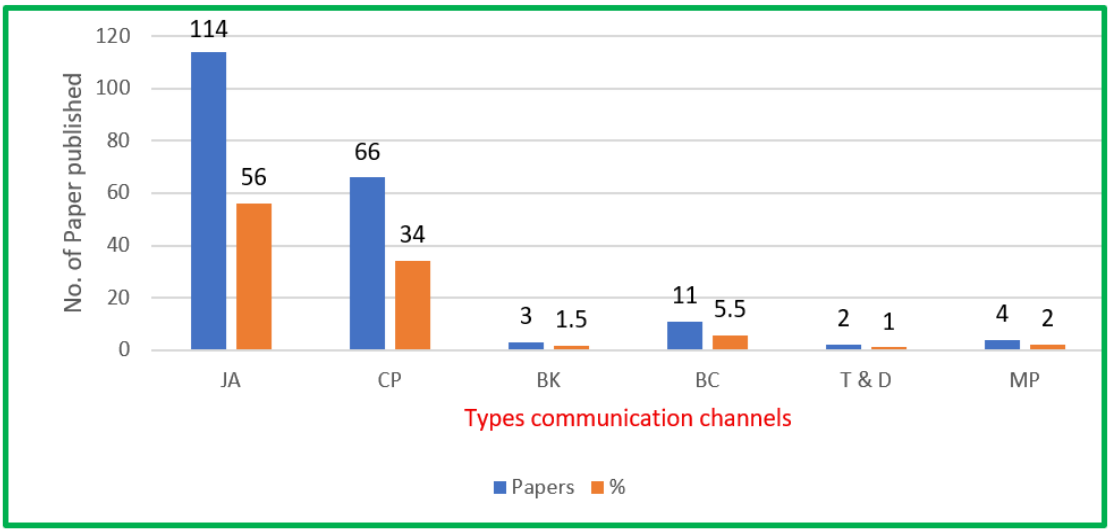

Figure 2: Types of publication sources with paper production communication channels for Latha's publications.

Table 5: List of Preferred Communication Channels for Latha's Publications.

Sl. No.	Communication Channels	TP	%	FYP	LYP	IF	h-Index	Origin
	Journal Articles (114, 56 %)							
1	Geotextiles and Geomembranes	16	8.00	1999	2025	5.292	117	Netherlands
2	Indian Geotechnical Journal	13	6.50	2001	2025	1.4	28	India
3	International Journal of Geosynthetics and Ground Engineering	11	5.50	2015	2023	2.3	35	Germany
4	Rock Mechanics and Rock Engineering	7	3.50	2010	2029	6.6	153	Austria
5	International Journal of Geomechanics	5	2.50	2009	2024	3.3	94	USA
6	International Journal of Rock Mechanics and Mining Sciences	5	2.50	2002	2012	7.1	214	Netherlands
7	Geomechanics and Geoengineering	5	2.50	2010	2016	2.44	41	UK
8	Bulletin of Engineering Geology and the Environment	4	2.00	2019	2023	4.2	95	Germany
9	Geosynthetics International	4	2.00	2007	2017	2.85	71	UK
10	International Journal of Geotechnical Engineering	4	2.00	2010	2016	2.2	38	UK
11	Geotechnical testing journal	3	1.50	2000	2014	1.2	75	India
12	Granular Matter	3	1.50	2018	2024	2.9	85	USA
13	Journal of Materials in Civil engineering	3	1.50	2015	2024	3	149	USA
14	Journal of the Indian Institute of Science	3	1.50	2024	2025	2.3	43	India
15	Journal of Rock Mechanics and Tunneling Technology	2	1.00	2002	2003			India
16	Proceedings of the Institution of Civil Engineers-Ground Improvement 11 (3 …	3	1.50	2007	2014	0.373	51	UK
17	Soil Dynamics and Earthquake Engineering	2	1.00	2023	2025	4.6	139	Netherlands
18-38	21 Other Journals with 1 paper each	21	10.50			-	-	
	Conference Papers (CP) (66, 34 %)					-	-	
39	Indian Geotechnical Conference	6	3.00	2010	2022	-	-	India
40	GeoCongress 2008: Geosustainability and Geohazard Mitigation, 757-764	4	2.00	2008	2014	-	-	USA
41	Golden Jubilee Conference of the IGS Bangalore Chapter, Geo-Innovations, 30-31 October 2014	3	1.50	2014	2014	-	-	India
42	Recent Advances in Geotechnical Engineering, Volume 1; Conference paper. Women Indian Geotechnical Conference, 3-12	3	1.50	2025	2025	-	-	India
43	Indian Young Geotechnical Engineers Conference, 13-20	2	1.00	2021	2025	-	-	India
44	International Conference on Environmental Geotechnology, Recycled Waste …	2	1.00	2022	2024	-	-	Spain
45	Proceedings of the 9ICEG 9th International Congress on Environmental Geotechnics 25-28 June, 2023 | Chania, Greece.	2	1.00	2023	2023	-	-	Greece
46	Proceedings of the Indian Geotechnical Conference 2022 Volume 10 10, 287	2	1.00	2010	2024	-	-	India
47	Women Indian Geotechnical Conference, 161-171	2	1.00	2024	2024	-	-	India
48-87	40 Other Conference Proceedings with 1 paper each	40	20.00			-	-	
	Books (BK) (3, 1.5 %)					-	-	
88	Geo-Chicago	3	1.50	2016	2016	-	-	USA
	Book Chapter (BC) (11, 5.5%)					-	-	
89	Lecture Notes in Civil Engineering	4	2.00	2021	2023	-	-	Singapore

Sl. No.	Communication Channels	TP	%	FYP	LYP	IF	h-Index	Origin
90-96	7 Other Book Chapters with 1 paper each	7	3.50			-	-	
	Thesis & Dissertation (T & D) (2, 1%)					-	-	
97	Indian Institute of Technology Madras (Dissertation for the Doctoral Degree). https://scholar.google.co.in/scholar?	1	0.50	2000	2000	-	-	India
98	University of Mysore (Thesis). https://ir.cftri.res.in/9404/1/T-2261.pdf	1	0.50	2007	2007	-	-	India
	Miscellaneous (MP) (4, 2%)					-	-	
	ResearchGate e-Publication					-	-	
99	https://www. researchgate. net/publication/….	2	1.00	2015	2015	-	-	Unknown
100	Channels not identified (CNI)	2	1.00	2008	2008	-	-	Unknown
Total		200	100					

Zone II: More sources yielding the next 1/3 of articles.

Zone III: Even more sources yielding the final 1/3.

The *ideal multiplier (Bradford multiplier, k*) between the number of sources in successive zones should follow a *geometric progression*: If Zone I has n sources, then Zones II and III should have approximately $n \cdot k$ and $n \cdot k^2$ sources respectively i.e., ratio of three zones is $n : n.k : n.k^2$

Validation of Bradford's Law

Calculation of theoretical multipliers

Now let, n = 9 and k be the Bradford multiplier, then expected

- Zone II sources = $9 \cdot k$
- Zone III sources = $9 \cdot k^2$

So, from the data set in Table 7,

Zone II actual: 32 / 9 = 3.56

Zone III actual: 59 / 9 = 6.56

So, estimated k = 3.56, and $k^2 = 12.68$

But 59 is much lower than $9 \cdot k^2 = 114$ if k = 3.56.

This suggests *Zone III is smaller than expected*, and the distribution deviates slightly from a perfect Bradford distribution.

Comparison with ideal Bradford distribution

Zone	Ideal Number	Actual Number	Remarks
I	9	9	Match
II	$9 \times 2.56 = 23.04$ or 23	32	Higher than ideal
III	$9 \times (2.56)^2 = 58.98$ or 59	59	Match

The *average multiplier that is* a geometric progression between zones = $\sqrt{\frac{59}{9}}$ or 2.56 and Zone III fits, but Zone II exceeds the expected value. Hence, the data partially validates Bradford's Law**.** The publication sources divide into three zones producing approximately equal thirds of total articles (66, 66, and 68 papers), aligning well with the law's foundational premise. However, the number of sources in Zone II is higher than expected, while Zone III aligns more closely with the predicted value based on the average multiplier (2.56). This indicates a slightly skewed distribution, possibly due to interdisciplinary publishing or varying productivity across journals. Despite minor deviations, the data reasonably follows Bradford's Law, affirming the presence of a core set of high-yield sources followed by broader, less concentrated publication venues.

Relative Citation Index

Table 8 highlights the distribution of 5,162 citations across years, along with Citation Per Paper (CPP) and Relative Citation Index (RCI), offering insights into the impact of M. Latha's publications. The year 2008 stands out with 8 papers garnering the highest citation share-16.89% of total citations-with a CPP of 109 and an RCI of 4.22, indicating more than four times the average impact. Similarly, 2007 shows strong performance with 9 papers cited 620 times (12.02%), yielding a CPP of 68.89 and an RCI of 2.67. Notably, a single paper published in 1999 attracted 431 citations-an exceptional CPP of 431 and the highest RCI of 16.72%, signifying outstanding scholarly influence.

These values reflect not only consistent academic productivity but also the enduring relevance and high impact of select foundational works. The fluctuating RCI values across years suggest that while volume of publications varies, citation influence is concentrated in a few highly impactful papers, a pattern typical of influential academic careers.

Collaborative Measures with CI, CC and MCC

Table 9 presents year-wise collaboration metrics for M. Latha's publications over the 28-year span from 1998 to 2025, revealing key trends in her research collaboration patterns. The highest Collaboration Index (CI) of 4.00 in 2003 suggests

that her papers that year had the highest average number of co-authors per publication, indicating strong collaborative activity. Conversely, the lowest CI of 1.25 in 2009 points to more individually driven work. The average CI across the period is 2.32, showing a moderate but consistent level of co-authorship. The Collaboration Coefficient (CC), which adjusts for the proportion of multi-authored papers, ranges from a low of 0.25 in 2011 to a peak of 0.75 in 2003, with an overall average of 0.47, reflecting a balanced mix of solo and collaborative work. The Modified Collaboration Coefficient (MCC), which gives more nuanced weight to varying authorship levels, records a maximum of 1.04 in 2001 and zero values in 1998 and 1999, likely due to solo authorship in those years. With an average MCC of 0.47, the data overall indicates a healthy trend of collaboration, with peaks during the early 2000s and a gradual normalization thereafter, reflecting evolving research networks and co-authorship patterns over time.

The collaboration metrics reveal that M. Latha Gali maintained a *steady and balanced collaborative profile*, with peak teamwork during the early 2000s followed by stabilization in later years. This pattern reflects the *maturation of her research network*, transitioning from intensive co-authorship phases to more focused and selective collaborations.

Relative Growth Rate (ReGR) and Double Time (Dt)

Table 10 indicates the Relative Growth rate (ReGR) and the Doubling time (Dt) of Latha's publications.

Relative Growth Rate (ReGR)

Prof. M. Latha Gali's publications reflect a strong domestic research base complemented by selective international collaborations, highlighting both sustained engagement with Indian institutions and targeted partnerships with high-impact global journals. Collaborations are concentrated in India due to institutional ties, mentorship roles, and long-term project continuity, while thematic evolution from core geotechnical studies to applied and interdisciplinary research mirrors her progression from early-career scholar to globally recognized expert. The Relative Growth Rate (ReGR) in the table reflects how quickly M. Latha's research paper output has increased from year to year, calculated using the natural logarithmic growth of Cumulative Total Papers (CTP). It provides insights into the rate of increase in publications over time. It is calculated using the formula.

$$\text{ReGR} = \frac{W2-w1}{T2-T1}, \text{ where}$$

W1 = Natural logarithm of the *initial number* of cumulative total papers between two years,

W2 = Natural logarithm of the *final number* of cumulative total papers between two years,

T1 = Unit of initial time,

T2 = Unit of final time.

Here's a summary of the trends and patterns observed in the ReGR from 1998 to 2025 into some period divisions.

- Early Years (1998-2001): High Initial Growth,

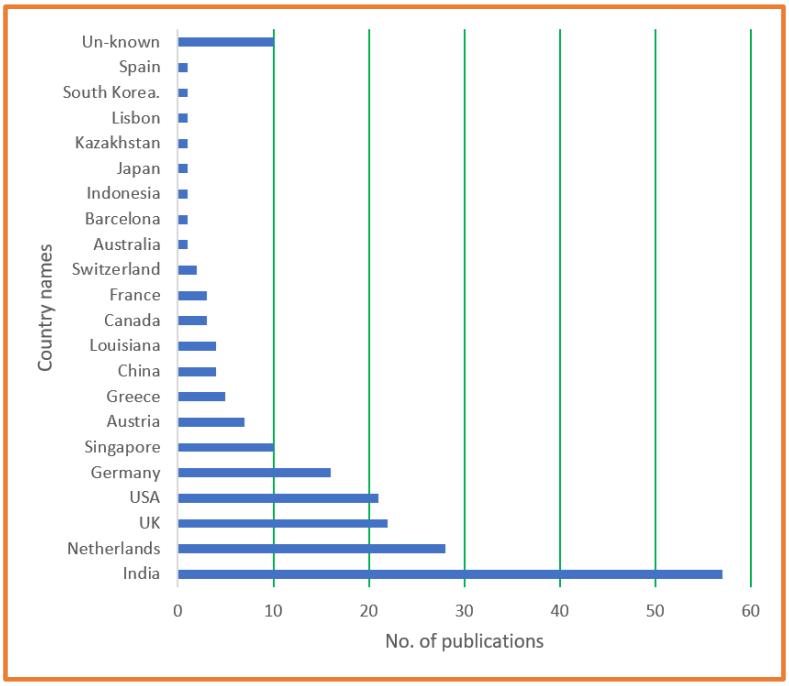

Figure 3: Showing country-wise M Latha's publication, 1998-2025.

- 1998-2000: The ReGR spikes significantly, reaching 1.2528 in 2000. This shows a rapid increase in research activity,
- 2001: A sharp drop to 0.3566, indicating a decline in growth momentum,

This period reflects the start of M. Latha's publishing career, with a steep initial increase followed by early fluctuations.

- 2002-2005: Fluctuation and Stagnation,
- ReGR drops to very low values, even hitting 0 in 2005, indicating no growth in cumulative publications that year.

This period sees alternating small growth and negative publication % growth.

This suggests an inconsistent publishing trend, possibly due to external factors (e.g. academic responsibilities, funding, research direction changes).

2006-2010: Moderate Growth Resurgence

ReGR recovered in 2006 (0.3878) and gradually declines by 2010.

The mean ReGR over this span is 0.2657, indicating moderate and stable growth.

This reflects a return to a more productive research phase with a gradual increase in output.

- 2011-2015: Low and Variable Growth,
- ReGR values are low again, especially 2011 (0.0357) and 2013 (0.069),
- Small spikes in 2012 and 2014, but overall, this period has a mean ReGR of 0.1090,

This indicates a slower pace of publication growth with brief increases.

- 2016-2020: Slight Improvement and Stabilization,
- ReGR ranges from 0.0339 to 0.1361, with an upward trend in 2016 and 2021,
- By 2020, values stabilize around 0.0392, showing consistent, if modest, growth.

This reflects a *stable but slow growth rate*, suggesting a balanced output.

- 2021-2024: Resurgence Followed by Decline,
- ReGR rises to 0.131 in 2023, showing another spike in productivity,
- However, it drops to 0.1054 in 2024 and then sharply to 0.0513 in 2025.

After a strong publishing year in 2023, the growth begins to slow again, suggesting either saturation or shifting priorities.

Overall insights on ReGR are:

- **Peaks:** Major spikes occurred in 2000, 2006, and 2023, aligning with productive periods,
- **Troughs:** Years like 2005, 2011, and 2025 had very low ReGR, indicating stagnation or reduced output,
- Mean ReGR is declining over time, showing that while cumulative publications increased, the rate of growth is tapering off-a common trend in mature academic careers.

Doubling Time (Dt)

Doubling Time (Dt) indicates how long it would take for M. Latha's cumulative publications to double, based on the Relative Growth Rate (ReGR). It is calculated using the formula.

$$Dt = \frac{0.6931}{ReGR}$$

Table 6: Origin Wise Distributions of Publications, 1998-2025.

Country	TP	%
National Level		
India	57	28.50
Netherlands	28	14.00
UK	22	11.00
USA	21	10.50
Germany	16	8.00
Singapore	10	5.00
Austria	7	3.50
Greece	5	2.50
China	4	2.00
Louisiana	4	2.00
Canada	3	1.50
France	3	1.50
Switzerland	2	1.00
Australia	1	0.50
Barcelona	1	0.50
Indonesia	1	0.50
Japan	1	0.50
Kazakhstan	1	0.50
Lisbon	1	0.50
South Korea.	1	0.50
Spain	1	0.50
Un-known	10	5.00
Total	200	100

When, 0.6931 = natural log of 2, and ReGR = the relative growth rate of paper.

It is evident that the Doubling Time (Dt) of publications has shown a significant upward trend over the years. From 1998 to 2001, the average doubling time was relatively short at 0.8742**,** reflecting a period of *rapid research growth***.** However, this pace slowed considerably in later years. Between 2018 and 2021, the average Dt rose sharply to 16.3582, indicating minimal growth in publication output. A slight recovery is seen from 2022 to 2025, where the average Dt decreased to 8.6183, yet it remains much higher than the early years, suggesting a continued slowdown in the rate of publication growth**.**

The above analysis indicates that the relative growth rate and doubling time is highly fluctuating. ReGR and Dt are inversely

Table 7: Zone wise distribution of papers and channels for validation of Bradford laws.

Zones	CC	TP	%
I	9	66	33%
II	32	66	33%
III	59	68	34%
	100	200	

Table 8: Calculation for relative citation index of Lath's publications, 1998-2025.

Year	TP	% of TP	CTP	% of CTP	Citation (CT)	% of CT	CPP	RCI =
1998	1	0.50	1	0.50	4	0.08	4	0.16
1999	1	0.50	2	1.00	431	8.36	431	16.72
2000	5	2.50	7	3.50	276	5.36	55.2	2.14
2001	3	1.50	10	5.00	40	0.77	13.34	0.51
2002	4	2.00	14	7.00	153	2.96	38.25	1.48
2003	1	0.50	15	7.50	4	0.08	4	0.16
2004	4	2.00	19	9.50	9	0.18	2.25	0.09
2006	9	4.50	28	14.00	309	5.99	34.33	1.33
2007	9	4.50	37	18.50	620	12.02	68.89	2.67
2008	10	5.00	47	23.50	215	4.18	21.5	0.84
2009	8	4.00	55	27.50	872	16.89	109	4.22
2010	7	3.50	62	31.00	235	4.55	33.57	1.3
2011	2	1.00	64	32.00	55	1.07	27.5	1.07
2012	6	3.00	70	35.00	106	2.05	17.67	0.68
2013	5	2.50	75	37.50	189	3.66	37.8	1.46
2014	14	7.00	89	44.50	184	3.56	13.14	0.51
2015	7	3.50	96	48.00	354	6.86	50.57	1.96
2016	14	7.00	110	55.00	428	8.29	30.57	1.18
2017	6	3.00	116	58.00	90	1.74	15	0.58
2018	4	2.00	120	60.00	176	3.42	44	1.71
2019	5	2.50	125	62.50	99	1.92	19.8	0.77
2020	5	2.50	130	65.00	31	0.62	6.2	0.25
2021	9	4.50	139	69.50	7	0.14	0.78	0.03
2022	11	5.50	150	75.00	69	1.34	6.27	0.24
2023	21	10.50	171	85.50	168	3.25	8	0.31
2024	19	9.50	190	95.00	32	0.62	1.68	0.07
2025	10	5.00	200	100	6	0.12	0.6	0.02
	200				5162	100		

Table 9: Collaborative Measures of CI, CC, and MCC.

Year	Total	Authorship Pattern					Collaboration Metrics		
		I	II	III	IV	V	CI	CC	MCC
1998	1			1			3.00	0.67	0.00
1999	1			1			3.00	0.67	0.00
2000	5	1		4			2.60	0.65	0.81
2001	3			2	1		3.34	0.69	1.04
2002	4		4				2.00	0.50	0.67
2003	1				1		4.00	0.75	0.00
2004	4		4				2.00	0.50	0.67
2006	9	1	5	3			2.22	0.57	0.64
2007	9	1	7	1			2.00	0.46	0.52
2008	10		8	2			2.20	0.53	0.59
2009	8	1	6	1			1.25	0.46	0.53
2010	7		6	1			2.14	0.52	0.61
2011	2	1	1				1.50	0.25	0.50
2012	6		4	2			2.34	0.55	0.66
2013	5		3	2			2.40	0.57	0.71
2014	14	1	10	2	1		2.21	0.51	0.55
2015	7	1	5	1			2.00	0.45	0.53
2016	14		10	4			2.29	0.55	0.59
2017	6	1	2	2	1		2.50	0.51	0.61
2018	4			2	2		3.50	0.71	0.95
2019	5	1	3		1		2.20	0.45	0.56
2020	5		4	1			2.20	0.57	0.71
2021	9	1	3	4	1		2.56	0.55	0.62
2022	11		8	2	1		2.36	0.55	0.61
2023	21		16	5			2.24	0.54	0.64
2024	19	1	10	6	1	1	2.53	0.61	0.64
2025	10	1	6	3			2.20	0.50	0.56
Total	200	12	125	52	10	1	2.32	0.47	0.47

proportional that has proved by graphical presentation in Figure 4. Higher ReGR values result in quicker doubling of publications, while lower ReGR values stretch the time needed to double the output, reflecting slower research productivity. As ReGR declines over time (especially after 2010), Dt increases, showing that publication growth slows significantly in later years.

The publication growth in 2024 is -9.52%, while highest percentage of publication growth is 400% in 2000. The analysis shows Gali's research output experienced *variable growth over time*, with periods of rapid productivity followed by slower expansion. The inverse relationship between Relative Growth Rate (ReGR) and Doubling Time (Dt) highlights that while early to mid-career phases saw quick accumulation of publications, the pace naturally slowed in later years. This trend reflects a mature and stabilized research trajectory, where focus may shift from sheer quantity to quality, collaboration, and impactful publications, emphasizing sustained influence rather than rapid output.

Top Cited Scholarly Articles

Table 11 presents citation data from M. Latha's 15 most cited research articles, each cited 105 times or more by other scholars. The highest number of citations, 431**,** was received by the paper titled "Behaviour of sand confined with single and multiple geocells", published in *Geotextiles and Geomembranes (1999)***,** which has a Citation Growth Rate (CGR) of 16.58**.** This is followed by 377 citations for "Bearing capacity of square footings on geosynthetic reinforced sand", published in 2009 in the same journal, with a CGR of 23.56. The third most cited

article is "Effects of reinforcement form on the behavior of geosynthetic reinforced sand" (2007), also in Geotextiles and Geomembranes, which received 345 citations and has a CGR of 19.17. Another notable work, "Effect of reinforcement form on the bearing capacity of square footings on sand" (2009), garnered 290 citations with a CGR of 18.13, among other highly cited publications. Despite fluctuations in annual publication counts, Dr. Latha's research impact remains significant, as seen from her 15 top-cited papers, each with 105 citations. Her most cited article received 431 citations, and several others received over 300, with high Citation Growth Rates (CGR) that is a clear indicator of *long-term scholarly influence*, especially in *geosynthetics and soil reinforcement* research.

The citation analysis underscores Latha Gali's high research impact and enduring scholarly influence, particularly in geosynthetics and soil reinforcement. Her consistently high Citation Growth Rates across multiple top-cited papers reflect sustained relevance and wide recognition of her work within the global geotechnical research community.

Comparative Observations

Here are several notable Indian geotechnical scientists and engineers who have made significant contributions to the field of geotechnical engineering from which a comparative statement with Madhavi Latha may include (Rajagopal & Arnepalli, 2025; Krishna & Latha, 2023; Indian Geotechnical Society, 2025; Singh, n.d.; Singh, n.d(a))

Table 10: Relative growth rate and Doubling time of M Latha's research papers.

Year	TP	CTP	W1	W2	ReGR =	Mean ReGR	Dt= $\frac{0.6931}{ReGR}$	Mean Dt	% of PG= × 100
1998	1	1		0	0	0.5756	0	0.8742	0
1999	1	2	0	0.6931	0.6931		1		0
2000	5	7	0.6931	1.9459	1.2528		0.5532		400
2001	3	10	1.9459	2.3025	0.3566		1.9436		-40
2002	4	14	2.3025	2.6390	0.3365	0.1604	2.0597	3.7591	33.34
2003	1	15	2.6390	2.7080	0.0690		10.0449		300
2004	4	19	2.7080	2.9444	0.2364		2.9318		-100
2005	0	19	2.9444	2.9444	0		0		0
2006	9	28	2.9444	3.3322	0.3878	0.2657	1.7872	2.8952	0
2007	9	37	3.3322	3.6109	0.2787		2.4869		0
2008	10	47	3.6109	3.8501	0.2392		2.8975		11.12
2009	8	55	3.8501	4.0073	0.1572		4.4090		-20
2010	7	62	4.0073	4.1231	0.1158	0.0775	5.9853	10.7950	-12.5
2011	2	64	4.1231	4.1588	0.0357		19.4145		-71
2012	6	70	4.1588	4.2484	0.0896		7.7354		200
2013	5	75	4.2484	4.3174	0.0690		10.0449		-16.67
2014	14	89	4.3174	4.4886	0.1712	0.1090	4.0484	7.8374	180
2015	7	96	4.4886	4.5643	0.0757		9.1558		-50
2016	14	110	4.5643	4.7004	0.1361		5.0925		100
2017	6	116	4.7004	4.7535	0.0531		13.0527		200
2018	4	120	4.7535	4.7874	0.0339	0.0452	20.4454	16.3582	-33.34
2019	5	125	4.7874	4.8283	0.0409		16.9462		25
2020	5	130	4.8283	4.8675	0.0392		17.6811		0
2021	9	139	4.8675	4.9344	0.0669		10.3602		80
2022	11	150	4.9344	5.0106	0.0762	0.0909	9.0958	8.6183	22.23
2023	21	171	5.0106	5.1416	0.1310		5.2908		90.91
2024	19	190	5.1416	5.2470	0.1054		6.5759		-9.52
2025	10	200	5.2470	5.2983	0.0513		13.5107		-47.37

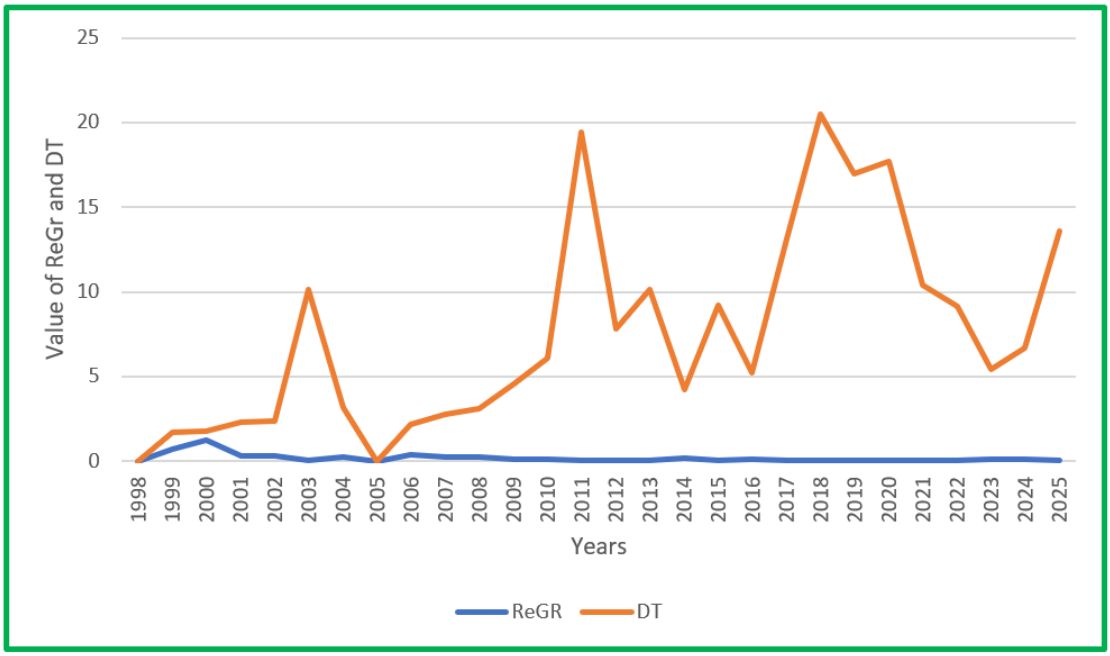

Figure 4: Graphical presentation of relationship between ReGR and Dt during 1998-2025.

Scope of Application

Prof. Madhavi Latha: focuses on reinforced soil structures (walls, embankments, slopes) using geosynthetics and soil-reinforcement mechanisms; more "soil behaviour + reinforcement" oriented.

Prof. Sitharam: Emphasises seismic/dynamic/earthquake aspects - site response, liquefaction, micro-zonation - i.e., "soil/ground behaviour under seismic/dynamic loading".

Prof. Singh: Emphasises environmental/unsaturated/contaminant issues - "soil behaviour under unsaturated, contaminated, or industrial-waste influenced conditions".

Research Approach

Madhavi Latha: strong on experimental (laboratory/model scale), micro-mechanistic imaging (interface micro-topography), geosynthetic-reinforced systems, and practical large-scale structures.

Sitharam: combines geotechnical engineering with dynamic modelling, instrumentation, large-scale site investigations, micro-zonation etc.

Singh: wide interdisciplinary approach with soil chemistry/physics, contaminant transport, unsaturated soils, waste materials - more fundamental and environmental.

Engineered Structures vs Supplementary Focus

Madhavi Latha: direct on soil-reinforced earth structures (walls, slopes, embankments) and geosynthetic reinforcement; thus, bridging fundamental soil/soil-geosynthetic behaviour and engineered systems.

Sitharam: more focused on ground/soil behaviour under dynamic/seismic loads, including foundations and improved soils; structure design is less central than site/ground behaviour.

Singh: focuses on soil behaviour in the context of environmental/geochemical factors and unsaturated conditions; structural reinforcement is less dominant than soil-waste-contaminant interaction.

Practical Impact/Engineering System Emphasis

Madhavi Latha's research has clear applied impact in large-scale retaining/infrastructure systems (e.g., geocell supported embankments) and bridging micro to macro behaviour.

Sitharam's impact is more in seismic hazard assessment, site response, design guidelines for earthquake geotechnics.

Singh's impact is in environmental geotechnics, soil-waste interactions, and perhaps less on large earth-retaining systems per se.

Why Madhavi Latha stands out among these

Because her work uniquely melds: the *fundamental micro-mechanics of soil/geosynthetic interfaces* (micro-topography, image-based studies) with *full-scale structural systems* (reinforced soil walls/embankments) and *geosynthetic reinforcement* (geocells, geogrids) - thereby achieving both depth and practical system breadth.

In contrast, while all three are eminent, Madhavi Latha's focus on *soil reinforcement and sustainable earth-retaining systems using geosynthetics*, with strong experimental foundation and application to large-scale systems, gives her a distinctive niche within Indian geotechnical research.

Table 11: Top cited scholarly publications of M Latha, 1998-2025.

Rank	Paper's Title	Sources	CR	AoP (As on 2025)	CGR or CPY
1	Behaviour of sand confined with single and multiple geocells	Geotextiles and Geomembranes (1999)	431	26	16.58
2	Bearing capacity of square footings on geosynthetic reinforced sand	Geotextiles and Geomembranes (2009)	377	16	23.56
3	Effects of reinforcement form on the behavior of geosynthetic reinforced sand	Geotextiles and Geomembranes (2007)	345	18	19.17
4	Effect of reinforcement form on the bearing capacity of square footings on sand	Geotextiles and Geomembranes (2009)	290	16	18.13
5	Model studies on geocell supported embankments constructed over a soft clay foundation	Geotechnical Testing Journal (2000)	241	25	9.64
6	Influence of particle size on the friction and interfacial shear strength of sands of similar morphology	International Journal of Geosynthetics and Ground Engineering (2015)	213	10	21.3
7	Experimental and theoretical investigations on geocell-supported embankments	International Journal of Geomechanics (2006)	206	19	10.84
8	Effect of particle size of sand and surface asperities of reinforcement on their interface shear behaviour	Geotextiles and Geomembranes (2016)	151	9	16.78
9	Simulation of excavations in jointed rock masses using a practical equivalent continuum approach	International Journal of Rock Mechanics and Mining Sciences (2002)	148	23	6.43
10	Seismic response of reinforced soil retaining wall models: influence of backfill relative density	Geotextiles and Geomembranes (2008)	136	17	8
11	Parametric finite element analyses of geocell-supported embankments	Canadian Geotechnical Journal (2007)	136	18	7.56
12	Numerical simulation of the behaviour of geocell reinforced sand in foundations	International Journal of Geomechanics (2009)	131	16	8.19
13	Effect of frequency on seismic response of reinforced soil slopes in shaking table tests	Geotextiles and Geomembranes (2013)	125	12	10.42
14	Image based shape characterization of granular materials and its effect on kinematics of particle motion	Granular Matter (2018)	107	7	15.29
15	Seismic response of wrap-faced reinforced soil-retaining wall models using shaking table tests	Geosynthetics International (2007)	105	18	5.84

In summary, Dr. M. Gali differentiates herself by concentrating on *reinforced-soil systems* (walls/embankments/slopes) *using geosynthetics* and by successfully integrating *micro-mechanical laboratory work with larger structural applications*. Meanwhile, Prof. Sitharam's strength lies in *earthquake/geodynamic geotechnics* and Prof. Singh's in *environmental/unsaturated soil geotechnics*. Each is outstanding but Madhavi Latha's blend of reinforcement-mechanics and practical retaining systems gives her a unique and influential position among Indian geotechnical scientists.

CONCLUSION

The scientometric study of Dr. Gali Madhavi Latha's research career provides not only a quantitative account of her scholarly impact but also valuable qualitative insights into the evolution of excellence in engineering research. Her trajectory exemplifies how sustained commitment to a niche area geosynthetics and

soil reinforcement can yield both national and global influence. From early academic curiosity to mature intellectual leadership, Dr. Latha's career reflects the synergistic interplay between mentorship, institutional support, and individual perseverance.

Beyond personal achievement, this analysis carries broader implications for research policy and academic ecosystem development. It underscores the importance of nurturing long-term, high-impact research through stable funding, cross-institutional collaboration, and mentorship-driven academic environments. Policies that encourage continuity and depth rather than short-term productivity metrics can foster innovation and meaningful contributions akin to Dr. Latha's.

From a gender representation perspective, Dr. Latha's accomplishments are particularly significant. As one of the few women leading groundbreaking work in geotechnical engineering-a field traditionally dominated by men-her career challenges stereotypes and serves as an empowering model for aspiring women engineers and researchers. Her success story reinforces the need for institutional mechanisms that support gender inclusivity, equitable research opportunities, and recognition of women's contributions in STEM disciplines.

Dr. Gali Madhavi Latha is a respected geotechnical engineer whose work continues to influence research and practice in the field. She contributed to major projects like the Chenab Bridge and often acknowledges the teamwork behind her success. Dr. Latha credits two mentors for shaping her career - *Prof. A. Sreerama Rao*, who introduced her to soil mechanics during her B.Tech. at JNTU Kakinada, and *Prof. K. Rajagopal*, her Ph.D. guide at IIT Madras, who deepened her knowledge and research skills. She believes Prof. Rao sparked her interest, while Prof. Rajagopal helped her master the subject (IISc, n.d.).

In essence, Dr. Gali Madhavi Latha's scholarly journey exemplifies how individual excellence, when supported by visionary mentorship and institutional commitment, can transcend personal boundaries to shape an entire discipline. Her career stands as both a benchmark for scientometric reflection and an inspiration for future generations striving to blend innovation, inclusivity, and impact in engineering research.

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ABBREVIATIONS

TP: Total Papers; **CTP:** Cumulative Total Papers; **ABA:** Author's Biological Age; **PPA:** Paper Productive Age; **SA:** Single-Authored Papers; **MA:** Multi-Authored Papers; **CoA:** Co-Authors; **DC:** Degree of Collaboration; **CT:** Citation; **CPP:** Citation per Paper; **RCI:** Relative Cited Index; **IF:** Impact Factor; **PG:** Publication Growth; **TC:** Total Citations; **AoP:** Age of Paper; **CR:** Citations Received; **CGR:** Citation Growth Rate; **CPY:** Citation per Year; **BD:** Double-Authored; **TA:** Triple-Authored; **FA:** Four-Authored; **FV:** Five-Authored; **CC:** Communication Channels; **FYP:** First Year of Publication; **LYP:** Last Year of Publication; **PY:** Papers per Year; **ISSMGE:** International Society of Soil Mechanics and Geotechnical Engineering; **FIYGEC:** First Indian Young Geotechnical Engineers Conference.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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