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Research Article

Dr. Abed Chaudhury, Bangladeshi-Australian Gene Scientist: A Scientometric Portrait

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ABSTRACT

Dr. Abdul M (Abed) Chaudhury allies Abed Chaudhury is a scientist of international reputation. He is an Australia-Bangladesh based gene scientist with a sound knowledge in genetics, crop breeding, molecular biology, human nutrition and biotech. Recent past, he is the pioneer of 'Panchabrihi, -yields five times, a new rice cultivation method, a revolutionary innovation to agricultural research. This study is based on his 68 publications brought out during 1984-2023, throughout 40 years of his research career. It shows various aspects of his career. It tries to draw a scientific portrait of the scientist analyzing several bibliometric indicators. From the collected data of his biography and bibliography of research publications, this study quantitatively assesses the contributions of the scientist highlighting year wise growth of research products, authorship patterns, author productivity, research spectrum and co-authors, leading collaborative authors, scattering of publications in various communication channels, his most preferred journals, and relationships with degree of collaboration. It counts Citation Growth Rate according to citation received, uncited indexes and Relative citation impact in different Abstracting and Indexing Journals. Annual Growth rate, Relative Growth rate, and doubling time are also enumerated in this study. It also examines whether the data set follows Lotka's Law and Badford's Law or not.

Keywords: Bibliometric study, Panchabrihi, Abed Chaudhury, Gene Science, Molecular Biology, Agricultural research, Bangladesh, Australia, Paddy, Rice, Seed discovery, Fertilization Independent Seed (FIS), Apomixes, Fractional seed without fertilization.

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INTRODUCTION

Foods, health and education are the basic and necessary needs for day to day life of people all over the world. If basic needs are not sufficient, the people of the country will be poor in all respects and those countries also could not be developed. Agriculture refers to crop and animal husbandry, aquaculture, fisheries, and forestry for food and non-food products. Agriculture was the key development of the practice of living in one place for a long time i.e., rises of human civilization. To make human civilization better, some agricultural revolutions took place around the world such as British Agricultural Revolution, Green Revolution, Neolithic Revolution, etc. (Wikipedia, 2024). The development of agriculture nearly 12,000 years ago which has changed the way humans lived. Wildgrains were collected and eaten from at least 104,000 years ago. By around 9500 BC, the eight Neolithic founder crops like wheat, barley, peas, lentils, bitter vetch, chickpeas, and flax, etc. were cultivated in a large area in the Eastern Mediterranean region of West Asia and core territory of Middle East. Rice was domesticated in China by 6200 BC with earliest known cultivation from 5700 BC. Rice was also domesticated in West Africa and cultivated by 1000 BC (Wikipedia, 2024a). Traditionally, Asian countries have the largest share in rice production worldwide. Over 513 million metric tons of milled rice was produced in the last harvesting year globally. As per the most recent official data, it is learnt that quantity of production of rice was over 208 million metric tons in 2022, and China was the world's leading paddy rice producer, followed by India and Bangladesh (FAO, 2022; Shahbandeh, 2024).

This scientometric study is based on biography and bibliography of research publications of Dr. Chaudhury. There are many bibliometric analysis carried out by several library and information scientist on eminent persons/ scientists either living or death from different disciplines. Mostly have been highlighted by the author in his different publications (Koley and Sen, 2016) and by others (Rao, 2013; Dutta, 2019; Sidlingappa *et al*., 2023; Teli and Maity, 2021). Notwithstanding, no such study on Chaudhury, the Genetic scientist cum rich researcher has been done till now. Hence this study and this is an original work.

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SHORT BIOGRAPHY OF DR. ABED CHAUDHURY

Early Life and Education

Chaudhury is an Australian-Bangladeshi renowned geneticist as well as rice researcher. He is also looked at one of the most distinguished leading international figures in modern biology. He was born in a Bengali Muslim family, the Zamindars of Kanihati in Hajipur Union, Kulaura, Moulvibazar District of Sylhet Division, Bangladesh on 1 February 1956. His father was Abdul Mannan (Ibrahim) Chaudhury and mother was Hafiza Khatun. He passed Madhyamik from the *Moulvibazar Government High School,* and higher secondary (HSC) from *Notre Dame College, Dhaka.* He completed his B.Sc., Honours in Chemistry at the *University* of *Dhaka, Bangladesh in 1979, and his M. S. (*Molecular Biology and Chemistry) from *University of Oregon, Eugene, USA* in 1981. After that, he received his PhD degree in Molecular Biology from Organic State Institute of Molecular Biology, University of Oregon, Eugene, USA in 1984. His thesis title is 'Homologous Recombination in *Escherichia coli*' (Everybodywiki.com, 2023; Bengal Byte, 2022; Kanihati.com, 2003; Knowledge Hub, 2020). Chaudhury currently lives in Australia.

Professional Career

Chaudhury, the gene scientist started professional career as a teacher and researcher at different institutions like *National Institute of Health (NIH),USA, Massachusetts Institute of Technology (MIT), USA* and while here, he conducted post doctoral research in Food and Nutrition and Plant Biology. He has devoted his professional knowledge in Rice Breeding and has led research programmes in Australian Centre for International Agricultural Research (ACIAR) and International Rice Research Institute (IRRI). He was a visiting scientist at Ecole Normale Supérieure of France (Bengal Byte, 2022; Knowledge Hub, 2020). He led a team of scientists at Australian National Science Agency, and under his supervision different research activities were done there. Chaudhury also was associated with several institutions for research works. Besides, he is a co-founder of Genofax, a global biotechnology company which acts in developing AI technologies for genomic medicine. Chaudhury tries to begin its big data driven medication in Bangladesh (Dhaka Tribune, 2024; Tasnim, 2023). Before coming into contact with Genofax, Choudhury has many outstanding research works in crop breeding, climate mitigation, and genetics globally, including notable contributions to the agricultural sector of Bangladesh (Tasnim, 2023).

He has memberships of different professional societies namely Genetics Society of America, Inter society of Plant Molecular Biology, American Association of Advancement of Science, New York Academy of Science, etc. Chaudhury was committee members of several organizations such as CSIRO Forum committee (1995-2000); Plant Industry Panel (1992-1994); Sexual Plant reproduction association as Australia Representative (2000-2001); the International Plant Genetic Resource Institute, Rome, Italy. He also worked as a grant-reviewer such as regular reviewers of grants of NSF, USDA, US small business grants, NIH, USA and ARC of Australia; ad-hoc adviser to the Austrian Government in summer, 2000; and reviewers of all major international journals specializing in Plant Science (Kanihati.com, 2003).

Research Contributions

After completing his PhD in 1984, he joined as Head of Scientific Innovation at Loam Bio, Australia; Chief Scientist and Director at Vita Grain Pte. Ltd., and Vita Rice; Principal Scientist at Syngenta Australia and New Zealand. Before that, he worked as Senior Principal Research Scientist (Plant Biology) at the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia for 19 years where he pioneered the work on Fertilization Independent Seed (FIS) (Knowledge Hub, 2020). He established the foundation of work on polycomb group genes in seed development. He has also contributed to the development of many varieties of crops that are important for human nutrition such as black rice, black tomato and others glucose reducing rice. He also worked at Soil Company (Bengal Byte, 2022; ATSE, 2022). When he led as a postdoctoral scientist at HHI and MIT, USA, he discovered a new gene namely *'Rekdi'* through genetic recombination which drew an immense attention and interest in research and practices in the USA and Europe in 1980s. After that he created three Fertilization Independent Seed (FIS). His FIS formula commenced an 'era of apomixes'. The mutants can produce fractional seed without fertilization. There are first characterized genes involved in apomixes, a method of making seed without the father (Knowledge Hub, 2020; Bengal Byte, 2022). This was his one of the revolutionary innovations. Out of many innovations, *'red-maize'* was one of the most prominent innovations. It is a drought-tolerant with more nutritious than rice; and resistant to cancer diseases. He also invented different types of new rice like *Hafiza-1, Jalalia, Tanha and Doon*. Recently, in 2023, he has developed *'Panchabrihi'*- uncommon paddy seed yields five times throughout the year, and *'Kanihati 1 to 16'*, a new variety of rice that is cultivated in Amon season. It has named after his homeland. This newly discovered rice can be cultivated during short time and is produced huge in quantity (Alam, 2023). Dr. Chaudhury is a researcher on heredity. He also invented red rice and colored corn. Colored corn, which is anti-diabetic and anti-cancer, is discussed worldwide. He is currently studying on high yielding rice production and future food security in Australia (Gfmdhaka.com, 2022). Chaudhury's research activity has spanned more than 40 years in the field of molecular biology and allied. Many students have been awarded PhD degree under his guidance including Julie Glover (ANU), Amy Chin Atkins (ANU), Thomas Choi (Melbourne University), and Ming Luo (ANU) (Kanihati.com, 2003).

Panchabrihi: a New Discovery of Rice Production Method

After 20 years working as a leading rice researcher at Australian National Research Organization, he discovered nearly 300 paddy seeds. He went Australia and stayed there for working purpose, yet he has been at the agriculture farm in his birth place 'Kanihati' for testing and cultivating paddy seeds that he discovered. Thus, it is going on. Then, Chaudhury started to think why once harvested rice plant could not produce many times like as mango or jackfruit. From this thought, he began new research journey for today's Panchabrihi. At the beginning, he continued to separate those rice seeds from which again new sheaf of paddy were grown after cutting and harvesting once ripping paddy. In this way, 12 types of paddy seeds were found by him. He started cultivation with the 12 types of seeds and observed that these gave regular yielding second time. Then, again, he tried to get yielding third time and he also succeeded in that. But except four types of seeds (out of 12) the rest were ruined after giving four time yielding. He went on study on the four types of seed for ten years using two methods. One is hybridization between local seed and high yielding seeds. Second one is hybridization between local seed and local hybrid seeds. Thus, after long efforts with the farmers of Kanihati, Chaudhury discovered 'Panchabrihi' that gave yielding during three seasons Boro, Aus and Amon or throughout the year (Bengal Byte, 2022). 'Panchabrihi' is a newly invented uncommon paddy. It is a historic discovery of agricultural research that is very much needed mainly in the rice eating countries for meeting food shortage. Especially that's how natural calamities like flood and drought are took place in Bangladesh and India every year; it will relieve the food crisis of the growing population of the countries. Though, it can be cultivated worldwide. So, 'Panchabrihi', a new type of rice production method that is considered to be a landmark discovery of 21st century in a genetic research. The 'Panchabrihi' was named by Dr. Chaudhury, is combination of two terms- 'Pancha' meaning 'five', and 'brihi' that means 'paddy'. Reasons for this type of naming are that if this paddy seed is once planted in the field, it will yield five times throughout the year and during three seasons. It is worth noting that 'Panchabrihi' cultivation allows for the production of one variety of Boro, two of Aman, and two of Aush from one rice tree. In Indian states like Assam, West Bengal, Odisha, and Bangladesh, rice is usually sown thrice in a year such as Aus, Amon, and Boro. Aus is sown in summer along with pre-monsoonal rains and harvested in autumn. Aman is sown in the rainy season (July-August) and harvested in winter. Boro is sown in winter and harvested in summer.

Research Implications

This variety of rice will yield five times a year from one plant. After first time, its production will be reduced in the second time; the third time this yield is much higher than previous productions. According to the explanation of Chaudhury with an example, if the first time 40g of rice is produced per unit of a plant, it will be 20g in the second time, followed by 50 to 60g in the third time, 20g in the fourth and 15g in the fifth time. This rice seed yields three-time higher production than regular separate cultivation of Boro, Aus and Amon (Billah, 2023). It needs not to completely remove the rice plant after the first harvesting. As per the description of the scientist, methods of cultivation has described below (Gfmdhaka.com, 2022). He engaged farmers in his birthplace Kanihati in Sylhet, Bangladesh to build a rural innovation hub i.e., farmer-led innovation platform for increasing biodiversity and generation of climate-compliant crop, which recently led to the innovation of 'Panchabrihi', a new type of rice cultivation method (Tasnim, 2023). For many years he has been working enthusiastically to reform his home-place *Kanihati* into a rural hub of intellectual activity especial attention to educational improvement. To give a shape his ideas, he initiated a project namely "Kanihati Experiment," for demonstration of social, intellectual, agricultural and environmental transformation (Bengal Institute, 2024; Rice News Today, 2024). For this purpose, he has built an agriculture farm in his native place 'Kanihati'. Procedures of cultivation of 'Panchabrihi' are given below as described by the scientist.

Seasons or Throughout the Year

'Panchabrihi' paddy is harvested for three seasons- Bora, Aus and Aman or the whole year.

Materials and Methods

The scientist described the procedure for the cultivation of the rice. First time for boro season, it is sown in January (winter). After 110 days, during first week of May, it is harvested first time. Then after 45 days, in July, it is started second time production. Next, after every one and half months, third, fourth- and fifth-time production will be began respectively. It must be noted that with proper irrigation and care, use of urea fertilizer in right ratio, the crop grows to a height of 85 cm to one meter in 110 days. Every time after production, the paddy is to be cut at a height of 35 cm from the ground.

Production

For the first time, the production of harvested paddy may be four tons per hectare. Since then, the yielding per hectare is two-three tons. All varieties can be yielded about 16 tons per hectare.

Easily Seed Preservation

Farmers themselves can collect seeds from the harvested paddy and easily preserve them for future cultivation.

Research Limitations

The 'Panchabrihi' yields five times a year. It cannot have impressed local scientists of Bangladesh Rice Research Institute (BRRI) or Bangladesh Agricultural Research Institute (BARI). The scientist wants to cultivate this paddy seed in Bangladesh and minimize the crisis of food of the growing population of the country. Few experts raise questions about his discovery not yet peer-reviewed or no publication of the findings of this discovery in any journal (Billah, 2023; Rice News Today, 2024). The description of his innovation, he demonstrated in presence of several journalists at a seminar organized by the London-Bangla Press Club on October, 2023 (Alam, 2023). However, some body takes it positive and it is in discussion and criticism in Bangladesh. It is just flying on different social Medias. Hope that its true facts will come in front of all and start its cultivation in Bangladesh and other rice producing countries.

Future Research

Chaudhury is cultivating 'Panchabrihi' in homeland in Bangladesh for bringing interest of such paddy seed. He also tries to introduce it among the farmers outside the Bangladesh. As it is produced more than one time, it may solve the shortage of foods especially in the rice-eating countries. Not only is that it also environment friendly. Bangladesh as well as West Bengal, Assam is affected by flood, drought many years and the paddy cultivation using this method may supply of rice in the period of crises at any time.

Chaudhury's Talents beyond Scientific Research Works

Dr. Abed is a multitalented figure. Beyond his talent in scientific research, he is a powerful thinker, science writer, activist, and a man of literature. He has written so many non-fiction books and several books of poetry in both Bangla and English. His first book *Shoibal O Ontorikko* (Bengali): an anthology of poems published by Dibya Prokash in 1999. His books include the *Blueprint of Experience; Human Genome: Man of Genes, Dream, Existence, River, and other Poems*, etc. in Bengali, and *Paradigm Shift, the Gene revolution, the Future of Food* in English. In addition, his other books are namely *Nirbachito Kobita, Anguished Rivers and Other Designs, Shopno Sotta Nodi and Onnanno Kobita*. Besides, he also has written columns such as *Durba Sisir O Porbotmala,* and *Priyo Australia* online news portal (Everybodywiki.com, 2023; Knowledge Hub, 2020). For his varieties of talent, some are said that he is "A Man of Sheer of Brilliance" (Knowledge Hub, 2020).

Honors and Achievements

Out of the scientists of National Research Council of Australia whose names have been recommended for nomination for Nobel Prize, Chaudhury is one of them (Bengal Byte, 2022). He received several honour and achievements (Kanihati.com, 2003; Alam, 2023):

1987-1989: Hoffman La Roche Fellow of the Life Science Research Foundation, Massachusetts Institute of Technology, USA.

1984-1986: Visiting Fellowship, National Institute of Health, USA.

1979-1984: Post-graduate Research Fellowship, University of Oregon, Eugene, USA.

Honorary posts, he held

1989 (March & onwards): Research Scientist, Senior Research Scientist, and Principal Research Scientist at CSIRO Division of Plant Industry, Canberra, Australia.

1992 (& on onwards): Subprogram Leader at CSIRO Plant Industry.

1987 (January) – 1989 (February): LSRF Postdoctoral Fellow at Massachusetts Institute of Technology, USA.

1984 (December) – 1986 (December): Visiting Fellow of the National Institute of Health, USA.

Research Grants he received

1992: Grant from Rockefeller Foundation on Apomixis.

1997: ACIAR Grant on Apomixis.

2000: Bayer Crop Science Grant on Apomixis.

Honours he received as an invited speaker, invited plenary speaker, chairman speaker, co-organizer, and teacher.

1990: 4th International Conference on Arabidopsis research, Vienna.

1992: International Congress on Flowering, Amsterdam, Netherlands.

1993: Workshop on Apomixis, International Rice Research Institute, Philippines.

1993: 5th International Conference on Arabidopsis, Columbus, Ohio, USA.

1994: "Plants for the Future" – A meeting of a joint US-Australia bilateral exchange, Cairns, Australia.

1994: Chairman Lecture, International Congress on Plant Reproduction, Vienna, Austria (did not attend).

1995: 6th International Arabidopsis Congress, Madison, USA.

1996: (i) International Congress of sexual Plant reproduction, Lorne, Victoria, Australia; (ii) Banbury Conference on Plant reproduction, Cold Spring Harbour, USA;(iii) Plenary Speaker, Asia-Pacific Congress on Agricultural Biotechnology, Hua-Hin Thailand; (iv) Institute of Molecular Agrobiology, Singapore.

1997: (i) 50th Golden Jubilee Lecture, Delhi University; (ii) ISPMB Conference Singapore.

1998: (i) Bellagio Conference on Apomixis; (ii) Asia-Pacific Agricultural Biotechnology Conference.

2000: (i) International Conference of Sexual Plant reproduction Research, Banff, Canada, April; (ii) European Apomixis Workshop, Bath, UK, May; (iii) International Society of Plant Molecular Biology, Quebec City, Canada; June; (iv) PGS/Aventis Laboratories, Ghent, May; (v) Biology Department University of Milan, Italy, May; (vi), INRA, Versailles, France May; (vii) Invited speaker CNRS laboratories, Giff Sur Yvette, France June; (viii) Invited Speaker, Ecole Normale Superieure, Lyon, France, April; (ix) Fred Hutchinson Cancer Research Center, Seattle, Washington, April; (x) Genoscope, Evry, France, June; (xi) Apomixis session at International Conference on Sexual Plant reproduction, Banff, Canada; (xii) International Society of Plant Molecular Biology, Quebec city, Canada.

2001: (i) International Apomixis Conference in Como, Italy in April; (ii) An International conference organized by NIAS, Japan in Tsukuba in November; (iii) A Course organized on Molecular Plant Breeding organized by International Center of Genetic Engineering and Biotechnology held in Dhaka University, Bangladesh in November; (iv) International Arabidopsis Conference held in Seville, Spain in July.

2003: Lorne Genome Conference, Australia.

Other awards

2015: Abdul Mannan Chaudhury Memorial Award.

2022: Activate and ATSE Awards.

OBJECTIVES

The main objectives of the study are:

To identify the year- and age wise distribution of authorship pattern of Chaudhury;

To observe the status of the scientist as main author and co-author;

To measure the degree of collaboration (collaboration coefficient);

To calculate author productivity;

To identify the research spectrum with co-authors;

To find out peak period of productivity;

To identify channel wise papers published;

To count citation received and Citation Growth Rate;

To determine Relative Un-cited Index; and Relative Citation Impact;

To examine the validity of Lotka's Law for Co-authors;

To test Bradford's law for publication channels.

SCOPE & METHODOLOGY

Through searching the name "Dr. Abed Chaudhury" using Google Scholar (GS), Research Gate (RG) and PubMed (PM) databases, and filtering the publications with his variant names such as Abed Chaudhury, A M Chaudhury, A Chaudhury, a list of his 68 scientific research publications during 1984-2023 has been prepared for this scientometric analysis. In addition, some publications and other data have been accumulated from his CV and different offline and online resources. The collected data were transferred into MS-excel and Words. Data are tabulated using various tables as required in this study. This study investigates authorship pattern, main authors and co-authors, author productivity and research team from 68 papers. Various others facts such as collaboration coefficient, age wise publication pattern, peak period of productivity, publication channel wise scattering of publications, Citation Growth Rate count, Relative uncited index and Relative Citation Impact, Annual Growth rate, Relative Growth rate and Doubling time, etc. are generated. Finally, it has also been examined validity of data set for Lotka's Law and Bradford's law.

DATA ANALYSIS & DISCUSSION

Year-and-Age wise Authorship Patterns

Table 1 shows year and Chaudhury's age wise papers during 1984-2023. His first collaborative paper appeared in 1984 when he was 29 years old and his productive life spanned 40 years. Out of 68, there are four single authored papers 1 in 1993 (age 38), 2 in 2001 (age 46), and 1 in 2005 (age 50), and remaining 64 are multi-authored papers. Out of them, he has produced 19 papers as first author, 10 as second-author, 8 as third author, 6 as fourth author, and 10 as fifth author and so on. He has two papers, one in 2023 (age 68) and year not found for other under mega-authorship. He led the team as first author in as many as 19 papers. In all he has published 45 papers as co-authors. In his 40 years of productive life, he has no publication in 1987-88, 1990, 2003-04, 2006, 2011-12, 2104, 2016, and 2018-22. From the table, it is also observed that the scientist has published 54 (79.41%) papers, more than 50% when he was 50 years of his age. When he completed 60 years, more than 90% papers have been published by him. He produced 3 papers in his retried period. Year of publication has not identified (YNF) for one paper. Over all 290 co-authors were involved in research work along with the scientist. His productivity peaked at the age of 46 in the year 2001.

It is observed that Chaudhury has contributed a maximum number i.e., 8 of outstanding contributions at the age of 46, i.e., in the year 2001, followed by 7 at the age 44 in the year 1999, 5 papers each in the years 1998 and 2000 at the age of 43 and 45. He has published 4 papers each in the years 1994 (age 39), 1996 (age 41) and 2002 (age 47). Three papers have been contributed by him in 2005 at the age of 50 and so on.

Table 1: Year-and- age wise paper production of Chaudhury.

Year	TAP	CAP	AA	PPA	SAP	MAP	Authorship Position (P)										CoA	DC =MAP/TAP
							P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	$P_{10} \geq$		
1984	2	2	29	1		2	1		1								8	1.00
1985	2	4	30	2		2	2										2	1.00
1986	2	6	31	3		2		1	1								5	1.00
1989	2	8	34	6		2	2										2	1.00
1991	1	9	36	8		1				1							7	1.00
1992	1	10	37	9		1	1										4	1.00
1993	2	12	38	10	1	1	1										3	0.50
1994	4	16	39	11		4	3	1									11	1.00
1995	2	18	40	12		2	1		1								6	1.00
1996	4	22	41	13		4		1		2	1						20	1.00
1997	1	23	42	14		1	1										5	1.00
1998	5	28	43	15		5	1			1	2			1			22	1.00
1999	7	35	44	16		7	3			1	1	1			1		47	1.00
2000	5	40	45	17		5			1		4						18	1.00
2001	8	47	46	18	2	6	3	1	1			1					22	0.75
2002	4	51	47	19		4		3	1								6	1.00
2005	3	54	50	22	1	2		1			1						5	0.67
2007	2	56	52	24		2				1		1					15	1.00
2008	2	58	53	25		2			1					1			10	1.00
2009	2	60	54	26		2		1	1								5	1.00
2010	2	62	55	27		2					1	1					15	1.00
2013	1	63	58	30		1		1									2	1.00
2015	1	64	60	32		1							1				9	1.00
2017	1	65	62	34		1								1			9	1.00
2023	1	66	68	40		1										1	15	1.00
YNF	1	68		**		1										1	17	1.00
Total	68				4	64	19	10	8	6	10	4	1	3	1	2	290	0.94

Abbreviations: TAP= Annual Publication, CAP= Cumulative Annual Publication, AA= Author's Age, PPA= Publication Productive Age, SAP = Single Authored Publications, MAP= Multiple Authored Publications P_1 = author in 1st position; P_2 = author in 2nd position & so on; CoA = No. of Co-authors, DC= Degree of Collaboration = MAP/TAP; YNF= Year of publication not found.

Degree of Collaboration

It is observed that during 40 years of his productive period, the DC has its maximum value 1 only in 23 years i.e., no single-authored paper has been published in 23 years (Table 1). There is DC value equal to 0.5 for one year i.e., 1993; the same greater than 0.5 for two years, 2001 (DC 0.75) and 2005 (DC 0.67). In all, DC Value is 0.94.

Annual Growth Rate (AGR) of Research Articles

Table 2 shows annual growth rate and cumulative annual growth rate of publications. To measure the AGR, the following formula can be used, that is AGR= (End value – First value) x 100/ First value (Jain & Meera, 2022). For example, here first one has been worked out for hints, for the years 1984 to 1985. So, here, End value corresponding the year 1985 =2, First value corresponding the year 1984= 2. Therefore, AGR = (2-2) x 100/2= 0 and so on.

In case of annual growth, in 1997 and 1998, there is an increase of 400% from 1 to 5 papers. In 1993-94 and 1995-96, a 100% growth from the previous year. After 1998, it has gradually declined to 28.57% in the year 2000; again, it has increased. In cumulative annual growth (CAG), it was seen that during the starting years, the increase was 20 to 100% till in 2001. After that CAG varies from 1 to 6%. It can be mentioned that inference in number of publications exists between 1 to 8.

Table 2: Annual Growth Rate of research publications and Cumulative Annual Growth.

Year	Research Articles	Cumulative Total	AGR = (End value – First value) x 100/First value	
			Results	
			AGR (%)	Cumulative-AGR (%)
1984	2	2	--	--
1985	2	4	0	100.00
1986	2	6	0	50.00
1987	0	6	-100	0
1988	0	6	0	0
1989	2	8	0	33.33
1990	0	8	-100	0
1991	1	9	0	12.50
1992	1	10	0	11.11
1993	2	12	100.00	20.00
1994	4	16	100.00	33.33
1995	2	18	100.00	12.50
1996	4	22	100.00	22.22
1997	1	23	75.00	4.54
1998	5	28	400.00	21.73
1999	7	35	40.00	25.00
2000	5	40	28.57	14.28
2001	8	48	60.00	20.00
2002	4	52	-50.00	6.25
2003	0	52	-100.00	0
2004	0	52	0	0
2005	3	55	0	5.76
2006	0	55	0	0
2007	2	57	0	3.63
2008	2	59	0	3.51
2009	2	61	0	3.38
2010	2	63	0	3.27
2011	0	63	-100.00	0
2012	0	63	0	0
2013	1	64	0	1.58
2014	0	64	100.00	0
2015	1	65	0	1.56
2016	0	65	100.00	0
2017	1	66	0	1.53
2018	0	66	100.00	0
2019	0	66	0	0
2020	0	66	0	0
2021	0	66	0	0
2022	0	66	0	0
2023	1	67	0	1.51
YNF	1	68	0	1.49

Relative Growth Rate (RGR) and Doubling Time (DT)

RGR and DT are two important indicators in bibliometric study. RGR is the increment in the number of research article per unit of time. Table 3 counts RCR and DT from 1984-2023. RGR and DT have been measured from 1984 to 2023. RGR is calculated year wise. The following formula has used for finding the value of RGR (Mondal and Raychoudhury, 2017; Jain and Meera, 2022; Sawale and Mete, 2021; Mondal, 2021):

$$RGR = W2 – W1 / T2 – T1$$

Where,

W_1 = Natural log of initial number of research articles;

W2 = Natural log of final number of research articles;

T1 – T2 = Unit difference between the initial year (time) and final year (time).

Here, time difference is one year. So, formula shortly is:

$$RGR = W2 – W1$$

The corresponding DT can be measured as DT = 0.693/ RGR, one by one (Mondal and Raychoudhury, 2017; Jain and Meera, 2022) and enumerated values for DGR and DT have been shown in Table 4. The DGR has been decreased from 0.693 in 1985 to 0.015 in 2023 during the time span of 38 years. During the years, the DT has been increased from 1985 (1.000) to 2023(46.200). All over its curve has been up and down in the time span of 38 years (Figure 1).

Non-Collaborative Papers

Table 4 shows non-collaborative publication pattern and time span for publication. Chaudhury produced a largest number of non-collaborative papers i.e., 68 throughout his life. Five-author collaboration has created in the largest number of papers, i. e., 16 with the time span of 18 years. Two-author papers totaling 13 was published in a time span of 26 years. Four-author papers i.e., 9 have seen the light of day in a time span of 23 years. Besides, eight-author 6 papers took 27 year of time spans. There are 5 three-author papers which have produced in a time span of 28 years. Year of publication for one paper could not be ascertained.

Table 3: Relative Growth Rate and Doubling time of publication of research articles.

Year	Research Articles	Cumulative Total	W_1	W_2	RGR = (W_2 minus W_1) / 1	DT = 0.693/ RGR
1984	2	2	--	0.6931	0	0
1985	2	4	0.6931	1.3862	0.693	1.000
1986	2	6	1.3862	1.7917	0.406	1.706
1987	0	6	1.7917	1.7917	0	0
1988	0	6	1.7917	1.7917	0	0
1989	2	8	1.7917	2.0794	0.287	2.415
1990	0	8	2.0794	2.0794	0	0
1991	1	9	2.0794	2.1972	0.118	5.872
1992	1	10	2.1972	2.3025	0.105	6.600
1993	2	12	2.3025	2.4849	0.182	3.807
1994	4	16	2.4849	2.7725	0.288	2.406
1995	2	18	2.7725	2.8903	0.118	5.872
1996	4	22	2.8903	3.0910	0.201	3.447
1997	1	23	3.0910	3.1354	0.044	15.750
1998	5	28	3.1354	3.3322	0.241	2.875
1999	7	35	3.3322	3.5553	0.223	3.107
2000	5	40	3.5553	3.6888	0.136	5.095
2001	8	48	3.6888	3.8712	0.182	3.807
2002	4	52	3.8712	3.9512	0.080	8.662
2003	0	52	3.9512	3.9512	0	0
2004	0	52	3.9512	3.9512	0	0
2005	3	55	3.9512	4.0073	0.056	12.375

Year	Research Articles	Cumulative Total	W_1	W_2	RGR = (W_2 minus W_1) / 1	DT = 0.693/ RGR
2006	0	55	4.0073	4.0073	0	0
2007	2	57	4.0073	4.0430	0	0
2008	2	59	4.0430	4.0775	0.035	19.800
2009	2	61	4.0775	4.1108	0.033	21.000
2010	2	63	4.1108	4.1431	0	0
2011	0	63	4.1431	4.1431	0	0
2012	0	63	4.1431	4.1431	0	0
2013	1	64	4.1431	4.1588	0.016	43.312
2014	0	64	4.1588	4.1588	0	0
2015	1	65	4.1588	4.1743	0.015	46.200
2016	0	65	4.1743	4.1743	0	0
2017	1	66	4.1743	4.1896	0.015	46.200
2018	0	66	4.1896	4.1896	0	0
2019	0	66	4.1896	4.1896	0	0
2020	0	66	4.1896	4.1896	0	0
2021	0	66	4.1896	4.1896	0	0
2022	0	66	4.1896	4.1896	0	0
2023	1	67	4.1896	4.2046	0.015	46.200
YNF	1	68	4.2046	4.2195	0.014	49.500

Table 4: **Non-collaborative publication and time span.**

No. of authors	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	16A	18A	TP
No. of non-collaborative	4	-	-	-	-	-	-	-	-	-	-	-	-	4
No. of collaborative papers	-	13	5	9	16	5	1	6	2	2	2	1	2	64
Time Span	13	26	28	23	18	11	1	27	15	3	9	1	1**	
Duration	1993-2005	1984-2009	1986-2013	1986-2008	1992-2009	1997-2007	2001-2001	1984-2010	1996-2010	2015-2017	1999-2007	2023-2023	1999-1999	

Abbreviations: 1A= one authored paper, 2A= two authored papers & so on. TP= Total Paper. ** Year of publication not identified for one eighteen-authored paper

Status in Byline of Authors

Table 5 depicts the status of Chaudhury in the byline of authors in his 68 collaborative papers. He appears as the first author as many as 19 cases. He occupies the second and fifth place in 10 cases each, third place in 8 papers, forth position in 6 papers, and so on. He has placed 9^{th}, 13^{th} and 14^{th} position in 1 case each.

Publications by Quinquennium

The quinquennium publication data of Chaudhury has been counted in the Table 1 and graphical representation has been shown in Figure 2. The highest publications has figured 24 during 1999-2003, at the age range of 44 to 48 followed by 16 papers during 1994 to 1998 (age range 39 to 43; 7 contributions during 2004 to 2008 (age range 49-53); 6 papers each during 1984 to 1998 (age range 29 to 33) and 1989 to 1993 (age range 34 to 38) respectively. More than 76% papers have been contributed by the scientist during the first four quinquenniums (age range 29 to 48). It is observed that the author's productivity has increased with the time span of 20 years of his active productive age and then declines with age. His productivity peaked during the fourth quinquennium (Figure 2) when he has published 24 papers during age range 44 to 48.

Prolific Collaborators

Table 6 enlists name wise prominent co-authors' publications and affiliations. Research team of Chaudhury consists of 149 individual co-authors in his productive career and produced as many as 32 papers in collaboration with Elizabeth Dennis who

Table 5: Position in the byline in collaborative papers.

Publications	Status or position in the byline											
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	13th	14th	Total
Two-authored	7	6										13
Three-authored	1	2	2									5
Four-authored	5		4									9
Five-authored	3	2	1	2	8							16
Six-authored	1				1	3						5
Seven-authored	1											1
Eight-authored	1		1	1		1		2				6
Nine-authored				1	1							2
Tenth-authored							1	1				2
Eleven-authored				1					1			2
Sixteen- authored											1	1
Eighteen-authored				1						1		2
Total	19	10	8	6	10	4	1	3	1	1	1	64

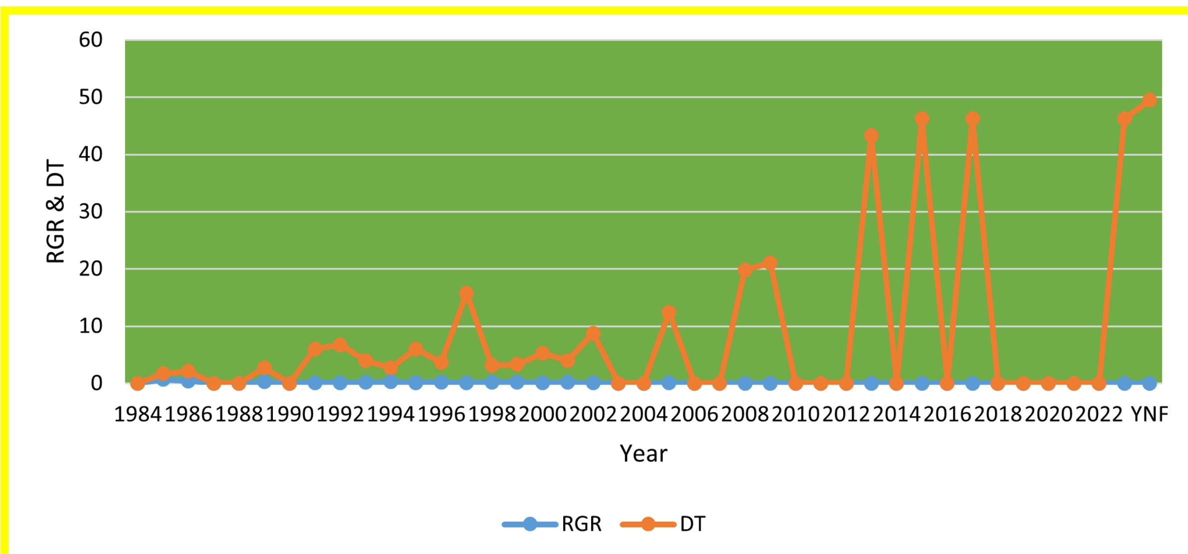

Figure 1: Graphical representation of RGR & DT, 1984-2023.

is found to be the most productive collaborative of the scientist. There are eight collaborators with whom he has published five and more than five papers. Apart from Elizabeth Dennis, other significant collaborators are J. Peacock (N22), M. Luo (N15), S. Craig (12), Frederic Berger (N8), Anna M Koltunow (N8), P. Bilodeau (N6), etc. Apart, a group of two co-authors has published 5 papers each; a class of two authors 4 papers each; a batch of five co-authors 3 papers each; another a category of 21 authors has published 2 papers each along with the scientist. There are 112 authors published 1 paper each.

Lotka's Law Testing

As Lotka's Law, 60% of total author should have 1 paper each, 15% will have 2 papers each, 7% should have 3 papers each and so on. For the data set from this study, here 75.17% have 1 paper each that is ≥60%; and 14.05% have 2 papers each, not equal to 15%; 3.36% have 3 papers each that could not reach to 7%, the standard percentage as per law, and so on. Therefore, the data set does not validate the Lotka's law.

Publication Channels

Table 7 shows the rank list of four types of publication channels. His most publications are Journal Articles (JA) (77.95%), followed

Table 6: List of name wise prominent co-authors' publications and affiliations.

PWA	Co-author's Names	FYP	LYP	Time Span (Years)	P/Y
32	Dennis, Elizabeth	1991	2010	20	1.60
22	Peacock, J.	1991	2010	20	1.10
15	Luo, M.	1998	2023	26	0.58
12	Graig, S.	1992	2000	9	1.33
8	Berger, Frederic	2001	2010	10	0.8
8	Kaltunow, Anna M.	1995	2015	11	0.55
6	Bilodeau, P.	1996	2000	5	1.2
5	Helliwell, Chris	1996	2013	8	0.63
5	Smith, G.R.	1984	1986	3	1.67
4	Zhang, Hongyu	2013	2023	11	0.36
4	Finnegan, E.	1996	2023	28	0.14
3	Raikhel N.V.	1999	1999	1	3.00
3	Upadhyaya, N.	1999	2007	9	0.33
3	Glover, J.	1996	1998	3	1.00
3	Signer, E.R.	1989	1994	6	0.50
3	Bloemer, K.C.	1996	1996	1	3.00
2	Chin-Atkins, A.N.	1996	2001	6	0.33
2	Amundsen, S.B.K.	1984	1986	3	0.67
2	Brettel, R.I.S.	1991	1994	4	0.5
2	Farrell, L.B.	1996	1996	1	2.00
2	Knox, R.B.	1994	1998	5	0.4
2	Lavithis, M.	1994	1998	5	0.4
2	Singh, M.B.	1994	1998	5	0.4
2	Taylor, A.F.	1984	1986	3	0.67
2	Taylor, P.E.	1994	1998	5	0.4
2	Sundaresan, Venkatesan	1999	1999	1	2.00
2	Hocart, C.	1996	2000	5	0.4
2	Letham, D.S.	1993	2000	8	0.25
2	Lohe, A.R.	2002	2002	1	2.00
2	Luo, Mingzhu	2007	2008	2	1.00
2	MacIntosh, G.C.	1999	1999	1	2.00
2	Ming, L.	1995	1997	3	0.67
2	Nogue, F.	2000	2000	1	2.00
2	Okada, Kiyotaka	1999	1999	1	2.00
2	Wu, Xianjun	2017	2023	7	0.28
2	Wu, Xiaoba	2017	2023	7	0.29
2	Xie, Liqiong	2017	2023	7	0.29
112	112 authors 1paper each			1 year each	1 paper per year
Total	149 co-authors				

Abbreviations: PWA= Papers with Chaudhury, FPY= First Publication Year, LPY= Last Publication Year, P/Y= Paper per year; ** could not be ascertained.

Table 7: Preferred Channel of Publications.

Sl. No.	Content-carriers	TP	%-age	C-%-age	FPY	LPY	Country	FP	IP
Gr. A	Journal Articles (JA: 77.95%)								
1	Proceedings of the National Academy of Sciences of the United States of America.	7	10.29	10.29	1984	2005	USA	JA	11.100
2	The Plant journal: for cell and molecular biology	5	7.35	17.64	1993	2017	USA	JA	7.091
3	The Plant Cell	3	4.42	22.06	1999	2002	USA	JA	12.085
4	Australian J. Plant Physiol.	3	4.42		1992	1996	Australia	JA	3.000
5	Current Opinion in Plant Biology	3	4.42		1998	2002	Netherlands	JA	9.600
6	Plant Physiology	3	4.42	35.32	1995	1998	UK	JA	8.005
7	Genetics	2	2.94		2008	2010	USA	JA	4.402
8	Plant Growth Regul.	2	2.94		2000	2000	USA	JA	4.800
9	Trends in plant science	2	2.94		2005	2009	Netherlands	JA	20.500
10	Plant Molecular Biology Reporter	2	2.94		1989	1996	USA	JA	2.100
11	Sexual Plant Reproduction	2	2.94		1994	1999	USA	JA	**
12	Seminars in Cell & Developmental Biology	2	2.94	52.96	1996	2001	Netherlands	JA	6.138
13	Annual review of cell and developmental biology,	1	1.47		2001	2001	USA	JA	11.300
14	Cold spring Harbor Symposium of Quantitative Biology	1	1.47		1984	1984	USA	JA	**
15	Current Biology	1	1.47		2001	2001	USA	JA	10.900
16	Development	1	1.47		2001	2001	UK	JA	4.600
17	Journal of Bacteriology	1	1.47		1985	1985	USA	JA	3.200
18	Molecular and General genetics	1	1.47		1985	1985	USA	JA	3.100
19	Nature	1	1.47		2005	2005	UK	JA	64.800
20	Plant Cell Reports	1	1.47		1989	1989	Germany	JA	4.57
21	Journal of Experimental Botany	1	1.47		2015	2015	UK	JA	7.298
22	Journal of genetics and genomics	1	1.47		2013	2013	Netherlands	JA	5.900
23	Molecular plant	1	1.47		2009	2009	USA	JA	12.084
24	Nature Plants.	1	1.47		2023	2023	UK	JA	15.793
25	Plant Research	1	1.47		1999	1999	USA	JA	2.800
26	Plant	1	1.47		1996	1996	Switzerland	JA	4.500
27	Planta	1	1.47		1998	1998	Germany	JA	4.300
28	PloS one.	1	1.47		2008	2008	USA	JA	3.700
29	Theoretical and Applied Genetics	1	1.47	77.95	1991	1991	Germany		4.439
Gr. B	Composite Books (CB: 13.23%)								
30	e LS (Encyclopedia of Life Sciences)	4	5.88	83.83	1999	2001	USA	CB	
31	Apomixis: exploiting hybrid vigor in rice (edited by Gurdev S. Khush).	1	1.47		1994	1994	Philippines	CB	
32	Arabidopsis: An Atlas of Morphology and Development, Eds, Bowman, J. (Springer, New York).	1	1.47		1994	1994	USA		

33	Genetic Recombination in Saccharomyces cerevisiae, Eds J. Strathern and Amar Klar. Published by Cold Spring Harbour laboratory.	1	1.47		1986	1986	USA		
34	Managing Plant Genetic Diversity by V. Ramanatha Rao, A. H. D. Brown, M. Jackson. Publisher CABI Publishing.	1	1.47		2002	2002	UK	CB	
35	Rice functional genomics: challenges, progress and prospects.	1	1.47	91.18	2007	2007	USA	CB	
Gr. C	Conference Proceedings (CP 7.35%)								
36	Biotechnology and Sustainable Agriculture 2006 and Beyond: Proceedings of the 11th IAPTC&B Congress, Beijing, China.	1	1.47		2007	2007	China	CP	
37	ISHS Acta Horticulture 560: IV International Symposium on In Vitro Culture and Horticultural Breeding.	1	1.47		2000	2000	Finland	CP	
38	Proceedings of 17th world congress of soil science: Abstracts volume IV, Department of Land Development, Bangkok (Thailand)…	1	1.47		2002	2002	Thailand	CP	
39	Proceedings of an International Symposium on the Use of Induced Mutations and Molecular Techniques for Crop Improvement, International Atomic Energy Agency.	1	1.47		1995	1995	Austria	CP	
40	Abstracts, General Meeting of the International Programme on Rice Biotechnology, Phuket, Thailand.	1	1.47	98.53	1999	1999	Thailand	CP	
Gr. D	Others (OT: 1.47%)								
42	521 NB-LRRs work a "bait and switch" on pathogens 530 Confronting Maxwell's demon: biophysics of xylem embolism repair.	1	1.47	100	n.d.	n.d.	**	**	**
Total		68	100						

Abbreviations: TP = Total papers; FPY=First publication year; LPY= Last publication year; JA= Journal articles; CB= Composite books; CP= Conference proceedings; IP= Impact factors; n. d. = date of publication not found; ** could not be ascertained. C-%age = Cumulative percentage; FP = Form of publications.

by composite books (13.23%), conference proceedings (7.35%) and so on. His largest number of JA has published in his favorite journal *Proceedings of the National Academy of Sciences of the United States of America (N7, 10.29%),* and *The Plant journal: for cell and molecular biology (N5, 7.35%).* A class of journals like The *Plant Cell, Australian J. Plant Physiol., Current Opinion in Plant Biology, Plant Physiology* has published 3 papers (4.42%) each. In addition, a group of journals where he published 2 papers each in the journals *Genetics, Plant Growth Regul., Plant Molecular Biology Reporter, Seminars in Cell & Developmental Biology, etc.* Another category of 17 journals has been placed his 17 papers (i.e., 1 paper in each journal). Out of six composite books, *e LS* (Encyclopedia of Life Sciences) has published as many as 4 papers (5.88%). Rest is published in another 12 publication channels including Composite Books (CB), Conference Proceedings (CP) and others. Many of his papers are accepted by highly impact factor generated journals which are shown in the last column of the Table 7.

Publications by Country

Total 38 i.e., 56% of his papers have appeared in different publication channels that emanated from USA. Apart from it, his papers have published from Netherlands (8, 11.77%), UK (8, 11.77%), Australia, Germany, Thailand, Austria, China, Finland, Philippines, and Switzerland. Place of publication (CNF) for one paper could not be ascertained.

Citation Analysis

Highly Cited Scholarly Works and Citation Growth Rate (CGR)

Table 8 enlists highly cited 23 articles (out of 68) which have received more than 100 citations in GS and counts rate of CGR in online three indexing databases Google Scholar (GS), ResearchGate (RG), and PubMed (PM). From the data set, it is observed that the article "*Fertilization independent seed development in Arabidopsis thaliana*" has ranked first in GS (631citations), third in PM (177 citations) and no citation received in RG for the paper; corresponding CGRs are 22.54 in GS, and 6.32 in PM. The second one *"Miniseed3 (MINI3), a WRKY family gene, and HAIKU2 (IKU2), …, are regulators of seed size in Arabidopsis*" has cited by others 600 times (CGR 30.00) and ranked 2nd in GS, 485 times (CGR 24.25) and ranked 2nd in RG, and 242 times (CGR 12.12) and ranked 1st in PM. It is remarkable that the second paper shows a rise in the rate of CGR in GS, RG and PM respectively. Over all, amount of citation received and rate of CGR of most of the papers are high in GS throughout the study followed by RG and PM. Thus, his top 23 scholarly works have considered for CGR, and a CGR graph has been drawn in the Figure 3 with the values found in GS, RG and PM.

Citations Received Pattern

Table 9 shows citation received Chaudhury and his collaborative authors according to the range of citation distribution. It is seen that maximum number of papers i.e., 23 have received the citation range more than100 in GS, 25 papers' and 31 papers' citation range =0 in RG, and PM respectively. Fourteen (N14) papers in GS have not received any citations whereas 17 papers in RG and 8 papers in PM have received the citation range more than 100 respectively. It also enumerates that rates of citation per article are 11.91 in GS, 78.35 in RG and 31.16 in PM. On average he has received 202.55, 133.20 and 52.98 per year in GS, RG and PM respectively.

Table 8: Top 23 scholarly cited works of Chaudhury (which received 100+ citations).

Sl. No.	Title of paper	Communication channels (Year)	Times Cited or Total citation (TC)			Ranks			(AP) As on 2024	Citation Growth Rate = TC/AP		
			GS	RG	PM	GS	RG	PM		GS	RG	PM
01	Fertilization independent seed development in Arabidopsis thaliana.	Proc Natl Acad Sci U S A. (1997)	631	0	177	1	-	3	28	22.54	--	6.32
02	Miniseed3 (MINI3), a wrky family gene, and HAIKU2 (IKU2), a leucine-rich repeat (LRR) kinase gene, are regulators of seed size in Arabidopsis.	Proceedings of the National Academy of Sciences of the United States of America (2005)	600	485	242	2	2	1	20	30.00	24.25	12.10
03	Genes controlling fertilization-independent seed development in Arabidopsis thaliana.	Proceedings of the National Academy of Sciences of the United States of America (1999)	565	510	161	3	1	4	26	21.73	19.62	6.19
04	Interaction and parent-of-origin effects for FIS2, MEA, and FIE in the endosperm and embryo of developing Arabidopsis seeds	Proc Natl Acad Sci, USA (2000)	532	0	0	4	-	-	25	21,28	--	--
05	Expression and parent-of-origin effects for FIS2, MEA, and FIE in the endosperm and embryo of developing Arabidopsis seeds.	Proceedings of the National Academy of Sciences (2000)	531	445	180	5	3	2	25	21.24	17.80	7.20

Sl. No.	Title of paper	Communication channels (Year)	Times Cited or Total citation (TC)			Ranks			(AP) As on 2024	Citation Growth Rate = TC/AP		
			GS	RG	PM	GS	RG	PM		GS	RG	PM
06	amp1-a mutant with high cytokinin levels and altered embryonic pattern, faster vegetative growth, constitutive photomorphogenesis and precocious flowering	The Plant Journal (1993)	410	347	0	6	4	-	32	12.81	10.84	--
07	Genetic analysis of seed coat development in Arabidopsis.	Trends in plant science (2005)	388	320	125	7	5	6	20	19.40	16.00	6.25
08	The gene for an essential subunit of Exonuclease V.	Proceedings of the national Academy of Science, USA (1986)	337	295	139	8	6	5	39	8.64	7.56	3.56
09	PEMU: an improved promoter for gene expression in cereal cells.	Theoretical and Applied Genetics (1991)	328	199	43	9	10	14	34	9.65	5.85	1.26
10	Apomixis: molecular strategies for the generation of genetically identical seeds without fertilization.	Plant Physiology (1995)	316	198	36	10	11	16	30	10.53	6.60	1.20
11	Control of early seed development.	Annual review of cell and developmental biology (2001)	270	203	90	11	9	9	24	11.25	8.46	3.75
12	The VQ Motif protein IKU1 regulates endosperm growth and seed size in Arabidopsis.	The Plant journal: for cell and molecular biology (2010)	264	218	114	12	8	7	15	17.60	14.53	7.60
13	A new class of Escherichia coli recBC mutants: Implications for the role of RecBC enzyme in homologous recombination.	Proceedings of the national Academy of Science, USA (1984)	244	223	102	13	7	8	41	5.95	5.44	2.49
14	Expression, Imprinting, and Evolution of Rice Homologs of the Polycomb Group Genes.	Molecular plant (2009)	212	197	80	14	12	10	16	13.25	12.31	5.00
15	The Arabidopsis AMP1 Gene Encodes a Putative Glutamate Carboxypeptidase.	The Plant cell (2001)	211	152	63	15	13	11	24	8.79	6.33	2.63
16	Cloning and characterization of MS5 from Arabidopsis: a gene critical for male meiosis.	The Plant Journal (1998)	177	133	45	16	14	13	27	6.55	4.93	1.67
17	Fruit Development is actively restricted in the absence of fertilization in Arabidopsis	Development (2001)	162	130	49	17	15	12	24	6.75	5.42	2.04
18	Nuclear genes controlling male fertility.	Plant Cell (1993)	158	109	31	18	16	19	32	4.94	3.41	0.97
19	Polycomb group genes control pattern formation in Plant seed	Current Biology (2001)	145	133	49	19	14	12	24	6.04	5.54	2.04

Sl. No.	Title of paper	Communication channels (Year)	Times Cited or Total citation (TC)			Ranks			(AP) As on 2024	Citation Growth Rate = TC/AP		
			GS	RG	PM	GS	RG	PM		GS	RG	PM
20	Increased endogenous cytokinin in the Arabidopsis amp1 mutant corresponds with de-etiolation responses.	Plant (1996)	129	87	20	20	18	20	29	4.45	3.00	0.69
21	Role of Escherichia coli recBC enzyme in SOS induction.	Molecular and General genetics (1985)	113	98	35	21	17	17	40	2.83	2.45	0.88
22	Roles of recBC enzyme and Chi sites in homologous recombination.	Cold spring Harbor Symposium of Quantitative Biology (1984)	108	0	41	22	-	15	41	2.63	--	1.00
23	Parental memories shape seeds.	Trends in plant science (2009)	103	85	34	23	19	18	16	6.44	5.31	2.13

Table 9: **Ranking of publications by number of citations received.**

No. of Citation received	Number of publications (frequency) (TP)			%-age of publications			Total Citations (TC)		
	GS	RG	PM	GS	RG	PM	GS	RG	PM
Up to 0	14	25	31	20.59	36.76	45.58	--	--	--
1-10	6	4	6	8.82	5.88	8.82	22	23	29
11-20	6	4	5	8.82	5.88	7.35	92	60	80
21-30	4	5	5	5.88	7.35	7.35	99	132	`139
31-40	3	3	5	4.41	4.41	7.35	105	104	171
41-50	2	2	5	2.94	2.94	7.35	87	92	227
51-60	2	2	--	2.94	2.94	--	116	109	--
61-70	2	1	1	2.94	1.48	1.48	124	65	63
71-80	2	1	1	2.94	1.48	1.48	149	78	80
81-90	1	2	1	1.48	2.94	1.48	87	172	90
91-100	3	2	-	4.41	2.94	--	287	196	-
Above 100	23	17	8	33.83	25.00	11.76	6934	4297	1240
Total	68	68	68	100	100	100	8102	5328	2119
Citations per article= TC/TP							11.91	78.35	31.16
Paper productive age = PPA (years)							40	40	40
Citations per year = TC/ PPA							202.55	133.20	52.98

Table 10: **Relative citation impact comparison between GS, PM and RG.**

Year	TP	% of TP	Cited papers (CP)			Citation received Total citation (TC) &% -age						Citation per paper = TC/CP			Relative Citation Impact (RCI) =% of TC/% of TP		
						GS		RG		PM							
			GS	RG	PM	TC	%	TC	%	TC	%	GS	RG	PM	GS	RG	PM
1984	2	2.94	2	1	2	352	4.34	223	4.19	143	6.75	176	223	71.5	1.51	1.43	2.29
1985	2	2.94	2	2	2	206	2.54	196	3.68	70	3.3	103	98	35	0.86	1.25	1.12
1986	2	2.94	1	1	1	337	4.16	295	5.54	139	6.55	337	295	139	1.41	1.88	2.23
1989	2	2.94	2	1	1	43	0.54	16	0.3	3	0.15	21.5	16	3	0.18	0.10	0.05
1991	1	1.47	1	1	1	328	4.05	199	3.74	43	2.03	328	199	43	2.75	2.54	1.38
1992	1	1.47	0	1	0	0	0	29	0.55	0	0	0	29	0	0	0.37	0
1993	2	2.94	2	2	1	568	7.03	456	8.55	31	1.46	284	228	31	2.39	2.91	0.49
1994	4	5.88	2	1	1	102	1.26	5	0.09	28	1.34	51	5	28	0.21	0.12	0.22
1995	2	2.94	2	1	1	338	4.17	198	3.72	36	1.69	169	198	36	1.42	1.26	0.57
1996	4	5.88	4	3	1	213	2.63	147	2.76	20	0.95	53.25	49	20	0.45	0.46	0.16
1997	1	1.47	1	0	1	631	7.78	0	0	177	8.35	631	0	177	5.29	0	5.68
1998	5	7.36	3	2	3	330	4.07	211	3.97	89	4.2	110	105.5	29.67	0.55	0.54	0.57
1999	7	10.29	5	4	3	668	8.24	598	11.24	184	8.68	133.6	149.5	61.33	0.80	1.09	0.84
2000	5	7.36	5	4	1	1150	14.19	519	9.74	180	8.49	230	129.75	180	1.92	1.32	1.15
2001	8	11.77	6	4	5	876	10.82	618	11.59	280	13.21	146	154.5	56	0.92	0.98	1.12
2002	4	5.88	3	1	2	53	0.65	35	0.65	9	0.43	17.67	35	4.5	0.11	0.11	0.07
2005	3	4.42	3	3	3	1011	12.47	824	15.46	372	17.55	337	274.66	124	2.82	3.49	3.97
2007	2	2.94	1	1	0	71	0.87	43	0.8	0	0	71	43	0	0.29	0.27	0
2008	2	2.94	2	2	2	140	1.74	122	2.28	54	2.55	70	61	27	0.59	0.77	0.86
2009	2	2.94	2	2	2	315	3.88	282	5.29	114	5.37	157.5	141	57	1.32	1.79	1.82
2010	2	2.94	2	2	2	302	3.72	251	4.72	130	6.14	151	125.5	65	1.26	1.61	2.08
2013	1	1.47	1	1	1	16	0.19	13	0.25	5	0.25	16	13	5	0.13	0.17	0.17
2015	1	1.47	1	1	1	17	0.22	21	0.39	12	0.56	17	21	12	0.13	0.26	0.38
2017	1	1.47	1	1	0	35	0.44	26	0.48	0	0	53	26	0	0.29	0.32	0
2023	1	1.47	0	1	0	0	0	1	0.02	0	0	0	1	0	0	0.01	0
YNF	1	1.47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	68	100	54	43	37	8102	100	5328	100	2119	100	---	---	---	---	---	---

Relative Citation Impact

Different values of the Relative Citation Impact (RCI) in GS, RG and PM for Chaudhury has enumerated in Table 10. The highest RCI values are 5.29 in GS, 5.68 in PM in 1997; 3.49 in RG in 2005. On other hand, the lowest RCI values are counted 0.01 in RG, 0.05 in PM and 0.11 in GS for the year 2023, 1989 and 2002 respectively.

Relative Un-cited Index (RUI) and Comparison among GS, RG and PM

Table 11 shows Relative Un-cited Index (RUI) and Comparison among GS, RG and PM. Out of total, there are some uncited papers of Chaudhury viz., 14 (20.58%) in GS, 25 (36.76%) in RG and 31(45.58%) in PM during 1984-2023. It has also enumerated RUI values in this study and values lie between 0.01 and 0.05 in GS, RG and PM.

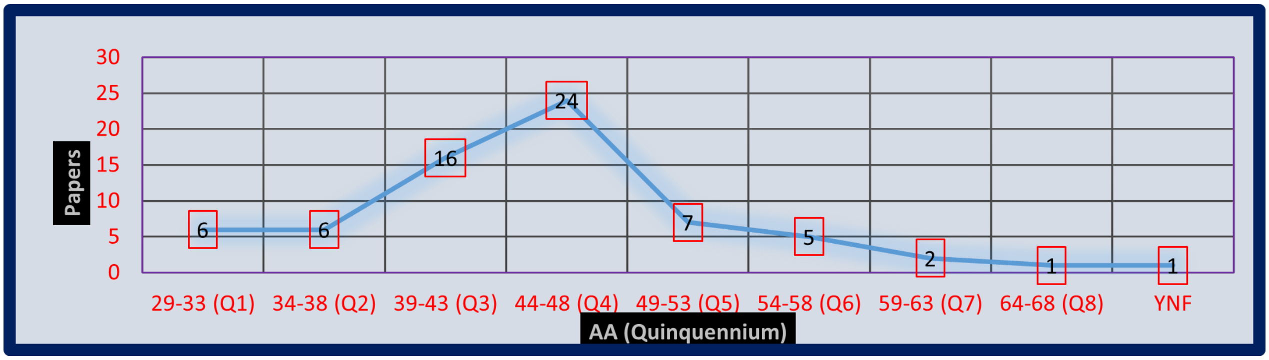

Figure 2: Quinquennium wise publications and peak period.

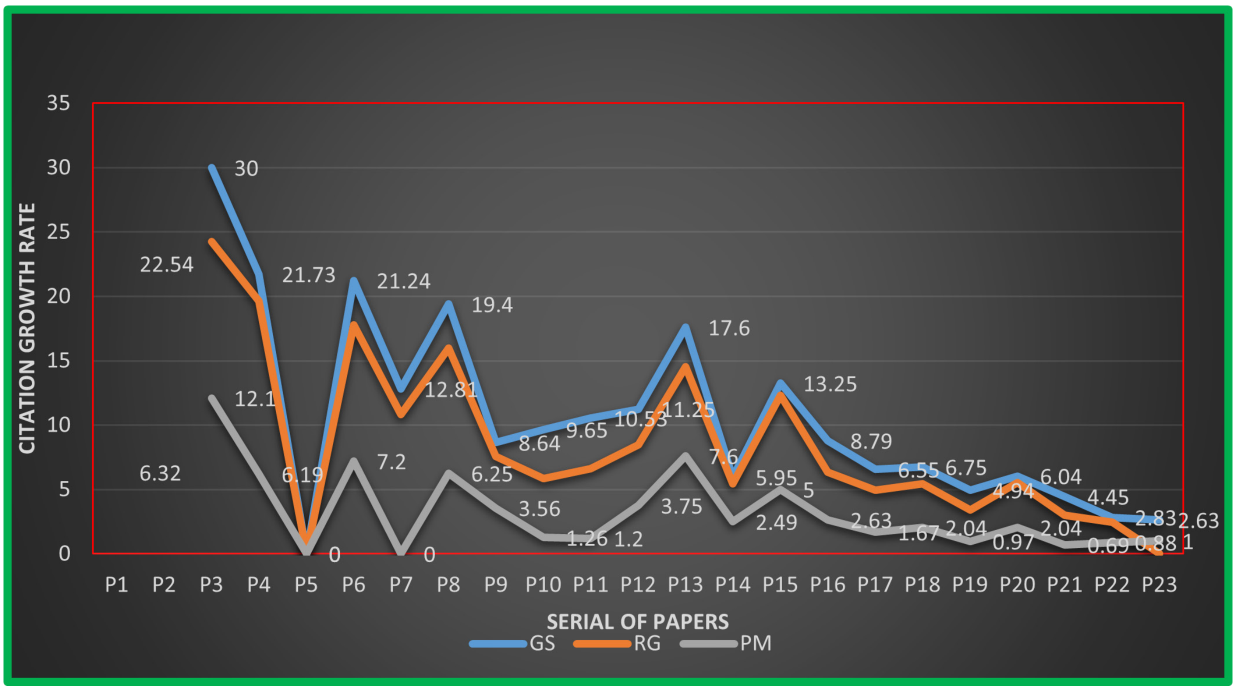

Figure 3: Citation Growth Rate in GS, RG & PM.

Table 11: **Related un-cited index in GS, RG and PM.**

Year [1]	Total Papers [2]	%-age [3]	Un-cited paper						Relative Un-cited Index (RUI) (comparison)= 5/3		
			Total [4]			Ratio = citation / total uncited paper [5]					
			GS	RG	PM	GS	RG	PM	GS	RG	PM
1984	2	2.94	-	1	0	--	0.04	--	--	0.01	
1985	2	2.94	-	-	-	--	--	--	--	--	--
1986	2	2.94	1	1	1	0.07	0.04	0.03	0.02	0.01	0.01
1989	2	2.94	-	1	1	--	0.04	0.03	--	0.01	0.01
1991	1	1.47	-	-	-	--	--	--	--	-	--
1992	1	1.47	1	-	1	0.07	--	0.03	0.05	--	0.02

Year [1]	Total Papers [2]	%-age [3]	Un-cited paper						Relative Un-cited Index (RUI) (comparison)= 5/3		
			Total [4]			Ratio = citation / total uncited paper [5]					
			GS	RG	PM	GS	RG	PM	GS	RG	PM
1993	2	2.94	-	-	1	--	--	0.03	--	--	0.01
1994	4	5.88	2	3	3	0.14	0.12	0.09	0.02	0.02	0.02
1995	2	2.94	0	1	1	--	0.04	0.03	--	0.01	0.01
1996	4	5.88	0	1	3	--	0.04	0.09	--	0.01	0.02
1997	1	1.47	0	1	0	--	0.04	--	--	0.03	--
1998	5	7.36	2	3	2	0.14	0.12	0.06	0.02	0.02	0.01
1999	7	10.29	2	3	4	0.14	0.12	0.13	0.01	0.01	0.01
2000	5	7.36	0	1	4	--	0.04	0.13	--	0.01	0.02
2001	8	11.77	2	4	3	0.14	0.15	0.09	0.01	0.01	0.01
2002	4	5.88	1	3	2	0.07	0.12	0.06	0.01	0.02	0.01
2005	3	4.42	0	0	0	--	--	--	--	--	--
2007	2	2.94	1	1	2	0.07	0.04	0.06	0.02	0.01	0.02
2008	2	2.94	0	0	0	--	--	--	--	--	--
2009	2	2.94	0	0	0	--	--	--	--	--	--
2010	2	2.94	0	0	0	--	--	--	--	--	--
2013	1	1.47	0	0	0	--	--	--	--	--	--
2015	1	1.47	0	0	0	--	--	--	--	--	--
2017	1	1.47	0	0	1	--	--	0.03	--	--	0.02
2023	1	1.47	1	0	1	0.07	--	0.03	0.04	--	0.02
YNF*	1	1.47	1	1	1	0.07	0.04	0.03	0.04	0.03	0.02
Total	68	100	14	25	31	--	--	--	--	--	--
%-age			20.58	36.76	45.58	--	--	--	--	--	--

*YNF= Year not found.

CONCLUSION

Chaudhury's Panchabrihi *is* a groundbreaking discovery of the 21st century for human kind. Its multiple productions may reduce food crisis in Bangladesh, India, Australia and other rice-feeding countries. The new and uncommon paddy seed is more productive and so the scientist expects it will be very helpful for Bangladeshi farmers. Because most of the areas in Bangladesh are flooded and draughty and hence cultivation cannot be possible properly there. It can be solved rice crisis especially in Bangladesh and India. Weather more and less is same in both the countries. Panchabrihi grows huge number of roots in the ground which help to produce carbon in soil that can improve the quality of the soil. This method he himself has been applying in his native village along with the local farmers of Bangladesh. For this purpose, there is an agricultural firm in his village 'Kanihati'. Cultivation of panchabrihi is cost saving method than multiple harvested seeds as it is once planted and yields five times with a good quantity throughout the year from the same plant. He has already generated nearly 300 new types of paddy seed. He has started his research works at the grass root level where poor, hardworking people i.e., farmers are living and thus civilization grows from the agriculture at the village level. Where agriculture is the foundation of the countries like Bangladesh, India, etc., his works in agriculture science is very much remarkable and Panchabrihi is also a revolutionary discovery in the world. Chaudhury, a scientist, writer, poet, well-wisher and social reformer, in a word, a multi-purposeful ideal man who can only look at the people living at the grass root level, fell their crisis and up lift their level using agricultural products. It is considered a landmark innovation in terms of preventing food crisis throughout year. Thus, for his outstanding works, Chaudhury is regarded as one of the most leading figures in modern biology. He has manifold experiences in genetics, crop breeding, molecular biology, human nutrition and biotech (Alam, 2023). This study is a respectful gratitude with the highlights of various scientometric indicators of research activities. He has produced 68 research publications in 40 years of his research career during 1984-2023. Out of various communication channels, nearly 78% papers have been scattered in highly impact 29 journals. He received many honours, achievements and grants for his research work from several organizations and funding agencies. He has received many citations in Google Scholar (GS) and Citation Growth rate is high in GS. He has received maximum citation from his article *"Miniseed3 (MINI3), a wrky family gene, and HAIKU2 (IKU2), a leucine-rich repeat (LRR) kinase gene, are regulators of seed size in Arabidopsis."* His production was peaked in 2001 at the age of 46. However, along with Panchabrihi, FIS, a colorful corn is also included in the list of his discoveries. This colorful corn is one of the best nutritious meals for child health as well as anti-diabetic and anti-cancer food.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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