

Trends and Growth Modelling of Research Output in the *Journal of Genetics*: A Bibliometric Perspective

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Abstract

This study presents a bibliometric analysis of publication trends and growth modelling of research output published in the *Journal of Genetics* over fifty years 1974 to 2024. Data comprising 2,105 records were retrieved from the Web of Science Core Collection and analysed using quantitative bibliometric techniques. Growth indicators such as Annual Average Growth Rate (AAGR), Compound Annual Growth Rate (CAGR), Relative Growth Rate (RGR), and Doubling Time (DT) were employed to examine the dynamics of scholarly output. The findings reveal distinct phases of development, including an initial period of sporadic growth, phases of rapid expansion, consolidation, peak productivity, and a recent slowdown in growth intensity. To further understand long-term publication behaviour, multiple growth models, linear, exponential, logarithmic, quadratic, and logistic, were applied. Among these, the logistic model provided the best fit, indicating that the journal's publication growth follows a mature and stabilised trajectory. The study highlights the usefulness of growth modelling in journal-level bibliometric analysis and offers insights into the evolution of genetics research dissemination.

Keywords: Bibliometrics, *Journal of Genetics*, Publication Growth, Relative Growth Rate, Doubling Time, Growth Modelling.

1. Introduction

Scholarly journals play a central role in the dissemination and advancement of scientific knowledge, serving as primary channels for communicating research findings and shaping disciplinary development. The systematic analysis of journal publications over time provides valuable insights into the evolution, maturity, and research dynamics of a field. In this context, bibliometric analysis has emerged as a widely used quantitative approach for evaluating patterns of scholarly communication, research productivity, and growth trends within specific journals and disciplines (Pritchard, 1969; Broadus, 1987). Bibliometric indicators related to publication growth are particularly useful for understanding how scientific knowledge expands and stabilizes over time.



Measures such as Relative Growth Rate (RGR) and Doubling Time (DT) have been extensively applied to assess the pace and intensity of research output in various scientific domains (Mahapatra, 1985; Egghe & Rousseau, 1990). While RGR reflects the rate at which cumulative literature increases, DT serves as an inverse indicator, representing the time required for the volume of publications to double. Together, these indicators help identify phases of emergence, rapid expansion, consolidation, and decline in scholarly activity.

In addition to descriptive growth indicators, the application of growth models provides a deeper understanding of long-term publication behaviour. Models derived from the work of Price (1963) and subsequent bibliometric scholars have demonstrated that scientific literature often follows identifiable growth patterns, ranging from exponential expansion in early stages to linear or declining trends as a field matures. Modelling publication growth at the journal level allows researchers to evaluate whether research output follows predictable trajectories and to assess the sustainability of scholarly production over extended periods. The field of genetics has witnessed significant transformations over the past several decades, driven by advances in molecular biology, genomics, bioinformatics, and high-throughput technologies. Journals dedicated to genetics research have played a crucial role in documenting these developments and facilitating the global exchange of scientific knowledge. Among them, the *Journal of Genetics* represents an important platform for publishing research contributions across diverse sub-fields of genetics, making it a suitable source for examining longitudinal publication trends and growth characteristics.

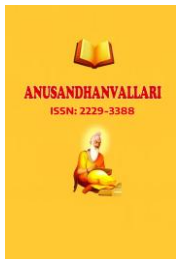
Despite the growing body of bibliometric studies on scientific disciplines, journal-specific analyses focusing on growth trends and modelling remain relatively limited, particularly for long-established journals in genetics. Examining the research output of a single journal over an extended time span provides a focused perspective on how scholarly communication evolves within a defined publication ecosystem. Such studies not only contribute to bibliometric literature but also offer insights for editors, researchers, and policy-makers regarding publication dynamics and research development. Against this backdrop, the present study undertakes a bibliometric analysis of research output published in the *Journal of Genetics*, with a specific focus on trends and growth modelling. By applying growth indicators such as RGR, DT, AAGR, and CAGR, along with suitable publication growth models, the study seeks to elucidate the temporal evolution of research output and to identify distinct phases in the journal's publication history.

2. Objectives

- To analyse the year-wise growth of publications in the *Journal of Genetics* over the study period.
- To measure the Relative Growth Rate (RGR) and Doubling Time (DT) of publications to understand the dynamics of research expansion.
- To assess the Annual Average Growth Rate (AAGR) and Compound Annual Growth Rate (CAGR) of research output.
- To apply and evaluate mathematical models for publication growth in the *Journal of Genetics*.

3. Scope and Methodology

The present study undertakes a bibliometric analysis of research output published in the *Journal of Genetics* covering a period of fifty years (1974–2024). The scope of the study is limited to 2,105 records indexed in the Web of Science Core Collection during the selected time span. Only research articles and review papers were included for analysis, while other document types such as editorials, letters, meeting abstracts, corrections, and book reviews were excluded to ensure analytical consistency and reliability. The study focuses exclusively on publication growth trends and growth modelling. It does not address citation impact, authorship collaboration, institutional productivity, or thematic analysis. The scope is therefore confined to examining the temporal



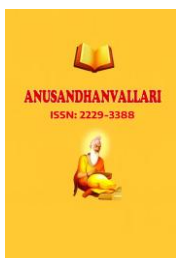
evolution of scholarly output using quantitative growth indicators and mathematical models, with the objective of identifying distinct phases of growth, stabilization, and decline in the journal's publication pattern.

A quantitative bibliometric research design was adopted for the study. Data were retrieved from the Web of Science Core Collection using the source title Journal of Genetics. The records were downloaded in CSV format and subjected to data screening and cleaning procedures. After removing duplicates and non-relevant records, a final dataset comprising 2,105 records was retained for analysis. The cleaned data were organised on a year-wise basis to examine annual publication trends. Descriptive statistical techniques were employed to analyse the growth of research output over time. To assess publication growth dynamics, key bibliometric indicators such as Relative Growth Rate (RGR) and Doubling Time (DT) were calculated using cumulative publication counts. Additionally, Annual Average Growth Rate (AAGR) and Compound Annual Growth Rate (CAGR) were computed to capture short-term fluctuations and long-term growth trends. Further, publication growth models were applied to evaluate the nature and pattern of research expansion in the Journal of Genetics. The results were presented using tables and graphical representations to facilitate clear interpretation. The findings were analysed from a bibliometric perspective to understand the developmental trajectory of the journal and to assess the sustainability of its research output over the study period.

4. Data Analysis and Interpretation

Table 1. Year-wise Growth of Publications

Year	Publications	AAGR	CAGR (%)
1974	1		
1976	1	0	0.00
1977	1	0	0.00
1987	17	16	1600.00
1988	19	2	11.76
1989	17	-2	-10.53
1990	16	-1	-5.88
1991	18	2	12.50
1992	11	-7	-38.89
1993	9	-2	-18.18
1994	8	-1	-11.11
1995	11	3	37.50
1996	39	28	254.55
1997	16	-23	-58.97
1998	17	1	6.25
1999	24	7	41.18
2000	17	-7	-29.17



2001	18	1	5.88
2002	12	-6	-33.33
2003	20	8	66.67
2004	39	19	95.00
2005	46	7	17.95
2006	41	-5	-10.87
2007	39	-2	-4.88
2008	72	33	84.62
2009	69	-3	-4.17
2010	81	12	17.39
2011	101	20	24.69
2012	66	-35	-34.65
2013	80	14	21.21
2014	114	34	42.50
2015	152	38	33.33
2016	162	10	6.58
2017	141	-21	-12.96
2018	170	29	20.57
2019	117	-53	-31.18
2020	86	-31	-26.50
2021	91	5	5.81
2022	66	-25	-27.47
2023	45	-21	-31.82
2024	35	-10	-22.22

Table 1 depicts the year-wise growth of publications in genetics by Indian researchers from 1974 to 2024, using the Annual Average Growth Rate (AAGR) and Compound Annual Growth Rate (CAGR) to capture short-term fluctuations and long-term growth trends. Publication activity during the 1970s was sporadic, with isolated outputs in 1974, 1976, and 1977, resulting in stagnant growth and a CAGR of 0.00%, indicative of an emerging research phase. A major growth inflection occurred in 1987, with 17 publications (AAGR = 16; CAGR = 1600%), marking the first significant expansion of Indian genetics research. Although subsequent years (1988–1992) showed moderate outputs, intermittent declines (1989 and 1992) reflect a consolidation phase influenced by limited institutional capacity and funding. A second surge emerged in the mid-1990s, particularly in 1996 (39

publications; CAGR = 254.55%), likely driven by the expansion of molecular biology infrastructure and academic–industry linkages, though growth remained volatile in the immediate aftermath.

From the late 1990s to the early 2000s, publication trends stabilised, with moderate but consistent growth, indicating the gradual maturation of the field. The period between 2005 and 2010 recorded sustained expansion, as annual output increased steadily, supported by positive CAGR values and aligned with global advances in genomics and bioinformatics. The years 2011–2018 represent the peak phase of Indian genetics research, with annual publications consistently exceeding 100 and reaching a maximum in 2018. Sustained positive growth during this period reflects enhanced research capacity, international collaboration, and improved access to advanced technologies. However, from 2019 onwards, a pronounced decline is evident, with negative growth rates culminating in a substantial reduction by 2024. This downturn may be attributed to the COVID-19 pandemic, shifting research priorities, funding constraints, and publication delays, suggesting a recent deceleration in research output.

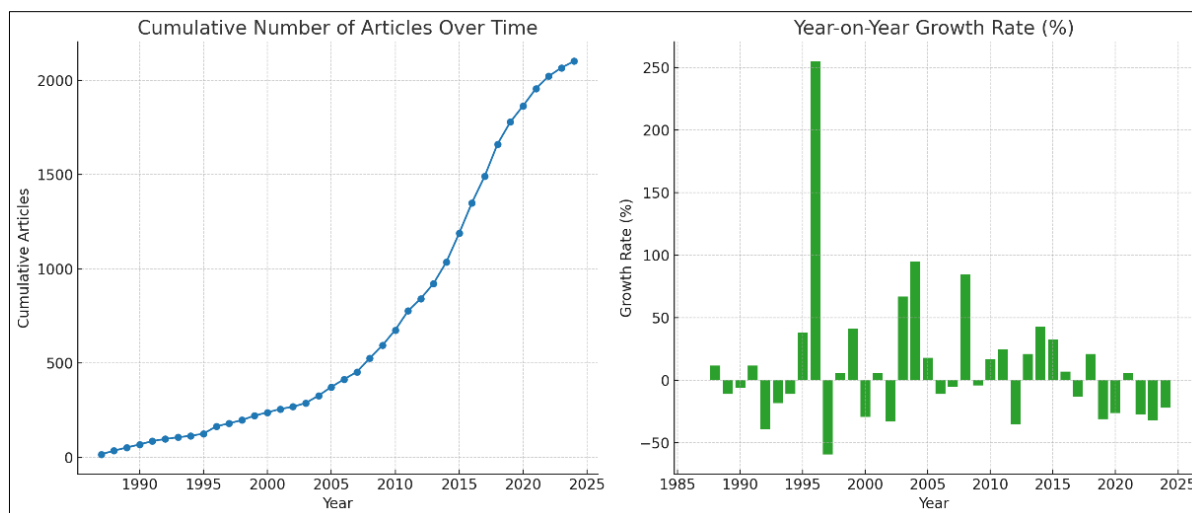


Figure 1. Cumulative number of articles and year-on-year growth (%)

4.1. Relative Growth Rate (RGR) and Doubling Time (Dt)

The Relative Growth Rate (RGR) and Doubling Time (Dt) are widely used bibliometric indicators that reflect the growth dynamics of scholarly literature. RGR measures the rate of increase in publications relative to the existing stock of research output, while Dt estimates the number of years required for the cumulative publications to double (Gupta, 1985; Mahapatra, 1985). These measures are beneficial in evaluating the growth trajectory of a discipline across decades.

Formulae Used:

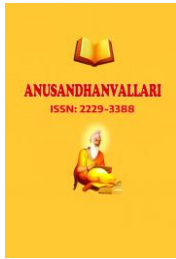
Relative Growth Rate (RGR)

$$RGR = \frac{1n W_2 - 1n W_1}{t_2 - t_1}$$

Where,

W_1 = cumulative number of publications at the beginning of a period,

W_2 = cumulative number of publications at the end of a period,



$t_2 - t_1$ = time interval between the two periods (in years).

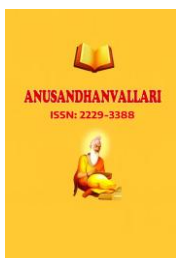
Doubling Time (Dt)

$$Dt = \frac{0.693}{RGR}$$

This relation is derived from exponential growth, where 0.693 is the natural log of 2 (Price, 1963; Mahapatra, 1985).

Table 2. Relative Growth Rate and Doubling Time of Publications

Year	NP	CNP	Nlp1	Nlp2	RGRp	DTp	Mean RGRp	Mean DTp
1974	1	1		0.00				
1976	1	2	0.00	0.69	0.69	1.00		
1977	1	3	0.69	1.10	0.41	1.71		
1987	17	20	1.10	3.00	1.90	0.37		
1988	19	39	3.00	3.66	0.67	1.04	1.28	0.70
1989	17	56	3.66	4.03	0.36	1.92		
1990	16	72	4.03	4.28	0.25	2.76		
1991	18	90	4.28	4.50	0.22	3.11		
1992	11	101	4.50	4.62	0.12	6.01		
1993	9	110	4.62	4.70	0.09	8.12	0.21	4.38
1994	8	118	4.70	4.77	0.07	9.87		
1995	11	129	4.77	4.86	0.09	7.78		
1996	39	168	4.86	5.12	0.26	2.62		
1997	16	184	5.12	5.21	0.09	7.62		
1998	17	201	5.21	5.30	0.09	7.84	0.12	7.15
1999	24	225	5.30	5.42	0.11	6.15		
2000	17	242	5.42	5.49	0.07	9.52		
2001	18	260	5.49	5.56	0.07	9.66		
2002	12	272	5.56	5.61	0.05	15.36		
2003	20	292	5.61	5.68	0.07	9.77	0.07	10.09
2004	39	331	5.68	5.80	0.13	5.53		
2005	46	377	5.80	5.93	0.13	5.33		
2006	41	418	5.93	6.04	0.10	6.71		



2007	39	457	6.04	6.12	0.09	7.77		
2008	72	529	6.12	6.27	0.15	4.74	0.12	6.02
2009	69	598	6.27	6.39	0.12	5.65		
2010	81	679	6.39	6.52	0.13	5.46		
2011	101	780	6.52	6.66	0.14	5.00		
2012	66	846	6.66	6.74	0.08	8.53		
2013	80	926	6.74	6.83	0.09	7.67	0.11	6.46
2014	114	1040	6.83	6.95	0.12	5.97		
2015	152	1192	6.95	7.08	0.14	5.08		
2016	162	1354	7.08	7.21	0.13	5.44		
2017	141	1495	7.21	7.31	0.10	7.00		
2018	170	1665	7.31	7.42	0.11	6.44	0.12	5.98
2019	117	1782	7.42	7.49	0.07	10.21		
2020	86	1868	7.49	7.53	0.05	14.71		
2021	91	1959	7.53	7.58	0.05	14.57		
2022	66	2025	7.58	7.61	0.03	20.92		
2023	45	2070	7.61	7.64	0.02	31.54		
2024	35	2105	7.64	7.65	0.02	41.34	0.03	24.61

Note: NP=Number of Publications, CN_P = Cumulative Number of Publications, Nlp1 = Natural log of the first value of CN_p, Nlp2 = Natural log of the last value of CN_p, RGR_P = Relative Growth Rate of Publications, DT_P = Doubling Time of Publications

Table 2 presents the Relative Growth Rate (RGR) and Doubling Time (DT) of publications in Indian genetics over a fifty-year period, offering insights into the evolution of scholarly growth in the field. RGR reflects the rate of increase in cumulative publications, while DT indicates the time required for the output to double, serving as an inverse measure of growth intensity. During the early phase (1974–1977), publication activity was minimal, resulting in negligible RGR values and undefined DT, a characteristic feature of an emerging research domain. A pronounced growth phase is observed between 1976 and 1988, with RGR values ranging from 0.36 to 1.90 and peaking in 1987–1988. Correspondingly, DT values were low, indicating rapid expansion. The mean RGR (0.69–1.28) and DT (0.70–4.38 years) up to 1993 confirm a high-growth trajectory during the formative years.

From the mid-1990s to mid-2000s, RGR values stabilized at lower levels (0.07–0.26), while DT increased substantially (2.62–15.36 years), suggesting a transition from rapid expansion to a more mature and stable phase. The mean RGR (0.12) and DT (7.15 years) during this period reinforce this trend. Renewed growth is evident between 2008 and 2018, with moderate RGR values (0.11–0.15) and reduced DT (4.74–6.44 years), reflecting the impact of advances in genomics, bioinformatics, and molecular genetics. However, post-2018, a sharp decline is observed, with RGR dropping to 0.02–0.07 and DT rising steeply to 41.34 years by 2024, indicating a significant slowdown in recent years. The RGR and DT analysis reveals a clear evolutionary pattern

in Indian genetics research, marked by early emergence, phases of rapid expansion, subsequent stabilization, and a recent decline in growth intensity, underscoring the need for renewed support to sustain future research momentum..

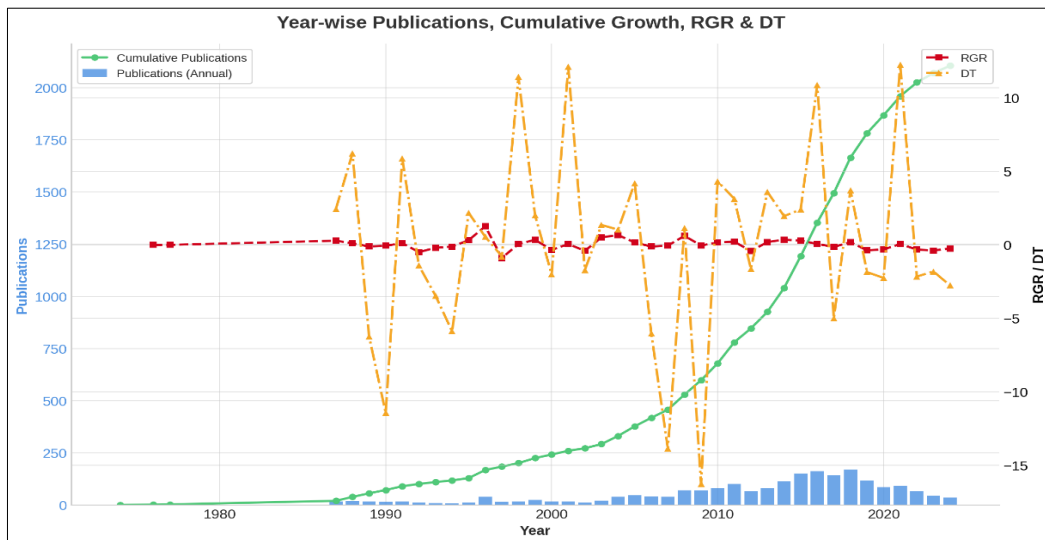


Figure 2. Year-wise publications, cumulative, RGR, and DT

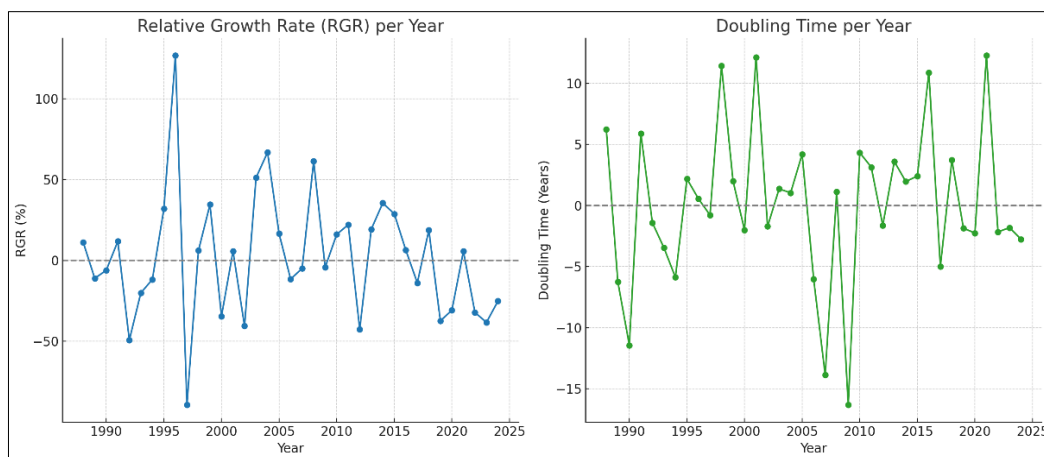


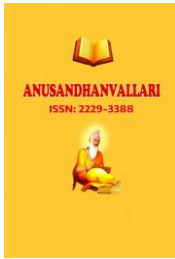
Figure 3. Relative Growth Rate (RGR) and Doubling Time (Dt) per year

4.2. Models to Fit for Publication Growth

The figure depicts the comparative fitting of five statistical models Linear, Exponential, Logarithmic, Quadratic, and Logistic to understand the trend of publication growth in the field of genetics in India. The fit of each model was evaluated using the coefficient of determination (R^2), which indicates how well the model explains the variation in the observed data.

Linear Model

$y = a + bt$ Assumes constant yearly growth.



□ Useful for short-term trends.

Exponential Growth Model

Formula:

$$Y(t) = ae^{(bt)}$$

Where:

- $Y(t)$ = cumulative publications at time t
- A = scaling constant (initial fitted parameter)
- b = exponential growth rate parameter (fitted)
- t = years since the starting year (normalised, i.e., $\text{Year} - \min(\text{Year})$)

Logarithmic Model

- $y = a + b \ln(t)$
- Growth slows over time but continues to rise.
- Suitable for maturing fields.

Polynomial (Quadratic / Cubic) Model

- $y = a + bt + ct^2 (+dt^3 \dots)$
- Captures acceleration/deceleration trends.
- Often used when there are peaks and declines.

Logistic (S-shaped) Model

Formula:

- $Y(t) = \frac{K}{1 + ae^{-bt}}$

Where:

- $Y(t)$ = cumulative publications at time
- K carrying capacity (maximum limit of growth, fitted)
- a = constant related to initial conditions (fitted)
- b = logistic growth rate parameter (fitted)
- t = years since the starting year

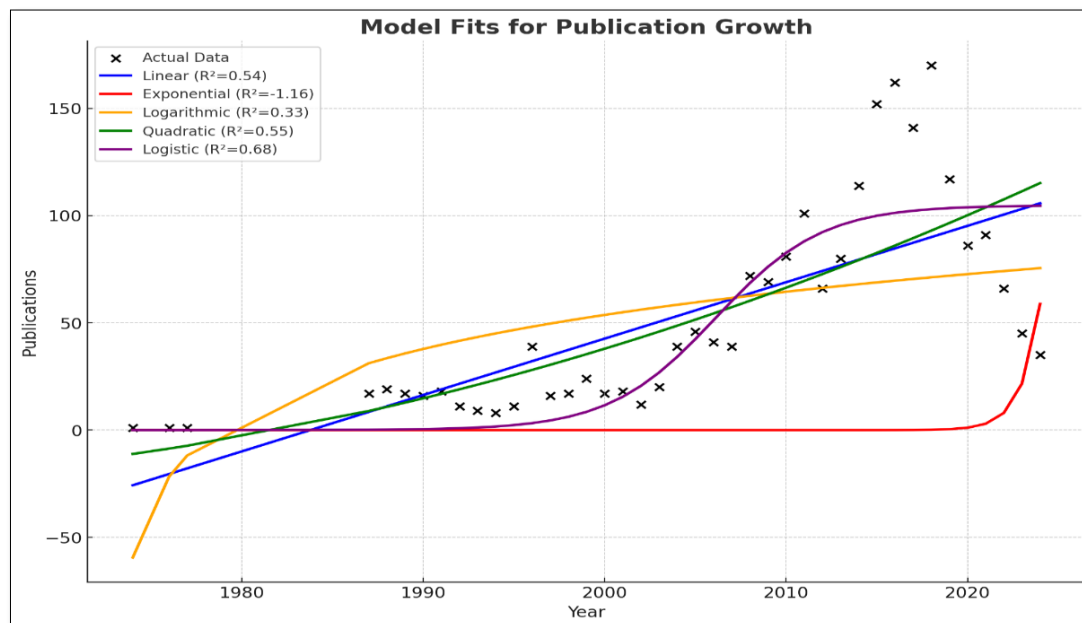
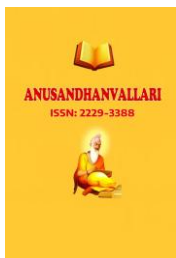


Figure 4. Model Fits for Publication Growth in the *Journal of Genetics*

The figure 4 designates the comparative performance of five statistical growth models such as Linear, Exponential, Logarithmic, Quadratic, and Logistic applied to the annual publication data of the *Journals of Genetics*. The purpose of applying these models was to evaluate the pattern and predictability of research output growth over time, thereby identifying the model that best explains the observed bibliometric trend. The Linear model ($R^2 = 0.54$) indicates a moderate fit, suggesting a consistent but steady increase in publication output across the study period. This implies that publication productivity in genetics has grown incrementally, though not strictly proportionally with time. The Quadratic model ($R^2 = 0.55$) shows a slightly better fit than the linear model, capturing the curvature in the growth trajectory that reflects acceleration during the mid-phase and a gradual stabilisation in recent years.

Conversely, the Exponential model ($R^2 = -1.16$) demonstrates a poor fit, with a negative R^2 value, indicating that the exponential growth pattern typically observed in emerging scientific domains does not apply to the field of genetics in India. Similarly, the Logarithmic model ($R^2 = 0.33$) poorly explains the data, as the observed growth does not exhibit the sharp initial rise followed by deceleration that characterises logarithmic trends. The Logistic model ($R^2 = 0.68$) provides the best fit among all tested models, capturing the *S-shaped* growth curve that reflects the natural progression of scientific output: an initial period of slow growth (developmental stage), followed by a phase of rapid increase (expansion stage), and a subsequent plateau (maturity stage). This model aligns well with the observed bibliometric data, suggesting that genetics research in India has entered a maturity phase, characterized by sustained productivity but a slower rate of increase in new publications. While the linear and quadratic models provide reasonable approximations, the logistic model most accurately represents the publication growth pattern, confirming that the evolution of genetics research output follows a logistic growth trajectory typical of a mature and stabilised research field.



4.3. Summary of Interpretation of Different Models

Table 3. Summary of Interpretation of Different Models

Model	R ² Value	Goodness of Fit	Interpretation
Linear	0.54	Moderate	Reflects a steady, linear increase in publications
Exponential	-1.16	Poor	Not suitable; growth not exponential
Logarithmic	0.33	Weak	Fails to explain nonlinear variation
Quadratic	0.55	Fair	Captures mid-phase acceleration
Logistic	0.68	Good	Best fit represents the maturity of research growth

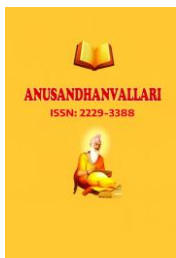
The analysis reveals that the growth of publications in the *Journal of Genetics* is best represented by the logistic model, suggesting that the field has transitioned from a phase of rapid expansion to a stable, mature stage. This aligns with bibliometric theories of research development, which propose that scientific fields typically evolve through cycles of emergence, expansion, and saturation.

5. Discussion of Results

The present bibliometric study examined the long-term trends and growth dynamics of research output published in the *Journal of Genetics* over a fifty-year period (1974–2024). By applying multiple growth indicators and mathematical models, the study provides a comprehensive understanding of the journal's publication behaviour and its evolutionary trajectory. The year-wise analysis of publications reveals a clear temporal progression marked by distinct growth phases. The initial phase (1974–1977) was characterised by sporadic publication activity and negligible growth, reflecting the nascent stage of genetics research dissemination through the journal. This early stagnation is typical of emerging scientific fields, where research infrastructure and scholarly communities are still developing.

A major expansion phase began in the late 1980s, particularly in 1987, which recorded a sharp surge in publications. This growth coincides with the strengthening of genetics research capacity, increased institutional support, and broader adoption of molecular and experimental techniques. However, the subsequent fluctuations observed during the early 1990s indicate that this expansion was not immediately sustained, suggesting a consolidation phase marked by uneven research productivity. From the late 1990s through the mid-2000s, publication output exhibited greater stability, with moderate but consistent growth. This period reflects the maturation of the field, where research output increased steadily without dramatic surges or declines. The sustained rise between 2005 and 2010 further underscores the journal's growing relevance, likely influenced by global advances in genomics, bioinformatics, and interdisciplinary research approaches.

The period between 2011 and 2018 represents the peak phase of publication activity, with annual outputs consistently exceeding 100 articles. This sustained growth indicates heightened research visibility, increased submission rates, and the consolidation of the *Journal of Genetics* as a prominent outlet for genetics research. Enhanced international collaboration, improved access to high-throughput technologies, and national research initiatives may have contributed to this robust output. However, a notable decline in publication growth is observed after 2018. The negative AAGR and CAGR values during the later years, coupled with declining publication counts, point towards a slowdown in research output. This trend may be attributed to multiple external



and systemic factors, including shifts in research priorities, funding constraints, publication delays, and disruptions caused by the COVID-19 pandemic. While a brief recovery was evident in 2021, the overall trend suggests a deceleration in growth intensity.

The analysis of Relative Growth Rate (RGR) and Doubling Time (DT) further reinforces these observations. High RGR values and low DT during the early expansion phases indicate rapid accumulation of scholarly output, whereas declining RGR and increasing DT in later years signify a transition towards stability and eventual slowdown. The sharp rise in DT after 2018 confirms that the cumulative literature is expanding at a much slower pace, characteristic of a mature research field. The application of publication growth models provides deeper insights into the nature of this evolution. Among the five models tested, the logistic model emerged as the best fit, indicating that publication growth in the *Journal of Genetics* follows an S-shaped trajectory. This pattern aligns with established bibliometric theories, which suggest that scientific field's progress through stages of emergence, rapid expansion, maturity, and saturation. The poor performance of the exponential model further confirms that the journal has moved beyond its initial growth phase and no longer exhibits unchecked expansion.

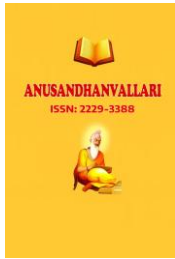
6. Conclusion

The present study provides a comprehensive bibliometric assessment of trends and growth modelling of research output in the *Journal of Genetics* over the period 1974–2024. The findings demonstrate that the journal's publication output has evolved through distinct developmental phases, beginning with early sporadic contributions, followed by periods of rapid expansion, consolidation, peak productivity, and a recent phase of declining growth intensity. The combined use of growth indicators such as AAGR, CAGR, RGR, and DT, along with multiple mathematical growth models, offers a robust framework for understanding long-term publication behaviour. The results clearly indicate that the logistic growth model best represents the publication trajectory, suggesting that the *Journal of Genetics* has reached a mature stage of scholarly development.

While the journal has achieved substantial cumulative growth and played a significant role in disseminating genetics research, the observed slowdown in recent years highlights the need for renewed strategic efforts. Encouraging high-impact submissions, fostering interdisciplinary research, strengthening international collaboration, and adapting to emerging areas in genetics may help sustain future growth. This study contributes to the bibliometric literature by demonstrating the usefulness of growth modelling in journal-level analysis and provides valuable insights for editors, researchers, and policy-makers seeking to understand and enhance the dynamics of scholarly communication in genetics research.

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