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Research Productivity, Citation Impact, and Collaboration Patterns of Public-Sector Universities in Khyber Pakhtunkhwa, Pakistan: A Bibliometric Analysis (2015–2024)

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Abstract
Research productivity and impact are increasingly used as measures of performance of higher education institutions; however, there is still limited evidence at the provincial level in developing countries. This study presents an extensive analysis of the research output of universities, Khyber Pakhtunkhwa Pakistan, during the period 2015-2024. Using data recovered from the Scopus database, the study looks at publication trends, citation impact, institutional and author productivity, disciplinary distribution, highly cited publications and collaboration. The results show a high growth of research outputs in universities, which is part of wider national reforms of higher education. Nevertheless, the productivity of research and the impact of citations is still unevenly distributed, with a few well-established institutions contributing a disproportionate number of publications as well as citations and collaborative link strength. Citation analysis shows that internationally affiliated publications and old cohorts of output are more visible compared to recent publications with lower average citation, partly due to citation time-lag effects. Disciplinary analysis reveals the advantages of science, engineering and health-related content areas over social sciences and the humanities. Collaboration network analysis shows that international and inter-institutional collaborations play a key role in increasing research visibility and impact. Overall, the study offers new insights at a provincial level about the performance of research in Pakistan and emphasizes the need for balanced capacity development, strategic collaboration and evaluation parameters normalized by the field. The findings provide evidence-based advice for policy makers and institutional heads trying to develop stronger research ecosystems in KP and other developing settings.
Keywords: Research productivity, Bibliometric analysis, Citation impact, Collaboration networks Khyber Pakhtunkhwa, Pakistan

Introduction

High education institutions (HEIs) play a crucial role in the production of human capital through the provision of a good setting for teaching and learning, and for the creation and dissemination of knowledge (Jia et al., 2025). The primary goal of higher education is to train individuals in critical thinking, and this capacity further fuels the development of new areas of knowledge (Xie et al., 2025). Quality teaching and research facilitates generation of new ideas, new disciplines, and new ways of refining theories (Ullah & Rafiq, 2022). Knowledge generation has increased

exponentially in 21st century; thus, periodic evaluation of research is also agreed by academicians, policy makers, and ranking agencies (Haq & Faridi, 2021). Research productivity in higher education refers to the quantity and quality of scholarly outputs produced by academic staff and institutions. This includes peer-reviewed journal articles, books, conference presentations, patents and other forms of knowledge creation and dissemination (Heaton-Shrestha et al., 2023; Uwizeye et al., 2021). It is usually measured through indicators such as the number of publications, citations impact, research grants received and contributions to innovation (Malaga, 2025). The evaluation of research productivity using bibliometric analysis has become an indispensable tool for the performance evaluation of higher education institutions in the world (Hensel, 2025; Hussain & Yar, 2020). Bibliometrics is a quantitative method to study scientific publications and their citations and measures to quantify research output, impact and patterns of collaboration (Wahid et al., 2023). This method has often been used to assess the scholarly and scientific advance of the HEIs (Ahmad, et al., 2020, Shahzad et al., 2021).

Research productivity has become an indistinguishable indicator of institutional excellence which mirrors the ability of universities to create new knowledge, scientific innovation, and aid national socioeconomic development (Aydin, & Taskin,2025). In Pakistan, there has been a great shift in the scenery of higher education and research in the last two decades (Saleem et al., 2024). The establishment of Higher Education Commission (HEC) in 2002 represented a significant institutional reform that contributed to structured research funding mechanisms, faculty development programs and performance based incentive systems, which collectively gave a huge boost to national research output (Haq & Rehman, 2021; Latif & Haq, 2020). Despite such gains, the improvement in the productivity of Pakistan's research has been rather patchy by institutions and regions. A rather small number of well-established universities, mostly located in Punjab and Sindh, continue to account for most of the national output (Waqee et al., 2025). This concentration brings issues of regional disparities especially the under-representation and scarcity of visibility of universities in provinces like Khyber Pakhtunkhwa. National bibliometric research persistently emphasizes the top contributors like Aga Khan University, COMSATS University Islamabad, Quaid-e-Azam University, and University of the Punjab in terms of scientific production (Ahmad et al., 2020).

Disciplinary analyses show different areas of national research strength. Medical and health sciences have reflected significant growth, particularly in health systems research post 2015 and a significant growth of publications on the topic of Coronavirus (Haq, 2021; Gupta et al., 2024). Engineering and information and communication technology (ICT) research have also largely expanded, especially in emerging technology fields (Memon et al., 2021). Agricultural and environmental sciences are other strategic areas and a manifestation of the priorities of development of Pakistan, and they continued to make a meaningful contribution to the overall scientific output of Pakistan (Hassan, 2022).

Literature Review

Research Productivity in Higher Education Systems

High levels of research productivity help to produce and share new knowledge, which directly advances society and economic development (Yadigarova, 2024). Strong research work also helps a university attract competitive funding, distinguished faculty and students, increasing its global recognition (Ryazanova & Jaskiene, 2022). Moreover, research output has a pivotal role in university rankings and is tightly connected with resource allocation, faculty promotion and institutional prestige (Ryazanova & Jaskiene, 2022). Research productivity also has enriched the quality of teaching by incorporating current findings into educational programs, promoting innovation, and developing critical thinking in students (Osayomwanbor, 2024).

Globally, research productivity varies widely because of the disparity in funding, institutional support and collaboration networks, and national policies (Yadigarova, 2024). In many countries, a small proportion of academics produce most of the research output and therefore there are large inequalities between institutions (Kwiek, 2018). International rankings and policy initiatives have put more emphasis on research performance as a key factor in competitiveness and excellence (Ryazanova & Jaskiene, 2022). Challenges such as resource limitation, lack of incentives, and different research cultures affect productivity, (Kadikilo et al., 2023). Institutional research productivity is one of the chief measures of academic excellence. It is applied in global and national ranking systems that are used in the assessment and comparison of universities (Halaweh, 2020).

Pakistan's National Research Landscape

The research output from Pakistan has increased since 2000 till 2024, especially after the creation of HEC in 2002. Evidence has revealed a high percentage of publications produced between 2000 and 2019 to be concentrated in the later years of the same period (Haq & Faridi, 2021; Hassan et al., 2024). Research growth has been dominated by science, technology, engineering disciplines the social sciences have been left behind in the volume of publications (Missen et al., 2020; Haq & Faridi, 2021). Although the global share of Pakistan's research output is still small, the rate of growth in research areas such as chemistry and materials science is one of the highest in the world (Hassan et al., 2022;). Despite established growth up till 2024, recent research has raised awareness of the challenges emerging in the field concerning funding, research quality, and institutional capacity (Khan et al., 2021; Rasool & Dilshad, 2023).

Pakistan research landscape has some notable strengths, weaknesses and regional disparities which determine productivity landscape. Among its strengths, HEC-driven reforms, particularly enhanced research funding and faculty development, and encouragement of international partnerships, have supported the establishment of a more competitive and supportive research environment (Hassan et al. 2024; Iqbal et al. 2018). Despite this progress, there are still several structural weaknesses which retard the performance of research. These include inadequate and irregular funding, infrastructural shortcomings, low collaborative culture and bureaucratic hindrances which help with the gap that has been existing between the amount of research and worldwide research impact (Rao, 2025; Rasool & Dilshad, 2023). Regional disparities have continued to be a feature of the higher education system in Pakistan. Punjab and Sindh are still leading on the national research output and institutional capacity while provinces such as Khyber Pakhtunkhwa and Balochistan are lagging due to small number of universities, lack of funding and infrastructural limitations (Javed et al., 2020; Khan et al., 2021)

Institutional Research Performance and Variations at the University Level in Pakistan

Institutional research productivity in Pakistan shows a great variation, which is due to differences in the availability of funding, the faculty expertise, infrastructure and opportunities for collaboration. Productivity is geo-concentrated with Islamabad based universities, which account for only 11% of recognized universities by HEC, generating almost 34% of the total research output of the country between 2008-2017, indicating stark regional disparities. Public sector universities still maintain their leading position on national research output as compared to private institutions (Javed et al., 2020; Ahmad et al., 2022; Ahmad et al., 2020). At the departmental level too, huge gaps still exist units with better infrastructure, stable funding, and good leadership, especially in science and engineering disciplines, consistently perform better than departments with less resources, as social sciences and recently established programs lag (Rasool & Dilshad, 2023; Ahmad et al., 2020).

Clear demarcations exist between high- and low-performing universities in the higher education system in Pakistan. High performing institutes including University of the Punjab and UET Lahore and few institutes of Islamabad always perform well because of their proper funding system, better international connection and well established research culture (Javed et al. 2020; Ahmad et al. 2022; Mairaj et al. 2023). On the contrary, private and regional universities, especially in Khyber Pakhtunkhwa and Balochistan, have certain challenges inflicted on them which add up to the low research productivity (Wajid et al., 2025).

Research productivity in Pakistan is influenced by several key factors and faculty quality emerges as a key determinant. Institutions that have foreign trained have a higher output because of stronger research capabilities and exposure to international circle (Ahmad et al., 2022; Wahid et al., 2022). Adequate financing and access to research grants have a direct impact on the quantity and quality of research work, while modern infrastructure, including laboratories, libraries, and ICT facilities, offer a necessary support for quality research (Ahmad et al., 2020; Mairaj et al., 2023; Mahmood et al., 2025). Collaboration also increases productivity through permitting more visibility and access to broader research communities, and institutional incentives and policies are important in creating motivation for sustained engagement in research (Sabah et al., 2019).

Citation Impact, Highly Cited Publications, and Research Visibility

Citation impact and research visibility are important measures of research quality especially in developing countries such as Pakistan where disparity in impact is evident. Citation-based metrics show a high degree of concentration and elite researchers make roughly 25% of national output while garnering almost 40% of total citations (Ahmad et al., 2022; Wahid et al., 2022). Although highly cited publications are not very common, they make a disproportionate impact on the total impact; for instance, only 1.6% of Pakistani papers related to Covid-19 were highly cited with more than 100 citations, indicating important role of international collaboration and external funding (Gupta et al., 2024; Ranjha et al., 2025).

Local and global citation patterns reflect that Pakistani research has important visibility problems as research shows that national publications are cited more often in domestic scholarly communities than in international arenas. This imbalance can be attributed, in part, to increased levels of self-citation, and the preference for publication in local journals (Baccini & Petrovich, 2023; Soroya et al., 2022). Research visibility and international citation rates improve significantly when scholars publish their research in high-impact, and open access journals, which provide wider dissemination and increased integration in research networks throughout the world (Ahmad et al., 2022; Asif et al., 2025). Publications that are published in reliable indexing systems such as Scopus and Web of Science, are much more likely to have a high global impact and receive more citations (Ahmad et al., 2022). Open access (OA) also increases citation performance as OA articles are also cited repeatedly and have a higher visibility than subscription-based publications (Tang et al., 2017).

Several factors play a pivotal role in the citation impact and visibility of the research work in Pakistan which is like global scholastic trends. International collaboration is an important predictor of citation success in that research that is co-authored with foreign partners has always been seen to have higher visibility and citation counts (Ahmad et al., 2022; Gupta et al., 2024; Sabah et al., 2019; Wahid et al., 2022). Open access publishing further enhances the citation performance by enhancing the accessibility and readership (Soroya et al., 2022; Yi et al., 2024). Journal quality also plays a decisive role whereby publications on journals with higher quartiles and internationally indexed journals are attracting more citations (Ahmad et al., 2022; Kohus et al., 2022).

Research Gap

The available literature shows significant progress in understanding the research productivity, citation impact and collaboration mode in Pakistan, which is supported by many studies on national level and institutional case studies. Notably, there is a serious dearth of systematic and province level bibliometric analyses with special reference to KP) which has been growing rapidly in terms of higher education sector and is contributing more to the national research output. Existing studies give relatively little empirical evidence on the collective performance of KP universities in terms of publication productivity, citation impact, institutional ranking and collaboration networks. Moreover, comparative evaluations of highly cited global and local publications from KP institutions are still limited and they limit the understanding of the province's scholarly influence and research visibility both at national and international levels.

To fill these gaps, the current study conducts a comprehensive multi-dimensional bibliometric analysis of the universities, under the public sector, in Khyber Pakhtunkhwa between the period of 2015-2024. By studying the publication trends, institutional productivity, citation impact, highly cited global and local publications, and the pattern of collaboration, this research offers an updated and regionally focused assessment that adds new empirical information to the research evaluation literature in Pakistan and informs policy and institutional decision making on the provincial level.

Research Questions (RQs)

RQ1. What are the temporal trends in research productivity of public-sector universities in Khyber Pakhtunkhwa from 2015 to 2024 in terms of annual publication output and growth patterns?

RQ2. How has the citation impact of KP universities' research evolved over time, and how do citation indicators differ across publication years?

RQ3. Which journals, universities, and authors contribute most significantly to the research output of KP universities, and how are productivity and citation impact distributed among them?

RQ4. What are the characteristics and thematic orientations of the most highly cited global and local publications produced by KP universities?

RQ5. How do institutional and international collaboration networks shape the research visibility and citation impact of KP universities, and which institutions and countries occupy central positions within these networks?

Methodology

The study employed a quantitative research design, which focuses on gathering and analyzing numerical data to identify patterns, relationships, and trends (Donthu et al., 2021). The research used a bibliometric approach, which is statistical and mathematical method to study trends in scholarly communication (Pritchard, 1969). It is the study of publications, citations, co-authorship, and other research outputs to determine the measure of scientific impact and productivity. Bibliometrics has also been widely used in higher education, where measures of university research productivity are performed, and comparisons can be made across disciplines, countries, and time (Hussain & Saddiqa, M 2020; Moral-Munoz et al., 2020; Ndwandwe et al., 2021)

Population and Sample

The study population comprised 34 public sector universities located in the province of KP, Pakistan (HEC, 2025). It was challenging to properly scope and manage the data required to analyze the research productivity of each university over the past decade. For this reason, the sample was selected based on purposive criteria. In particular, the analysis is limited to those universities that have been established since 2010. There is a total of thirteen (13) such

universities. The justification for this sampling is based on three considerations. First, universities founded before 2010 would have had a longer period to develop their academic faculty, research facilities, and publication capabilities than those established more recently. Second, these universities have historically had better research output and continued funding, largely due to faculty hiring and government funding. Third, there is more standardized and reliable performance-related information for these two groups of institutions for the past 10 years, which suits a longitudinal bibliometric study. Consistent with the second dimension of the study's population, the sample also includes the research productivity of these thirteen universities, covering the years 2015 to 2024.

Data Collection

The credibility and trustworthiness of bibliometric analysis are heavily dependent on the quality of the data source and the methods used to extract it. This research employed a systematic data collection approach to ensure the complete retrieval of publication records from selected universities in KP. The Scopus database was used to collect data, as it has a reputation for covering a wide range of peer-reviewed journals and research outputs (Baas et al., 2020).

Search Strategy and Data Extraction Procedure

The query used the Affiliation Identifiers (AF-IDs) of each university to make sure that the data was retrieved correctly. The query made sure that only final-stage journal articles published in English between 2015 and 2024 were found. Conference papers, reviews, and editorials were not included. An initial search found that the universities had published 28,388 articles during the study time. However, only 20,000 records can be exported from Scopus in a single session. To overcome this limit, the data export was performed in two steps: Phase-I (2015–2020): A total of 12104 records were identified and Phase-II (2021–2024) 16,284 records were retrieved. The records were exported as a CSV file format, thereby allowing further data cleaning and analysis. The exported datasets of the two phases were visually inspected for correctness, redundancy, and coherence of the metadata. The records were merged and saved into a single .csv file, with 28,388 records.

Data Analysis and Findings

Bibliometric software such as Biblioshiny and VOSviewer were used to analyze the data set. Biblioshiny was used to produce descriptive statistics (annual publication trends, citation analysis, most productive universities, and most cited articles) while VOSviewer was used for visualizing networks.

Annual Publication Output of Universities

Figure 1 illustrates the annual publication output of universities in KP, during the period 2015–2024, along with a projected trend for 2025–2026 based on the compound annual growth rate (CAGR). The trend demonstrates a consistent upward trajectory in research productivity over the decade, rising from 1,189 publications in 2015 to a peak of 4,410 publications in 2022, followed by a slight decline to 3,827 publications in 2024. This reflects an overall growth of 221.9% with a CAGR of 13.87%, indicating sustained expansion of research activities within the region's higher education sector.

The shaded orange area represents the projected period (2025–2026), showing the expected continuation of the growth trend if the historical CAGR persists. Under this projection, publication output is estimated to reach approximately 4,360 articles in 2025 and 4,970 articles in 2026. The inclusion of both observed and projected data highlights a decade of remarkable

growth in scholarly output, suggesting that KP universities have significantly strengthened their research capacity and are likely to maintain upward momentum in the near term.

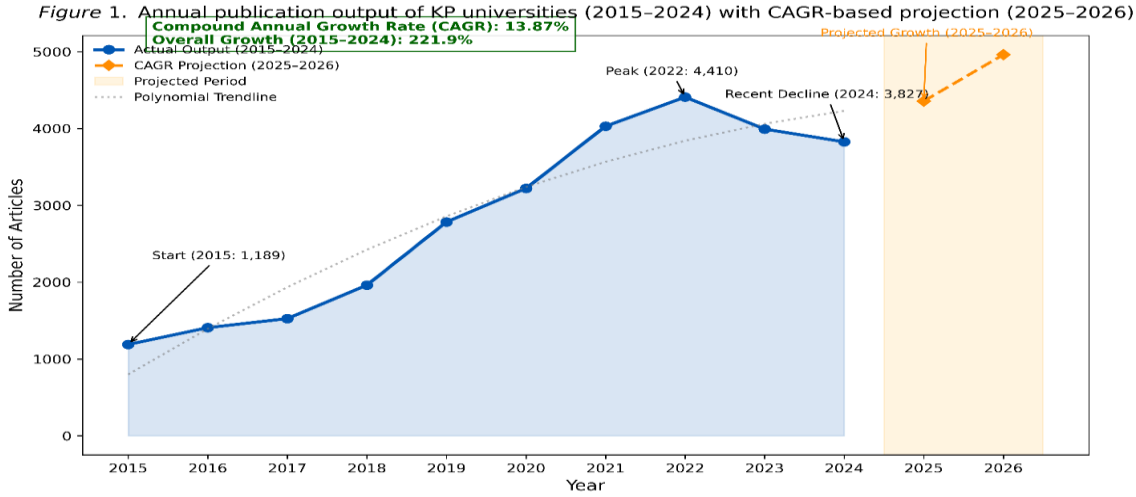


Figure 1. Annual publication output of KP universities (2015–2024) with CAGR-based projection (2025–2026)

Annual Total Citations

The citation impact of papers published from 2015 to 2024 indicates (Table 1) that earlier cohorts performed better, with a Mean Total Citation (TC) per Article peaking at 32.61 in 2019. The Mean Total Citation per Year also reached its highest at 4.66 in 2019, indicating the lasting influence of those articles. However, averages began to decline in 2020, with Mean TC per Article dropping to 6.14 by 2024, despite an increase in the number of publications. This decline is likely due to the decency of these works, which have had less time to gather citations. The mean total citation per year remained stable from 2018 to 2022 but decreased in 2023–2024, reflecting a delay in the impact of newer research.

Table 1: Annual Total Citations

Year	Mean TC per Art.	N	Mean TC per Year	Citable Years
2015	27.29	1189	2.48	11
2016	28.50	1408	2.85	10
2017	26.99	1526	3.00	9
2018	31.29	1962	3.91	8
2019	32.61	2784	4.66	7
2020	28.55	3222	4.76	6
2021	20.66	4030	4.13	5
2022	16.40	4410	4.10	4
2023	11.77	3993	3.92	3
2024	6.14	3827	3.07	2

Journals with Most Articles

It was observed that only a few journals were dominant, having a high count of articles (Table 2). The top two were Sarhad Journal of Agriculture (514 articles) and IEEE Access (507 articles) with a combined total of over 1,000 publications. These journals are followed by Scientific Reports (348), Environmental Science and Pollution Research (298), and PLOS ONE (280), evidencing that publications in the data set not only appear in regional journals but also in journals with international visibility. The existence of several journals based in Pakistan, Pakistan Journal of Botany (329), Pakistan Journal of Pharmaceutical Sciences (249), and Pakistan Journal of

Zoology (247) highlights the importance of national journals in supporting local visibility for the dissemination of research.

The other journals that published the most articles were AIMS Mathematics (236), Symmetry (183), and Mathematical Problems in Engineering (134). For the natural and life sciences, the top journals were Molecules (173), Journal of Molecular Structure (133), and Brazilian Journal of Biology (159). Multidisciplinary journals also published a significant number of articles, including Sustainability (227), Heliyon (213), and ACS Omega (162)

Table 2. Journals with the most Articles

S.#	Journals	No. of Articles	S.#	Journals	No. of Articles
1.	Sarhad Journal of Agriculture	514	26.	Desalination and Water Treatment	124
2.	IEEE Access	507	26.	European Physical Journal Plus	124
3.	Scientific Reports	348	27.	Journal of Materials Science: Materials In Electronics	124
4.	Pakistan Journal of Botany	329	28.	Sensors	120
5.	Environmental Science and Pollution Research	298	29.	Journal of Himalayan Earth Sciences	115
6.	Plos One	280	30.	Materials Research Express	114
7.	Pakistan Journal of Pharmaceutical Sciences	249	31	Journal of The Chemical Society of Pakistan	113
8.	Pakistan Journal of Zoology	247	32	International Journal of Biological Macromolecules	110
9.	Aims Mathematics	236	33.	Complexity	108
10.	Sustainability (Switzerland)	227	34.	Advances in Difference Equations	104
11.	Heliyon	213	35.	Saudi Journal of Biological Sciences	103
12.	Symmetry	183	36.	Bioorganic Chemistry	100
13.	Results In Physics	177	37.	Chemosphere	97
14.	Molecules	173	38.	Electronics (Switzerland)	96
15.	Computers, Materials and Continua	166	39.	Journal of Intelligent and Fuzzy Systems	96
16.	Acs Omega	162	40.	Journal of Function Spaces	95
17.	Brazilian Journal of Biology	159	41.	Energies	92
18.	RSC Advances	148	42.	Journal of Molecular Liquids	92
19.	Mathematics	145	43.	Fractals	91
20.	Applied Sciences (Switzerland)	144	44.	Frontiers in Plant Science	91
21.	Physica Scripta	144	45	Fractal and Fractional	90
22.	Alexandria Engineering Journal	137	46	Applied Ecology and Environmental Research	84
23.	Mathematical Problems in Engineering	134	47	Materials	84
24.	Journal of Molecular Structure	133	48	Polymers	83
25.	Journal of Animal and Plant Sciences	125	49	Microscopy Research and Technique	82

Global Cited Document (GCD)

An article in the dataset that has received a specific number of citations throughout the Scopus database is referred to as a worldwide cited document.

The findings in Table 3 illustrate that many articles published in or associated with The Lancet appear in the highest echelons of the list, possibly reflecting the importance of The Lancet and its related journals as sources of high-impact medical and health-related research. The most cited article, Bikbov et al. (2020), on the global burden of chronic kidney disease has 4839 citations with an astonishing annual citation rate of 806.50. On the same note, recent research conducted by Afshin et al. (2019) and Stanaway et al. (2018) has surpassed the 4,000 citation mark, indicating the global importance of burden-of-disease studies.

Health and Medical Sciences: Most of the frequently cited are systematic review articles in the context of the Global Burden of Disease (GBD) Study, highlighting the importance of large-scale, longitudinal studies globally in relation to the area of public health. These works garner significant attention because they are relevant to policy and contribute to global health initiatives.

Emerging Trends: In addition to health sciences, artificial intelligence (AI) research and COVID-19 research created highly cited documents as well. Indicatively, Chowdhury et al. (2020) on AI in pneumonia detection and Rahman et al. (2021) on image enhancement for rapid COVID-19 detection collected citations, which is indicative of the frenzy of the scientific community at the time of the pandemic.

Interdisciplinary Contributions: Articles in the fields of computer science (e.g., a deep learning framework to detect cancer and brain tumors), environmental sciences (e.g., how heavy metal is up taken by plants, how nanoparticles are synthesized using green methods), and engineering (e.g., models of thermal conductivity) reveal the interdisciplinary breadth of highly cited research. Such contributions demonstrate that the impact of global citation extends beyond the health sciences to technology, the environment, and applied sciences.

Recent High-Citation Growth: It is important to note that Naghavi et al. (2024) on antimicrobial resistance already received 813 citations in the same year of publication, which may make it one of the most influential articles in the future years because of the urgent global importance of the subject.

Table 3: Global Cited Document (GCD)

S #	Author	Title	Year	Journal	TC	TC/ Year
1	Bikbov et al	Global, regional, and national burden of chronic kidney disease, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017.	2020	The Lancet	4839	806.50
2	Afshin et al	Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017.	2019	The Lancet	4174	596.29
3	Stanaway et al	Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: A	2018	The Lancet	3977	497.13

		systematic analysis for the Global Burden of Disease Study 2017.				
4	Feigin et al.	Global, regional, and national burden of neurological disorders, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016.	2019	The Lancet Neurology	3646	520.86
5	Griswold et al	Alcohol use and burden for 195 countries and territories, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016	2018	The lancet	2583	322.88
6	Johnson et al	Global, regional, and national burden of stroke, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016	2019	The Lancet Neurology	2337	333.86
7	James et al	Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016.	2019	The Lancet Neurology	1457	208.14
8	Chowdhury et al	Can AI Help in Screening Viral and COVID-19 Pneumonia?	2020	IEEE Access	1314	219.00
9	Rahman et al	Exploring the effect of image enhancement techniques on COVID-19 detection using chest X-ray images	2021	Computers in Biology and Medicine	856	171.20
10	Mukhtar et al	Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era.	2020	Pakistan Journal of Medical Sciences	832	138.67
11	Naghavi et al	Global burden of bacterial antimicrobial resistance 1990-2021: A systematic analysis with forecasts to 2050.	2024	The Lancet	813	406.50
12	Jung et al	Phytochromes function as thermos sensors	2016	Science,	764	76.40
13	Khan A	The uptake and bioaccumulation of heavy metals by food plants, their effects on plants nutrients, and associated health risk: A review	2015	Environmental Science and Pollution Research	746	67.82
14	Sajjad et al	Multi-grade brain tumor classification using deep CNN with extensive data augmentation	2019	Journal of Computational Science	731	104.43
15	Khan et al	A novel deep learning based framework for the detection and classification of breast cancer using transfer learning	2019	Pattern Recognition Letters	680	97.14

16	Saeed et al	Promoting employee's PR environmental behavior through green human resource management practices	2019	Corporate Social Responsibility and Environmental Management	679	97.00
17	Hayat et al	Impact of Cattaneo–Christov heat flux model in flow of variable thermal conductivity fluid over a variable thicked surface.	2016	International Journal of Heat and Mass Transfer	676	67.60
18	Ullah et al	Action Recognition in Video Sequences using Deep Bi-Directional LSTM With CNN Features.	2018	IEEE Access	659	73.22
19	Sajid et al	Designs, formats and applications of lateral flow assay: A literature review	2015	Journal of Saudi Chemical Society	648	58.91
20	Faisal et al	Green Synthesis of Zinc Oxide (ZnO) Nanoparticles Using Aqueous Fruit Extracts of Myristica fragrans: Their Characterizations and Biological and Environmental Applications.	2021	ACS Omega	644	128.80
21	Wuttke et al	A catalog of genetic loci associated with kidney function from analyses of a million individuals.	2019	Nature Genetics	597	85.29
22	Fahad et al	Potential role of phytohormones and plant growth-promoting rhizobacteria in abiotic stresses: Consequences for changing environment	2015	Environmental Science and Pollution Research	556	50.55
23	Khalil et al	Speech Emotion Recognition Using Deep Learning Techniques: A Review	2019	IEEE Access	538	76.86
24	Sheena et al	Global, regional, and national burden of hepatitis B, 1990-2019: A systematic analysis for the Global Burden of Disease Study 2019	2022	The Lancet Gastroenterology & Hepatology	526	131.50
25	Poursham s et al	The global, regional, and national burden of pancreatic cancer and its attributable risk factors in 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Study 2017	2019	The Lancet Gastroenterology & Hepatology	525	75.00

Total Citation Per Year+ TC/Year
Local Cited Document (LCD)

An article in a dataset that has been cited by other articles in the same dataset is known as a local cited document. This metric quantifies the internal influence and relevance of a document within the specific research field, collection, or body of literature being analyzed. Table 4 shows the local cited documents (LCD) in the dataset, that is, the most cited articles by other works that are also present in the same bibliometric corpus.
Several important patterns emerge:

Local Citations – Moderate/Global Citations – Strong
Articles, such as those by Barkatullah et al. (2015) on ethnobotany and Siraj-ul-Islam et al. (2015) on numerical methods, received relatively **few local citations** (LC = 3 for both) and more global citations (GC = 83 and 58, respectively). This indicates that these works have a global impact but are less central in the internal citation network of this dataset.
Balanced Local and Global Recognition
Research articles by Amanullah et al. (2015) on phosphorus, nitrogen, and compost management in crop production often have LC values ranging between 3 and 5, accompanied by moderate GC (e.g., 28–86). This indicates that the contributions of the respective articles are the primary source of influence in the model with respect to the related studies in the dataset and are recognized in the broader community.
High LC/GC Ratios of High Field-Specific Significance
A few studies, such as Anjum and Khan (2020) (75% LC/GC ratio) and Khaleeq-Uz-Zaman et al. (2018), having 30%, show that the citations are highly concentrated in the dataset. It does show that the importance of each in the respective areas is high, even if it is not realized on a worldwide scale.

Thematic spectrum of locally impactful research
A random sample of locally referenced works covered various fields such as: Agricultural sciences (fertilizers, crop yield, amelioration / improvement to soil), Ethnobotany and medicinal plants, Applied mathematics and computational modelling, Nanomaterials and sensor technologies; and
Applications to fluid dynamics and physics. This diversity is indicative of the multidisciplinary nature of the dataset; however, some clusters, particularly those in agriculture and plant sciences, exhibit high internal intellectual cohesion.

Table 4: Local Cited Document (LCD)

S#	Authors	Title	Year	Source Title	LC	GC	LC/GC Ratio (%)
1	Fazl-I-Sattar et al	Phytochemical, spectroscopic and density functional theory study of Diospyrin, and non-bonding interactions of Diospyrin with atmospheric gases	2015	Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy	5	63	7.94
2	Amanullah and Inamullah	Residual phosphorus and zinc influence wheat productivity under rice–wheat cropping system	2016	Springer Plus	5	30	16.67

3	Amanullah et al	Compost and Nitrogen Management Influence Productivity of Spring Maize (Zea mays L.) under Deep and Conventional Tillage Systems in Semi-arid Regions	2015	Communications in Soil Science and Plant Analysis	4	28	14.29
4	Zulfiqar et al	Structural, dielectric and ferromagnetic behavior of (Zn, Co) co-doped SnO2 nanoparticles	2016	Ceramics International	4	38	10.53
5	Amanullah; Hidayatullah	Influence of Organic and Inorganic Nitrogen on Grain Yield and Yield Components of Hybrid Rice in Northwestern Pakistan	2016	Rice Science	4	55	7.27
6	Amanullah and Inamullah	Dry Matter Partitioning and Harvest Index Differ in Rice Genotypes with Variable Rates of Phosphorus and Zinc Nutrition	2016	Rice Science	4	86	4.65
7	Barkatullah et al	Quantitative ethnobotanical survey of medicinal flora thriving in Malakand Pass Hills, Khyber Pakhtunkhwa, Pakistan	2015	Journal of Ethnopharmacology	3	83	3.61
8	Siraj-ul-Islam and Zaman	New quadrature rules for highly oscillatory integrals with stationary points	2015	Journal of Computational and Applied Mathematics	3	31	9.68
9	Siraj-ul-Islam et al	Numerical solution of two-dimensional elliptic PDEs with nonlocal boundary conditions	2015	Computers and Mathematics with Applications	3	58	5.17
10	Khaleeq-Uz-Zaman et al	Phtyto-chemical composition, antimicrobial and phyto-toxic activity of Angelica glauca (Apiaceae)	2018	Pakistan Journal of Botany	3	10	30.00
11	Sami Ul Haq et al	The impact of side walls on the MHD flow of a second-grade fluid through a porous medium	2018	Neural Computing and Applications	3	10	30.00
12	Khan and Haneef	Distortion management of the Goos-Hänchen shifts	2018	Canadian Journal of Physics	3	10	30.00

		in reflection-transmission beams					
13	Anjum and Khan	Phenology, Crop Stand and Biomass of Wheat in Response to Farmyard Manure and Soil Amendments	2020	Sarhad Journal of Agriculture	3	4	75.00
14	Sulaiman et al	Quantitative ethnobotanical study of indigenous knowledge on medicinal plants used by the tribal communities of Gokand valley,district Buner, Khyber Pakhtunkhwa, Pakistan	2020	Plants	3	81	3.70
15	Muneeb-Ur-Rahman et al	Resistive- and capacitive-type humidity and temperature sensors based on a novel caged nickel sulfide for environmental monitoring	2020	Journal of Materials Science: Materials in Electronics	3	20	15.00
16	Ismail et al	Thermal stress alleviating potential of endophytic fungus Rhizopus oryzae inoculated to sunflower (Helianthus annuus L.) and soybean (glycine max L.)	2020	Pakistan Journal of Botany	3	67	4.48
17	Amanullah et al	Integrated Management of Phosphorus, Organic Sources, and Beneficial Microbes Improve Dry Matter Partitioning of Maize	2019	Communications in Soil Science and Plant Analysis	3	15	20.00
18	Gulalai et al	Nonlinear analysis of a nonlinear modified KdV equation under Atangana Baleanu Caputo derivative	2022	AIMS Mathematics	3	23	13.04
19	Irfanullah et al	Homozygous sequence variants in the NPR2 gene underlying acromesomelic dysplasia maroteaux type (AMDM) in consanguineous families	2015	Annals of Human Genetics	2	20	10.00
20	Siraj-ul-Islam et al	Meshless methods for multivariate highly oscillatory Fredholm integral equations	2015	Engineering Analysis with Boundary Elements	2	22	9.09

21	Amanullah et al	Preceding rice genotypes, residual phosphorus and zinc influence harvest index and biomass yield of subsequent wheat crop under rice-wheat system	2015	Pakistan Journal of Botany	2	7	28.57
22	Amanullah et al	Cool Season C3-Grasses (Wheat, Rye, Barley, and Oats) Differ in Shoot: root ratio when applied with different NPK sources	2015	Journal of Plant Nutrition	2	6	33.33
23	Shah et al	The electrical MHD and Hall current impact on micropolar nanofluid flow between rotating parallel plates	2018	Results in Physics	2	220	0.91
24	Ghiasuddin et al	A combined experimental and computational study of 3-bromo-5-(2,5-difluorophenyl) pyridine and 3,5-bis(naphthalen-1-yl)pyridine: Insight into the synthesis, spectroscopic, single crystal XRD, electronic, nonlinear optical and biological properties	2018	Journal of Molecular Structure	2	91	2.20
25	Ali et al	Chitosan-coated cotton cloth supported copper nanoparticles for toxic dye reduction	2018	International Journal of Biological Macromolecules	2	202	0.99
26	Arslan-Ayaydin et al	Avoiding interest-based revenues while constructing shariah-compliant portfolios: False negatives and false positives	2018	Journal of Portfolio Management	2	16	12.50

Authors' Affiliations

Table 5 illustrates the top 50 contributing author affiliations in the region contributing to the research output. The University of Peshawar leads the list with 11,875 associated authorships, followed closely by Abdul Wali Khan University Mardan (11,118) and the University of Agriculture Peshawar (7,407). The three universities alone contribute a significant percentage of the total affiliations, indicating their dominance in knowledge production in the province.

Other prominent contributors include Hazara University (7,066), the University of Malakand (6,688), and the University of Engineering and Technology, Peshawar (5,302), indicating a diffusion of research activity across general, agricultural, and technological fronts. The range of institutional engagement in the academic life of KP is reflected in mid-tier representatives,

including Kohat University of Science and Technology (4,197), Gomal University (3,686), and Quaid-i-Azam University (3,472).

Interestingly, the affiliations with national-level universities in KP are also recorded (e.g. University of Karachi, University of the Punjab, Government College University Faisalabad, University of Sargodha), as well as in international universities (e.g. Guangxi University (China, 1,275), King Abdulaziz University (Saudi Arabia, 1,238), Kyungpok National University (South Korea, 1,048), and King Saud University (Saudi Arabia, 1 This indicates the close collaborative networks that KP-based researchers have built nationally and globally.

It should also be noted that the counts in this paper refer to author-affiliation pairs, not unique article tallies. In other words, if five authors from the same university contributed to a single paper, then five counts will be counted. Therefore, the numbers represent a degree of institutional involvement in research activities, rather than an exact number of publications per university.

Table 5: Authors Affiliations

S#	**Affiliation**	**Articles**	S#	**Affiliation**	**Articles**
1.	University of Peshawar	11875	26.	Government College University Faisalabad	861
2.	Abdul Wali Khan University Mardan	11118	27.	Prince Sultan University	860
3.	The University of Agriculture	7407	28.	University of Nizwa	859
4.	Hazara University Pakistan	7066	29.	Prince Sattam Bin Abdulaziz University	850
5.	University of Malakand	6688	30.	Bahauddin Zakariya University	827
6.	University of Engineering and Technology	5302	31.	Taif University	826
7.	Kohat University of Science and Technology	4197	32.	University of Swat	819
8.	Gomal University	3686	33.	College of Pharmacy	818
9.	Quaid-I-Azam University	3472	34.	Northwest A&F University	817
10.	Comsats University Islamabad	3366	35.	Bacha Khan University	806
11.	Islamia College	3118	36.	University of Agriculture	772
12.	Khyber Medical University	2061	37.	The Islamia University of Bahawalpur	744
13.	University of Karachi	1607	38.	Shaheed Benazir Bhutto Women University	717
14.	University of Science and Technology Bannu	1297	39.	University of Sargodha	717
15.	Guangxi University	1275	40.	Princess Nourah Bint Abdulrahman University	703
16.	King Abdulaziz University	1238	41.	Huazhong Agricultural University	684
17.	Shaheed Benazir Bhutto University	1189	42.	International Islamic University	675
18.	College of Sciences	1173	43.	Sarhad University of Science and IT	663
19.	King Khalid University	1129	44.	Rapha International University	633

20.	University of Swabi	1124	45.	University of Veterinary and Animal Sciences	621
21.	King Saud University	1088	46.	Umm Al-Qura University	578
22.	Kyungpook National University (KNU)	1048	47.	Zhejiang University	576
23.	The University of Haripur	981	48.	PMAS-Arid Agriculture University Rawalpindi	571
24.	National University of Sciences and Technology	950	49.	University of Lahore	531
25.	University of the Punjab	930	50.	Abbottabad University of Science and Technology	515

Citation Analysis of Universities

The citation numbers for each university are listed in Table 6, and their citation networks are illustrated in Figure 2, providing an overall picture of institutional research impact.

The study reveals that Abdul Wali Khan University Mardan (5,916 documents; 128,247 citations) and the University of Peshawar (5,908 documents; 116,918 citations) are the top collaborating institutions in terms of citation impact. Other major contributors include the University of Agriculture, Peshawar (3,076 documents; 47,037 citations), Hazara University (3,664; 70,622 citations), and the University of Malakand (3,251; 58,801 citations), indicating that research productivity is disseminated throughout both old and newly established universities.

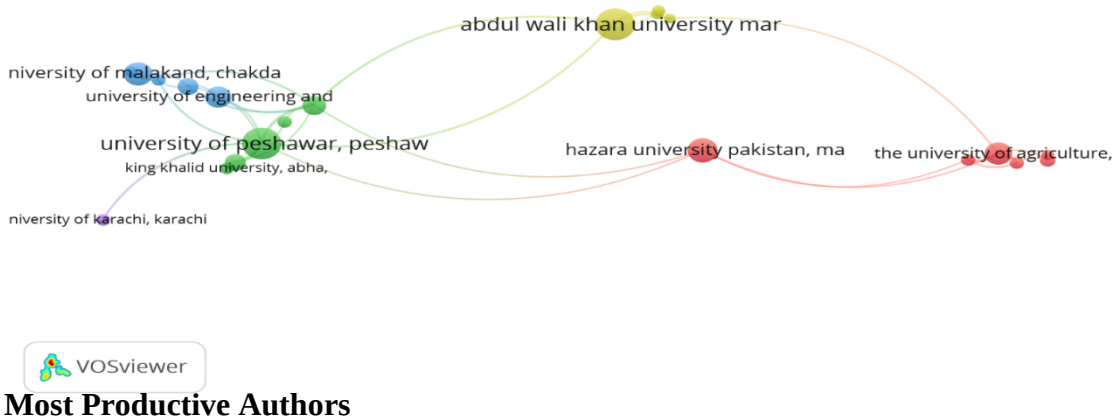
The visualization (Figure 2) also shows the collaborative clusters between institutions, strong citation links between the University of Peshawar, Abdul Wali Khan University Mardan, University of Agriculture Peshawar, and Hazara University. These clusters of cites suggest that the impact of the citations is not only due to a hot single institution but is driven by interlinking institutions within the KP. Additionally, the emergence of international universities such as King Khalid University (Saudi Arabia), King Saud University (Saudi Arabia), and Prince Sultan University (Saudi Arabia) is an indication of the importance of cross-border collaboration in increasing citation visibility. Ultimately, the above analysis indicates a high level of local citation, with locally increasing international connectivity of KP universities, reaffirming their standing within the broader scientific world.

Table 6: Citation Analysis of Universities

S#	University	Articles	citations	Total Link Strength
1.	University of Peshawar, Peshawar, Pakistan	5908	116918	19
2.	The University of Agriculture, Peshawar, Peshawar, Pakistan	3076	47037	14
3.	Islamia College, Peshawar, Peshawar, Pakistan	2107	41578	14
4.	University of Swabi, Swabi, Pakistan	771	13916	11
5.	Abdul Wali Khan University Mardan, Mardan, Pakistan	5916	128247	10
6.	Comsats University Islamabad, Abbottabad Campus, Abbottabad, Pakistan	776	16837	7
7.	Bacha Khan University, Charsadda, Pakistan	607	10449	7
8.	Gomal University, Dera Ismail Khan, Pakistan	1810	27701	6
9.	Quaid-I-Azam University, Islamabad, Pakistan	1699	39092	6
10.	Hazara University Pakistan, Mansehra, Pakistan	3664	70622	4

11.	Comsats University Islamabad, Islamabad, Pakistan	885	19839	4
12.	University of Malakand, Chakdara, Pakistan	3251	58801	3
13.	University of Engineering and Technology, Peshawar, Peshawar, Pakistan	2678	56690	3
14.	University of Karachi, Karachi, Pakistan	783	15383	3
15.	Shaheed Benazir Bhutto Women University, Peshawar, Pakistan	545	6057	3
16.	King Khalid University, Abha, Saudi Arabia	904	15277	2
17.	Shaheed Benazir Bhutto University, Nawabshah, Pakistan	842	22636	2
18.	University of Science and Technology Bannu, Bannu, Pakistan	761	14250	2
19.	Prince Sattam Bin Abdulaziz University, Al Kharj, Saudi Arabia	700	12339	2
20.	Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia	648	10218	2
21.	College Of Sciences, Riyadh, Saudi Arabia	950	13712	1
22.	The University of Haripur, Haripur, Pakistan	653	11106	1
23.	Kohat University of Science and Technology, Kohat, Pakistan	2225	40037	0
24.	Khyber Medical University, Peshawar, Pakistan	1163	13254	0
25.	King Saud University, Riyadh, Saudi Arabia	750	16527	0
26.	Taif University, Taif, Saudi Arabia	611	10548	0
27.	National University of Sciences and Technology, Islamabad, Pakistan	573	10976	0
28.	University of Swat, Charbagh, Pakistan	541	10623	0
29.	Prince Sultan University, Riyadh, Saudi Arabia	528	11460	0
30.	College Of Pharmacy, Riyadh, Saudi Arabia	527	6193	0

Figure 2 Networks of organizations



Most Productive Authors

Table 7 presents information relevant to the most productive authors working at universities in Khyber-Pakhtunkhwa from 2015 to 2024. Shah, Kamal emerge as the top authors with 364 articles and 8,642 citations indicating the core contribution to the overall productivity, Islam,

Saeed M. Naqib Ul follows closely with 281 articles but has the highest citations (9,349) signifying high influence and authors like Wadood, Abdul Chishti (278 articles) and Khan, Imran (270 articles) make a contribution but at a different citation impact. Authors, such as Abdeljawad (Maraaba) T. Thabet and Rahim, Fazal have both high productivity and the maximum value of the strength of the collaborative link.

Altogether, the results indicate that research productivity is concentrated among a few active authors, with the magnitude of their collaborative links determined by international and institutional collaborations.

Table 7: Most productive Authors

S. No.	Author	Articles	Citations	Total Link Strength
1	Shah, Kamal	364	8642	197
2	Islam, Saeed M. Naqib Ul	281	9349	159
3	Wadood, Abdul Chishti	278	7564	156
4	Khan, Imran	270	5555	23
5	Abdeljawad (Maraaba) T., Thabet	249	5106	174
6	Rauf, Abdur	245	4085	73
7	Ahmad, Iftikhar	242	5553	3
8	Muhammad, Yaseen	241	8154	3
9	Ali, Amjad	240	3725	39
10	Ullah, R. Q.	236	3413	98
11	Khan, Haroon	232	4158	63
12	Shah, Zahir	227	7545	115
13	Abdullah, Saleem	220	6114	3
14	Ullah, Irfan	217	2865	22
15	Ahmad, Hijaz	214	4929	7
16	Zahoor, Muhammad Kashif	210	3166	88
17	Murtaza, Ghulam	201	4648	8
18	Rahim, Fazal	200	6283	116
19	Khan, K. M.	199	4681	130
20	Sabir, Zulqurnain	198	6065	1
21	Khan, Ilyas	197	4078	66

Most productive Universities

Table 8 shows the top universities according to the research output: Abdul Wali Khan University Mardan (5,916 articles, 4,414 link strength) and the University of Peshawar (5,908 articles, 4,110 link strength) are the top two most prolific institutions, acting as primary nodes for research in Khyber Pakhtunkhwa. Hazara University (3,664) and the University of Malakand (3,251) are also notable contributors, illustrating their increasing role in local research. In a similar manner to special-purpose institutions like The University of Agriculture, Peshawar (3,076) and Khyber Medical University (1,163), which also contribute significantly towards agriculture and medical sciences, respectively.

International universities (Saudi Arabia) such as King Khalid University (904), King Saud University (750), and Prince Sattam bin Abdulaziz University (700) also reflect simultaneous international collaborations with the Pakistani universities.

The total link strength values indicate the strength of collaboration networks. For example, with a competitor pool with fewer documents (1,699), Quid-I-Azam University has a high link strength (2,510), indicating its centrality in collaborative projects.

Table 8: Most Productive Universities/Organizations

S#	Organization	Articles	Total Link Strength
1	Abdul Wali Khan University Mardan, Mardan, Pakistan	5916	4414
2	University of Peshawar, Peshawar, Pakistan	5908	4110
3	Hazara University Pakistan, Mansehra, Pakistan	3664	2813
4	University of Malakand, Chakdara, Pakistan	3251	2181
5	The University of Agriculture, Peshawar, Peshawar, Pakistan	3076	1612
6	University Of Engineering and Technology, Peshawar, Peshawar, Pakistan	2678	897
7	Kohat University of Science and Technology, Kohat, Pakistan	2225	1717
8	Islamia College, Peshawar, Peshawar, Pakistan	2107	2124
9	Gomal University, Dera Ismail Khan, Pakistan	1810	1156
10	Quaid-I-Azam University, Islamabad, Pakistan	1699	2510
11	Khyber Medical University, Peshawar, Pakistan	1163	595
12	College of Sciences, Riyadh, Saudi Arabia	950	1528
13	King Khalid University, Abha, Saudi Arabia	904	1350
14	Comsats University Islamabad, Islamabad, Pakistan	885	1329
15	Shaheed Benazir Bhutto University, Nawabshah, Pakistan	842	628
16	University of Karachi, Karachi, Pakistan	783	1317
17	Comsats University Islamabad, Abbottabad Campus, Abbottabad, Pakistan	776	1235
18	University Of Swabi, Swabi, Pakistan	771	1314
19	University Of Science and Technology Bannu, Bannu, Pakistan	761	585
20	King Saud University, Riyadh, Saudi Arabia	750	1125
21	Prince Sattam Bin Abdulaziz University, Al Kharj, Saudi Arabia	700	990

Most Productive Countries

Table shows countries with the highest interest in research collaboration with universities in Khyber Pakhtunkhwa (KP), Pakistan. Pakistan leads with 28,292 papers and over 554,000 citations, indicating its prominence in the region in terms of research activity. Other very active contributors include Saudi Arabia (7,577 articles) and China (7,006 articles), followed by South Korea, the United States, and Malaysia. The United Kingdom, Italy, and Germany are producing fewer articles, but they have a high citation impact and high levels of collaboration.

Table 9: Most productive countries

S#	Country	Articles	Citations	Total Link Strength
1	Pakistan	28292	554235	27478
2	Saudi Arabia	7577	143970	14458
3	China	7006	174015	11251
4	South Korea	1678	46594	3047
5	United States	1546	40587	3252
6	Malaysia	1486	37189	2783
7	United Kingdom	1294	33035	2394
8	Egypt	1278	27213	3322
9	Turkey	949	21421	2124
10	Taiwan	814	19995	2034
11	United Arab Emirates	697	14608	1555
12	Thailand	680	18154	1576
13	India	667	18119	1676
14	Italy	664	14861	1476
15	Australia	602	19196	1426
16	Germany	549	14126	1100

Discussion

This study provides a province level bibliometric profile of research productivity of public sector universities of Khyber Pakhtunkhwa (KP) contributing a missing regional layer to the work which has been done previously at the national level or on individual flagship institutions (Ahmad et al., 2020; Javed et al., 2020; Hamid et al., 2025). The results confirm the evidence that KP universities have increased their output substantially over the last decade, in line with previous evidence that Pakistan's scientific production has grown quickly since the early 2000s following HEC reforms (Ahmad et al., 2020). At the same time, the distribution of publications among a small number of more established KP universities is reminiscent of national trends that show that research capacity is unevenly distributed between institutions (Wahid et al., 2023; Hamid et al., 2025).

A major contribution of this study is the focus on regional differentiation within Pakistan. While previous analyses considered patterns of national output, or focused either on single-university case studies, such as that of the University of the Punjab (Ahmad et al., 2020), Islamabad based higher education institutions (Javed et al., 2020), or on particular universities such as Shifa Tameer-e-Millat and University of Peshawar (Jan et al, 2024, Mehnaz et al., 2023).

International collaboration turns out to be one of the most pronounced aspects of the research profile of KP universities. A sizeable proportion of publications have foreign co-authors, particularly from scientifically advanced counties in Asia and the Gulf countries. This is in line with findings from other studies worldwide showing that papers co-authored internationally are likely to receive more citations than purely domestic production (Sin, 2011; Wang et al., 2024; Kohus et al., 2022). Studies focusing on Pakistan and South Asia demonstrate that international partnerships can help overcome the barriers of visibility at the local level by linking researchers to global networks, high-impact journals and large-scale projects (Waqas et al., 2020; Wahid et al., 2023). The results therefore add to the case that provincial and institutional policies should actively promote cooperation, such as joint projects, mobility schemes and co-funded chairs, when international work is seen as a secondary or optional dimension.

The disciplinary structure of KP research is also in tune with evidence from previous bibliometric studies from Pakistan and similar contexts. It was found that engineering, physical sciences, agricultural and biological sciences and health-related fields are overrepresented in the subject-mix, while social sciences, humanities and some professional fields are still underrepresented.

National analysis of the science and technology production in Pakistan similarly revealed significant focus on natural sciences, engineering and medical research (Anwer et al., 2024; Khan, 2025), while relatively marginal proportions of social science and humanities scholarship was revealed (Waqas et al., 2020). Sector-specific bibliometric studies on health systems (Memon et al., 2021; Saleem et al., 2024), ICT and higher education studies (Chen, 2023) also show strong growth but mainly in the STEM or applied field. In this context, the disproportionately low representation of social sciences and humanities in KP universities may be due to structural factors such as less funding, weaker indexing of local journals, and different publication cultures (Sabah et al., 2019; Rashid et al., 2021).

Analysis of citation patterns indicates that the dataset reinforces long-standing concerns regarding the uneven distribution of research impact indicators. Older, research-intensive institutions in KP are more likely to have highly cited work and newer or peripheral universities have low citation counts despite increased publication counts. This is in line with previous assessments of Pakistani universities which revealed that institutional age, critical mass of senior researchers and established collaboration networks are linked to higher citation impact and international visibility (Ahmad et al., 2020; Javed et al., 2020). At the same time, the theory of bibliometrics warns that raw citation counts and journal-based metrics, such as the Impact Factor, can be misleading when comparing institutions with different disciplinary profile, publication language and age (Joshi 2014; Bornmann et al., 2020).

Conclusion

This study is a full bibliometric study of research productivity of public-sector universities of Khyber Pakhtunkhwa (KP), Pakistan, during 2015-2024 to fill a gap in the evaluation of research productivity on a provincial basis.The findings show a sustained rise in the output of research in the KP universities, indicating national higher education reforms and an increase in research capacity. However, this growth is uneven, which means a few well established institutions make disproportionate contributions to publications, citations, and the strength of their collaborations. Citation analysis is further used to show a focus of research impact, with older publications and internationally collaborative research outputs gaining greater visibility, thus showing the importance of time effects and global involvement in research evaluation. Collaboration network analysis shows the key importance of international and inter-institutional collaborations in boosting citation impact and scholarly influence. Strong cooperative links with foreign institutions (especially in scientifically advanced countries) greatly reinforce the worldwide integration of the KP universities, while domestic collaborations facilitate internal knowledge exchange in the province. There is apparent dominance of science, engineering and health-related disciplines, while social sciences and humanities are underrepresented because of structural and systemic constraints.

Taking together, these findings have several implications. First, provincial and university-level strategies should focus on strengthening existing strengths in STEM-related fields, and proactively developing under-represented disciplines, especially social sciences and humanities, to provide a context sensitivity of development and policy analysis. Second, research support programs in KP should include a combination of international collaboration incentives and investments in local infrastructure and mentoring and doctoral training to prevent over dependency on international partners. Third, the assessment of institutional performance should include field normalized and time adjusted measures of bibliometric indicators with assessments through qualitative peer review to ensure fair evaluation of different stages of development by universities. Finally, future work could replicate and expand this mapping efforts in the province by including multiple databases, altimetric and network analysis to capture both the traditional measure of scholarly impact and societal engagement.

References

Ahmad, S., Javed, Y., Hussain Khahro, S., & Shahid, A. (2020). Research contribution of the oldest seat of higher learning in Pakistan: A bibliometric analysis of university of the Punjab. *Publications*, *8*(3), 43. https://www.mdpi.com/2304-6775/8/3/43

Ahmad, S., Qureshi, I. U., Ramzan, M., & Rehman, S. U. (2022). Research Elite of Pakistan: Profile and Determinants of Productivity and Impact. *Publishing Research Quarterly*, *38*(2), 263-280. https://doi.org/10.1007/s12109-022-09874-5

Anwer, F., & Malik, A. A. (2024). Hypertension Research in Pakistan: A Scientometric Analysis of Two Decades (2003-2022). *Cureus*, *16*(5), 1-11.

Asif, M., Naveed, M. A., & Awan, W. A. Effect of information literacy on teaching effectiveness, creativity and research productivity: A case of University Academicians in Pakistan. *Journal of Librarianship and Information Science*, *0*(0), 09610006251339831. https://doi.org/10.1177/09610006251339831

Aydın, F., & Taşkın, Z. (2025). Research funding in Turkiye: linking TUBITAK policy change to scientific productivity. *Scientometrics*, *130*(11), 6455-6475. https://doi.org/10.1007/s11192-025-05461-5

Baccini, A., & Petrovich, E. (2023). A global exploratory comparison of country self-citations 1996-2019. *PLOS ONE*, *18*(12), e0294669. https://doi.org/10.1371/journal.pone.0294669

Bornmann, L., Haunschild, R., & Mutz, R. (2020). Should citations be field-normalized in evaluative bibliometrics? An empirical analysis based on propensity score matching. *Journal of Informetrics*, *14*(4), 101098. https://doi.org/https://doi.org/10.1016/j.joi.2020.101098

Chen, J. (2023). A scientometric analysis of information technology in sustainable higher education: knowledge structure and frontier trends. *Discover Sustainability*, *4*(1), 35. https://doi.org/10.1007/s43621-023-00148-4

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*, 285-296. https://doi.org/10.1016/j.jbusres.2021.04.070

Gupta, B. M., Dhawan, S. M., Singh, Y., Srivastava, N., Vaishya, R., Kappi, M., & Mamdapur, G. M. N. (2024). A Scientometric Analysis of Highly Cited Papers of Pakistan in COVID-19 Research 2020-2023. *Journal of Data Science, Informetrics, and Citation Studies*, *3*(2), 123-137. https://doi.org/10.5530/jcitation.3.2.15

Gupta, B. M., Vaishya, R., Mamdapur, G. M. N., Ali, K. S., & K. K, M. A. (2024). Pakistan's Contribution to COVID-19 Research: A Scientometric Analysis of Publications from 2020-2023. *Journal of Data Science, Informetrics, and Citation Studies*, *3*(3), 245-257. https://doi.org/10.5530/jcitation.3.3.26

Halaweh, M. (2020). Research Productivity Index (RPI): a new metric for measuring universities' research productivity. *Information Discovery and Delivery*, *49*(1), 29-35. https://doi.org/10.1108/idd-01-2020-0003

Hamid, A., Ali, N., Shah, N. U., & Syed, K. (2025). Research productivity in librarianship: a bibliometric analysis and visualization based on ISI Web of Science. *Global Knowledge, Memory and Communication*. https://doi.org/10.1108/gkmc-01-2024-0020

Haq, I. U. (2021). Evaluation of research productivity of the Islamia University of Bahawalpur, Pakistan. *Journal of Information Management and Practices*, *1*(2), 51-78.

Haq, I. U., & Faridi, R. A. (2021). Evaluating the research productivity of Pakistan in the 21st Century. In *Handbook of research on records and information management strategies for enhanced knowledge coordination* (pp. 407-423). IGI Global Scientific Publishing.

Hassan, W. (2022). Bibliometric Analysis of Proceedings of the Pakistan Academy of Sciences: Part A from 2016 to 2022: A short bibliometric note from 2016 to 2022. *Proceedings of*

the Pakistan Academy of Sciences: A. Physical and Computational Sciences, *59*(2), 1-29. https://doi.org/10.53560/PPASA(59-2)651

Hassan, W., Rahman, S., & Ara, A. (2021). The Research Publications Growth Rate of Pakistan in the Field of Material Sciences: Comparison with 50 countries: Material Sciences Research in Pakistan: Bibliometric Analysis. *Proceedings of the Pakistan Academy of Sciences: A. Physical and Computational Sciences*, *58*(3), 1-14.

Hassan, W., Rahman, S., & Ara, A. (2024). The research growth rate (2019-2020) of forty countries in the field of earth and planetary science research. *Proceedings of the Pakistan Academy of Sciences: A. Physical and Computational Sciences*, *61*(1), 71-80.

Heaton-Shrestha, C., Ooms, A., Brady, M., Pedley, G., Bacon, I., Strong, S., & Dundas, J. (2023). Interventions to enhance the research productivity of academic staff in higher education schools of nursing: A systematic review. *Nurse Education in Practice*, *72*, 103741. https://doi.org/10.1016/j.nepr.2023.103741

Hensel, P. G. (2025). Scientific software as geopolitics: evidence of national attribution bias from a large-scale replication in bibliometrics. *Scientometrics*, *130*(11), 6135-6152. https://doi.org/10.1007/s11192-025-05466-0

Higher Education Commission (HEC). (2023). *Recognized Universities and Degree Awarding Institutes*. https://www.hec.gov.pk

Hussain, M., & Yar, M. S. (2020). Research productivity on knowledge management from Pakistan: A study from 2000-2020. *Library Philosophy and Practice (e-journal).* 1-11. https://digitalcommons.unl.edu/libphilprac/4765

Hussain, M., & Saddiqa, M. (2020). Trends of publications in Peshawar Islamicus research journal: A bibliometric study from 2010-2020. *Library Philosophy and Practice (e-journal), 4373*. https://digitalcommons.unl.edu/libphilprac/4373

Iqbal, H. M., Mahmood, K., & Iqbal, S. A. (2018). Factors Contributing Towards Research Productivity and Visibility: A case study of Pakistan. *Libri*, *68*(2), 85-98. https://doi.org/doi:10.1515/libri-2017-0105

Jan, T., Jan, R., & Bahadar, M. (2024). A bibliometric analysis of publications by the institute of chemical sciences, University of Peshawar, Pakistan, 1955-2022. *International Research Journal of Arts, Humanities and Social Sciences*, *2*(01), 207-219.

Javed, Y., Ahmad, S., & Khahro, S. H. (2020). Evaluating the research performance of Islamabad-based Higher Education Institutes. *Sage Open*, *10*(1), 1-11. https://doi.org/10.1177/2158244020902085

Jia, P., Xie, W., Tian, W., & Wang, X. (2025). The impact of IP protection on scientific output: evidence from the plant variety sector. *Scientometrics*, *130*(9), 5115-5141. https://doi.org/10.1007/s11192-025-05408-w

Joshi, M. (2014). Bibliometric indicators for evaluating the quality of scientific publications. *The journal of contemporary dental practice*, *15*(2), 258-262. https://doi.org/10.5005/jp-journals-10024-1525

Kadikilo, A. C., Kulshrestha, R., Sahay, A., & Nayak, P. (2023). Research promotion strategies to enhance research productivity in Tanzanian higher educational institutions. *Review of Education*, *11*(3), e3436. https://doi.org/https://doi.org/10.1002/rev3.3436

Khan, B., Mustafa, G., & Nawaz, A. (2021). Flourishing the Higher education in Pakistan: An exploratory analysis of the role of Higher Education Commission (HEC). *Journal of Applied Economics & Business Studies (JAEBS)*, *5*(3), 1-18.

Kohus, Z., Demeter, M., Szigeti, G. P., Kun, L., Lukács, E., & Czakó, K. (2022). The influence of international collaboration on the scientific impact in V4 countries. *Publications*, *10*(4), 35. https://doi.org/10.3390/publications10040035

Latif, A., & Haq, I. U. (2020). Bibliometric research productivity analysis: A case study of Shifa Tameer-e-Millat University. *Journal of Shifa Tameer-e-Millat University*, *3*(1), 49-55.

Mahmood, A., Rehman, N., Huang, X., & Riaz, I. (2025). Barriers to undergraduate medical students' research engagement in Pakistan: a qualitative exploration. *BMC Medical Education*, *25*(1), 592. https://doi.org/10.1186/s12909-025-07185-9

Mairaj, M. I., Aslam, S., & Ali, N. (2023). Scholarly Productivity of the University of Engineering and Technology, Lahore over 50 years (1973-2022): A bibliometric visualization from the Web of Science. *Pakistan Journal of Information Management and Libraries*, *25*, 18-37.

Malaga, R. S. (2025). Institutional capacity, faculty capability, and research productivity in higher education institutions: A moderated mediation model. *Edelweiss Applied Science and Technology*, *9*(2), 1920-1935.

Mehnaz, A., Jan, S. U., Nawaz, S., Bibi, S., & Khan, A. S. (2023). Research productivity of Khushal Khan Khattak University Karak-Pakistan: Through bibliometric lens. *Library Philosophy & Practice (e-journal)*. https://digitalcommons.unl.edu/libphilprac/7906/

Memon, M., Bhatti, S., & Memon, M. (2021). Bibliometric Analysis of Information and Communication Technology Research in Pakistan. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *3307*, 267-272.

Missen, M. M. S., Qureshi, S., Salamat, N., Akhtar, N., Asmat, H., Coustaty, M., & Prasath, V. B. S. (2020). Scientometric analysis of social science and science disciplines in a developing nation: a case study of Pakistan in the last decade. *Scientometrics*, *123*(1), 113-142. https://doi.org/10.1007/s11192-020-03379-8

Moral-Muñoz, J. A., Herrera-Viedma, E., Santisteban-Espejo, A., & Cobo, M. J. (2020). Software tools for conducting bibliometric analysis in science: An up-to-date review. *Profesional de la Información*, *29*(1).

Osayomwanbor, O. (2024). Research output and effective teaching: A scholarly discourse on lecturer productivity in tertiary institutions. *International Journal for Research in Applied Science and Engineering Technology*, *12*(12), 591-596.

Pritchard, A. (1969). Statistical bibliography or bibliometrics. *Journal of documentation*, *25*(4), 348-349.

Ranjha, K. U., Abid, S. F., Khan, M. H., Waheed, M. S., Sarfraz, L., Kashif, M., . . . Farooq, M. (2025). Low middle income countries and academic productivity of neurosurgery: A quantitative analysis from Pakistan. *Journal of Clinical Neuroscience*, *132*, 110992. https://doi.org/10.1016/j.jocn.2024.110992

Rao, S. (2025). The importance of basic, translational, and clinical research and innovation in developing countries: A focus on Pakistan. *INNOVAPATH*, *1*(1), 1-11.

Rashid, S., Rehman, S. U., Ashiq, M., & Khattak, A. (2021). A scientometric analysis of forty-three years of research in social support in education (1977–2020). *Education sciences*, *11*(4), 149.

Rasool, T., & Dilshad, M. (2023). Factors influencing research culture at public universities in Pakistan. *Research Journal for Societal Issues*, *5*(2), 41-58.

Ryazanova, O., & Jaskiene, J. (2022). Managing individual research productivity in academic organizations: A review of the evidence and a path forward. *Research Policy*, *51*(2), 104448. https://doi.org/10.1016/j.respol.2021.104448

Sabah, F., Hassan, S.-U., Muazzam, A., Iqbal, S., Soroya, S. H., & Sarwar, R. (2018). Scientific collaboration networks in Pakistan and their impact on institutional research performance: A case study based on Scopus publications. *Library Hi Tech*, *37*(1), 19-29. https://doi.org/10.1108/lht-03-2018-0036

Saleem, N. H., Asghar, M. N., Shirazi, H. D., & Chand, S. (2024). A bibliometric analysis of health systems research in Pakistan. *Eastern Mediterranean Health Journal*, *30*(6).

Shahzad, K., Iqbal, A., Ali, I., Naeem, M., Javed, Y., & Lateef, S. (2021). Research output of government college university Lahore, Pakistan: A bibliometric study based on Scopus Database from 1908 to 2020. *Library Philosophy and Practice (e-journal)*, *5941*, 1-28.

Siddique, N., Rehman, S. U., Ahmad, S., Mahmood, K., Khan, M. A., Adil, H. M., . . . Altaf, A. (2023). Research productivity of Pakistani female LIS authors, 1977 to 2020: A Bibliometric Analysis. *Sage Open*, *13*(4), 21582440231207188. https://doi.org/10.1177/21582440231207188

Siddique, N., Rehman, S. U., Khan, M. A., & Altaf, A. (2021). Library and information science research in Pakistan: A bibliometric analysis, 1957–2018. *Journal of Librarianship and Information Science*, *53*(1), 89-102. https://doi.org/10.1177/0961000620921930

Sin, S.-C. J. (2011). International coauthorship and citation impact: A bibliometric study of six LIS journals, 1980–2008. *Journal of the American Society for Information Science and Technology*, *62*(9), 1770-1783. https://doi.org/https://doi.org/10.1002/asi.21572

Singh, V. K., Singh, P., Karmakar, M., Leta, J., & Mayr, P. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics*, *126*(6), 5113-5142. https://doi.org/10.1007/s11192-021-03948-5

Soroya, S. H., Iqbal, S., Mahmood, K., Aljohani, N. R., Hassan, S.-U., & Nawaz, R. (2022). Exploring the research landscape in a developing country: gauging the prospects of growth, research impact and innovation. *Transforming Government: People, Process and Policy*, *16*(4), 567-581. https://doi.org/10.1108/tg-05-2022-0071

Tang, M., Bever, J. D., & Yu, F.-H. (2017). Open access increases citations of papers in ecology. *Ecosphere*, *8*(7), e01887. https://doi.org/https://doi.org/10.1002/ecs2.1887

Ullah, A., & Rafiq, M. (2022). Education and learning about research methodology: Views of LIS authors in Pakistan. *Information Development*, *38*(4), 688-703. https://doi.org/10.1177/02666669211022022

Uwizeye, D., Karimi, F., Thiong'o, C., Syonguvi, J., Ochieng, V., Kiroro, F., . . . Wao, H. (2021). Factors associated with research productivity in higher education institutions in Africa: a systematic review. *AAS Open Res*, *4*, 26. https://doi.org/10.12688/aasopenres.13211.2

Wahid, N., Amin, U., Khan, M. A., Siddique, N., & Warraich, N. F. (2023). Mapping the desktop research in Pakistan: a bibliometric analysis. *Global Knowledge, Memory and Communication*, *74*(1-2), 427-445. https://doi.org/10.1108/gkmc-07-2022-0159

Wahid, N., Warraich, N. F., & Tahira, M. (2021). Group level scientometric analysis of Pakistani authors. *COLLNET Journal of Scientometrics and Information Management*, *15*(2), 287-304. https://doi.org/10.1080/09737766.2021.1960219

Wahid, N., Warraich, N. F., & Tahira, M. (2022). Assessing the research profile of highly productive authors of Pakistan. *Global Knowledge, Memory and Communication*, *73*(1-2), 183-201. https://doi.org/10.1108/gkmc-01-2022-0012

Wajid, B., Saeed, U., & Wajid, I. (2025). Collaborate, collaborate, collaborate: A case study of Lahore's private universities presents high correlation between its research output and intra-university collaboration. *ProScholar Insights*, *4*(2), 69-80. https://doi.org/10.62997/psi.2025b-42084

Waltman, L., & van Eck, N. J. (2015). Field-normalized citation impact indicators and the choice of an appropriate counting method. *Journal of Informetrics*, *9*(4), 872-894. https://doi.org/10.1016/j.joi.2015.08.001

Wang, C., Yao, Y., Chen, Y., & Chen, J. (2025). The impact of evidence-based medicine curricula on information literacy among clinical medical undergraduates and postgraduates in China. *BMC Medical Education*, *25*(1), 520. https://doi.org/10.1186/s12909-025-07125-7

Wang, J., Frietsch, R., Neuhäusler, P., & Hooi, R. (2024). International collaboration leading to high citations: Global impact or home country effect? *Journal of Informetrics*, *18*(4), 101565. https://doi.org/https://doi.org/10.1016/j.joi.2024.101565

Waqas, A., Zafar, S., Lawlor, D. A., Wright, J., Hafeez, A., Ahmad, I. Rahman, A. (2020). A scientometric analysis of birth cohorts in South Asia: Way forward for Pakistan. *PLOS ONE*, *15*(7), e0235385. https://doi.org/10.1371/journal.pone.0235385

Waqee Ur, R., Tahir Munir, B., Iftikhar, H., Noor, F., & Usama, S. (2025). Role of Agriculture Extension Services in Enhancing Crop Productivity: A Review of Punjab, Pakistan. *Review Journal of Social Psychology & Social Works*, *3*(2), 382-395. https://www.socialworksreview.com/index.php/Journal/article/view/201

Xie, Q., Zhang, X., & Timakum, T. (2025). Investigating the temporal dynamics of topic variation, consistency, and diversity in funding and funded papers: evidence from Chinese LIS projects. *Scientometrics*, *130*(11), 6153-6189. https://doi.org/10.1007/s11192-025-05463-3

Yadigarova, L. (2025). Bibliometric analysis of the impact of international research collaborations: insights from social sciences. *International Scientific Journal of Universities and Leadership*(19), 37-48.

Yi, H., Cao, Y., Leng, Q., Wang, Y., Zhang, G., & Mao, Y. (2024). The impact of open access on citations, Pageviews, and downloads: a scientometric analysis in Postgraduate Medical Journal. *Postgraduate Medical Journal*, *100*(1187), 679-685. https://doi.org/10.1093/postmj/qgae047