EVALUATING HIGHER EDUCATION IN PAKISTAN: AN APPRAISAL OF RESEARCH PUBLICATION LANDSCAPE

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ABSTRACT

Over the last two and a half decades, hundreds of millions of dollars have been invested in setting up new universities across the country, funding faculty development programs, launching research grant schemes, and operationalizing national centers, and incubation programs. The ultimate goal of this enterprise was to elevate universities and degree-awarding institutions as centers of excellence for education, research, and development, fostering a rich and vibrant knowledge-based economy in Pakistan. The outcomes of this ambitious program are unfortunately not encouraging.

We have analyzed 1450 scholarly journals and conferences in engineering and computer science domain to dig out research papers originating from Pakistan. A new method of quality centric ranking of journals and conferences has been proposed which places journals in four categories: Alpha, Beta, Gamma and Delta, with Alpha category journals being the elite with extremely high prestige among research community. Our analysis shows that over the past 18 years, only 196 (0.51%) papers originating from Pakistan appeared in Alpha category journals. For the same period, we published 17,539 (45.94%) papers in journals listed in Delta category, the lowest category.

Interestingly, 9 out of 10 journals where we have published the most articles are open access journals requiring a significant amount (in US dollars) for publishing each paper, and all of these journals are in low categories (Gamma, Delta). It is surprising to see a country always complaining about low research funding, pays significant amount to publish in low category journals, and does not aim to publish in high quality journals which are mostly free of cost.

With these undeniable numbers, we formulate a setup of policy interventions for HEC which, if implemented, can significantly increase our representation in top quality journals and conferences, and improve our university ranking.

PREFACE

We undertake the first rigorous qualitative evaluation of Pakistan's research publication landscape. Our work is not focusing merely on numbers, such as the number of ISI-indexed publications of Pakistan; we are focusing on the number of research papers of Pakistan that appeared in top quality journals and conferences.

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ABBREVIATIONS

PPI	Peer Perception Index
HEC	Higher Education Commission
IF	Impact Factor
QAU	Quaid-e-Azam University
NUST	National University of Sciences and Technology
WoS	Web of Science ®
JIF	Journal Impact Factor
THE	Times Higher Education ®
TTS	Tenure Track System

INTRODUCTION

In 2002, Pakistan embarked on an ambitious higher education reform program: over the course of the next two decades, hundreds of millions of dollars were invested in setting up new universities across the country, funding faculty development programs, launching research grant schemes, and operationalizing national centers and incubation programs. A statutory body, the Higher Education Commission (HEC) was set up by the Government of Pakistan to fund, oversee, and regulate this emerging higher education ecosystem. The ultimate goal of this enterprise was to elevate universities and degree-awarding institutions as centers of excellence for education, research, and development, fostering a rich and vibrant knowledge-based economy in Pakistan.

The results have been dramatic. We focus here specifically on a single metric of research publications, a number which has skyrocketed in recent years. A study reports that the bulk of Pakistan's overall research output (~90%) was produced in the last 20 years alone (Ahmad, et al., 2020). Haq & Rehman (2021) note that a total of 201,807 WoS-Scopus indexed papers were produced in Pakistan over 2001-2020 across all domains. Of these, 54,217 (27%) were related to medical sciences. Moreover, the average number of papers being published every year is steadily increasing. A recent study reports that over 2007-2016, Pakistan's leading ten universities collectively produced over 40,000 research papers (Wahid et al., 2024). Another study tracks 134 'elite' Pakistani researchers for the period of 2009-2018 and notes that they produced ~ 55,000 scientific research publications, with almost half of these researchers affiliated with just three universities i.e. QAU, COMSATS, and PU (Ahmad et al., 2022). Another study finds that Pakistan produces on average 7,000 papers per year in the field of chemistry alone (Hassan et al., 2021).

These numbers are impressive, but give rise to further questions: our universities publish thousands of papers every year, but what is their standard and quality? Where do Pakistani researchers feature in the international landscape? Is there excellence to be found? How do we compare with neighboring countries? Do our higher education policies promote a culture of research excellence?

SCOPE OF THE PROJECT

We undertake the first rigorous qualitative evaluation of Pakistan's research publication landscape. Our project focuses on the following objectives:

- Analyze research publication data in engineering and computer science for the past 18 years, and see where papers originating from Pakistan are being published. Are we publishing in journals/conferences where top universities and countries publish?
- Build a National Live Portal real-time tracking and promotion of high quality research output from Pakistan. The portal will be open for all and will serve as a go-to resource for researchers, research students, and policymakers.
- Evaluate HEC's research publication policies in light of our findings and we propose policy interventions and strategies to promote quality research in Pakistan. We also provide tools and metrics stakeholders can use to evaluate academic research policies in the future.

We address the following research questions:

- Where are Pakistani engineering research papers being published?
- What is Pakistan's presence in the world's high-ranking publication venues?
- Are our current research metrics suitable to the task of measuring research quality?
- How does our engineering research compare with other groups, e.g., India, Iran, etc.?
- Where should prospective students look to for excellence?
- What reforms would we need to achieve research excellence in Pakistani universities?

Our results have direct bearing on the following policy questions:

- How effective is HEC's impact-factor-papers policy?
- How have HEC's research publication policies contributed to the open-access publishing ecosystem? What are the financial costs of Pakistan's open-access research publications?
- What incentives can we create to promote quality publications?
- What policies would help transition to a culture of quality research?
- Should we link research funding/promotion criteria to publication quality?
- How can we use research funding to promote quality?
- What policies are needed to build genuine Centers of Excellence for research in Pakistan?
- What role can stakeholders play in promoting quality research?
- How should we calibrate and measure higher education policy interventions?
- How do our research policies compare with other countries with similar conditions to our own?

LITERATURE REVIEW

There has been considerable work statistically analyzing the research output of different countries. Well–known university ranking systems and scientometric organizations (e.g. WoS, Scopus) regularly indulge in such analysis (Haq, 2021). A lot of work focuses on research output from Pakistani organizations. None, however, focuses on gauging the contribution of Pakistan at the top of the ladder, that we intend to do.

In an interesting study, Wahid et al. (2024) reported that top 10 universities in Pakistan had produced 40,210 research papers from 2007 to 2016. This looks like a sizable number. However, the authors did not analyze the quality of the research venues or the origin of the research paper (affiliation of the first author). This data reinforces our intuition that, although there is an increase in the number of publications associated with Pakistan, they are either published in low quality and borderline predatory journals, or not originated in Pakistan.

A recent study tracked the performance of 134 elite Pakistani researchers for the period 2009 - 2018 and noted down that they had produced ~ 55,000 scientific research publications during this period (Ahmad et al., 2022). A large chunk of these researchers (49%) were affiliated with three universities i.e. QAU, COMSATS, and PU. Even though only journals indexed in Web of Science (WoS) and Scopus were considered, there is no emphasis on the quality and repute of the journals.

The performance of The University of Punjab in research productivity has also been gauged compared to other universities (Ahmad et al., 2020). They note that a bulk of research output (~90%) from Pakistan, including from The University of Punjab, has been produced in the last 20 years. Haq & Rehman (2021) noted that a total number of 201,807 WoS-Scopus indexed papers were produced from Pakistan across all fields from 2001 to 2020. Out of these, 54,217 (27%) were related to medical sciences, and that the average number of documents being published every year is steadily increasing.

An interesting study found three preferred journals of most of the universities in Islamabad region (Javed et al., 2020). Not surprisingly, mediocre to low level journals are favorites. A similar study found that Islamia University Bahawalpur has produced 6,209 documents from the year 1980 to 2021, with Pakistan Journal of Pharmaceutical Sciences and Journal of the Chemical Society of Pakistan being among their favorite publication venues (Haq, 2021). Another study found that Pakistan produces, on average, 7,000 papers per year in the field of chemistry alone (Hassan et al., 2021).

An impressive study tries to draw a line between random publications and quality venue publications (brahim & Hassan, 2022). They find publications of Pakistani universities in top 25% SNIP score journals in a particular year. Even though this is a good step towards ensuring quality, in our opinion, the bar (top 25%) is quite low. Additionally, we intend to develop a quality-centric automatic live platform for all concerned.

Haq et al. (2020) presented data showing that most of the papers originated from Army Medical College are published in local Pakistani journals with Journal of the College of Physicians and Surgeons Pakistan and Journal of the Pakistan Medical Association being their most favorites. In an

invited article for Anaesthesia, Pain & Intensive Care journal, the author argues lack of institutional support, funding and bureaucratic hurdles impeding quality research output from Pakistan (Hussain, 2024). The article, unfortunately, does not provide any statistical analysis of research output from Pakistan.

Zubairi et. al. (2021) present an overview of the EdTech research in Pakistan in their working paper for EdTech Hub in collaboration with The World Bank and UKaid. They also note the paucity of research output related to EdTech coming out of Pakistan. The performance of Pakistani journals and papers published in these journals from Pakistan is evaluated in (Khan et al., 2015). Some studies [13] track the performance of researchers in the domain of library and information sciences over the past six decades (Anwar & Jan, 2017).

RESEARCH METRICS

Bibliometric indicators are quantitative measures used to evaluate the impact, quality, and influence of research outputs such as articles, journals, authors, and institutions. Below is a detailed overview of key metrics.

4.1. Citation Count

Definition: The total number of times a research article, author, or institution's work has been cited in other scholarly publications.

Purpose: Measures the direct influence of a research output based on how often others reference it.

Example: If a paper is cited 150 times in other indexed publications, its citation count is 150.

Criticism / Shortcomings:

Field-dependency: Some fields (e.g., medicine) inherently generate more citations than others (e.g., mathematics).

Time-lag: New papers take time to accumulate citations, making comparisons unfair.

Quantity ≠ Quality: A high citation count doesn't necessarily reflect research quality; controversial or flawed studies may also attract citations.

4.2. The h-Index

Definition: Proposed by Hirsch (2005), the h-index of an author is h if they have h papers each cited at least h times.

Purpose: Designed to balance productivity and impact by considering both number of publications and citation counts.

Example: An author with 10 papers where 6 papers have ≥6 citations each, and the rest fewer, has an h-index of 6.

Criticism / Shortcomings:

Ignores highly cited papers: Publishing a paper cited 10,000 times does not boost the h-index beyond a threshold.

Disadvantages early-career researchers: Requires time to accumulate.

Field differences: Not comparable across disciplines with varying citation norms.

4.3. The h5-Index

Definition: A variant of the h-index used by Google Scholar Metrics. It calculates the h-index based on articles published in the last 5 complete calendar years.

Purpose: Highlights recent research influence, avoiding bias toward older, well-cited works.

Example: If, in the last 5 years, a journal has 25 papers each cited at least 25 times, its h5 index = 25.

Criticism / Shortcomings:

Database-dependent: Uses Google Scholar's coverage, which may include non-peer-reviewed sources.

Short timeframe: Can favor rapidly evolving fields but disadvantage long-cycle disciplines (e.g., philosophy).

4.4. Journal Impact Factor (JIF)

Definition: Developed by Garfield (1972), JIF is the average number of citations received in a given year by articles published in a journal during the previous two years.

$$JIF = \frac{Citations\ in\ year\ X\ to\ items\ published\ in\ years\ X-1\ and\ X-2}{Number\ of\ citable\ items\ published\ in\ years\ X-1\ and\ X-2}$$

Purpose: Designed to assess the relative influence of journals within a field.

Example: If a journal published 200 articles in 2022–2023, and in 2024 these were cited 800 times, it's JIF = 800 / 200 = 4.0.

Criticism / Shortcomings:

Misused at author level: Designed for journals, not individual researchers.

Citation window bias: Two years may be too short for disciplines with slow citation patterns.

Gaming the metric: Journals may encourage self-citation or publish more review articles to inflate JIF.

4.5. SCImago Journal Rank (SJR)

Definition: A prestige-weighted journal metric that measures a journal's influence based on both citations received and the prestige of citing journals.

Purpose: Developed to refine JIF by accounting for where citations come from, not just how many.

Example: A citation from Nature carries more weight than one from a small, low-impact journal.

Criticism / Shortcomings:

Opaque algorithm: The weighting method is less transparent than JIF.

Field bias: Journals in fields with naturally high citation rates still dominate rankings.

4.6. Quartiles (Q1, Q2, Q3, Q4)

Definition: Journals are divided into four quartiles based on their ranking within a specific subject category, usually using JIF or SJR:

Q1: Top 25%

Q2: 25–50%

Q3: 50–75%

Q4: Bottom 25%

Purpose: Provides a relative standing of a journal within its discipline, aiding funding, publication, and evaluation decisions.

Example: A journal ranked 15th out of 120 in its category is in Q1.

Criticism / Shortcomings:

Category dependency: A journal may be Q1 in one field but Q3 in another.

Encourages "prestige chasing": Authors may prioritize Q1 journals over research relevance.

4.7. Eigenfactor Score

Definition: Measures a journal's total importance to the scientific community, considering both citation counts and the influence of citing journals over a 5-year period.

Purpose: Designed as an alternative to JIF to reward quality-weighted citations.

Example: If Journal A receives 5,000 citations mostly from top-tier journals, while Journal B receives 5,000 citations mostly from low-tier journals, Journal A will have a higher Eigenfactor.

Criticism / Shortcomings:

Complexity: Less intuitive than simple citation counts or JIF.

Size bias: Larger journals tend to have higher scores.

4.8. Altmetrics (Alternative Metrics)

Definition: Measures the online attention and social impact of research, including mentions on Twitter, news media, blogs, policy documents, etc.

Purpose: Complements traditional citation-based metrics by tracking real-time societal engagement.

Example: A paper widely shared on Twitter and cited in policy briefs but not yet in academic papers can have a high Altmetric Attention Score.

Criticism / Shortcomings:

Popularity ≠ quality: A sensational but flawed paper may get massive online attention.

Manipulation risk: Metrics can be artificially inflated through bot-driven promotion.

OUR QUALITY INDEX: PEER PERCEPTION INDEX

As described earlier, all major quality metrics used in journal ranking have their shortcomings and criticism. The impact factor is especially misused as this has become a de-facto standard in academia across the world. Many low quality and borderline predatory journals have managed to achieve a good impact factor.

In order to rank journals and conferences based on the reputation/perception among top researchers, and academicians affiliated with top universities and organizations, we use our novel idea of calculating the PEER PERCEPTION INDEX of a journal based on the following criteria.

λ_{c1} = No. of research publications in the journal/conference with first author affiliated to universities ranked 1st – 50th in THE global ranking.

λ_{c2} = No. of research publications in the journal/conference with first author affiliated to universities ranked 51st – 100th in THE global ranking.

λ_{c3} = No. of research publications in the journal/conference with first author affiliated to universities ranked 101st – 150th in THE global ranking.

λ_{c4} = No. of research publications in the journal/conference with first author affiliated to universities ranked 151st – 200th in THE global ranking.

λ = Total no. of publications in the journal/conference for the span of study

PPI = PEER PERCEPTION INDEX of the Journal/Conference

$$\mathbf{PPI} = \left[\mathbf{0.5}\left(\frac{\boldsymbol{\lambda_{c1}}}{\boldsymbol{\lambda}}\right) + \mathbf{0.25}\left(\frac{\boldsymbol{\lambda_{c2}}}{\boldsymbol{\lambda}}\right) + \mathbf{0.15}\left(\frac{\boldsymbol{\lambda_{c3}}}{\boldsymbol{\lambda}}\right) + \mathbf{0.1}\left(\frac{\boldsymbol{\lambda_{c4}}}{\boldsymbol{\lambda}}\right)\right] \times \mathbf{100}$$

Putting things into perspective, the formula essentially gives 50% of the weightage to the papers coming to journal/conference from our top bracket of universities/organizations (1st – 50th). The weightage decreases as we move to the lower brackets. Essentially, the journals/conferences having higher PPI would have the higher prestige. In other words, those are the venues where top universities/organizations publish their research.

*We use Times Higher Education (THE) ranking of universities for calculating PPI. Organizations such as Google, Facebook etc. who actively publish their research have been assigned rank after our inhouse deliberation.

5.1. Rationale behind Formulation of Peer Perception Index

Unfortunately, all major journal quality metrics are based on citations of the journals per paper. With the career growth of the academicians and researchers, as well as their prestige depending on these metrics, people have invented ways to influence these metrics to their advantage, the so-called paper milling, and bulk citation trends. A poor-quality paper being published in a predatory journal citing hundred research papers increases the citation count of all those papers. In our opinion, this compromises these metrics.

Our proposed journal Peer Perception Index (PPI) is inherently difficult to be influenced by any of these tactics. To influence our PPI, one has to convince researchers and scientists affiliated with globally top-ranked universities to publish in a particular journal whose PPI is required to be influenced. On top of that, succeeding in convincing a few top scientists will not significantly enhance our PPI. It will require a significant number of papers from top places. Moreover, with our constraint of first author papers, adding a collaborator from top universities will not matter, the papers have to be mainly conceived and authored at the top places.

This makes influencing our PPI very hard for any advantage.

CATEGORIZING JOURNAL/CONFERENCES

All journals/conferences assessed have been categorized into four categories based on their PPI scores. These categories are as follows:

- **Alpha (α) Journals/Conferences:** These are the journals/conferences scoring PPI higher than 15.00 i.e., $\mathbf{PPI \geq 15.00}$. In our opinion, these are the most prestigious journals/conferences, highly regarded by the research community.
- **Beta (β) Journals/Conferences:** These are the journals/conferences scoring PPI between 15.00 and 10.00 i.e., $\mathbf{15.00 < PPI \geq 10.00}$. In our opinion, these are still well-known and well-respected journals/conferences.
- **Gamma (γ) Journals/Conferences:** These are the journals/conferences scoring PPI between 10.00 and 5.00 i.e., $\mathbf{10.00 < PPI \geq 5.00}$. In our opinion, these are low quality journals/conferences, and should be considered as such.
- **Delta (δ) Journals/Conferences:** These are the journals/conferences scoring PPI between 5.00 and 2.00 i.e., $\mathbf{5.00 < PPI \geq 2.00}$. In our opinion, these are borderline predatory journals with negative repute among academic peers.

Any journal/conference which has been assessed by our system, and has PPI score less than 2.00 has not been assigned a category (**NONE**), indicating the journal/conference is not worth a category. Such journals/conferences have extremely negative opinion among academic peers.

CALCULATING PPI OF JOURNALS/CONFERENCES

Finding PPI scores of each journal requires carefully analyzing all publications in the journal for the affiliations of their first authors. This is a tedious task. We followed two methods for the collection of data which are described below.

7.1. Web Scraping

Web scraping is a powerful tool for automating the collection of large amounts of data from websites. It can be used to extract structured information from web content according to desired requirements. This is a very time-consuming task if done manually. For our purposes, we designed sophisticated web crawler that collects data from the portals and websites of different academic publishers and then analyze the affiliations of authors from the published research articles. Our crawlers automated the data extraction process.

The crawlers were developed in Python, which provides libraries for making HTTP requests to retrieve web pages and for parsing HTML documents. The process starts by identifying the websites that provide the list of published papers along with the information about the authors and their affiliations. For websites which contain static HTML content, HTTP requests along with HTML parsing are sufficient to retrieve the contents. But more modern websites have dynamic content which is loaded via JavaScript at runtime. These websites then require interaction with a simulated user to retrieve the html contents and extract the desired data. This is done by creating a bot that can access these pages and select the desired fields to properly load the HTML contents.

Our tool was designed to visit the website of each venue to locate papers published for each edition over the last 25 years. For each published paper, the title of the paper along with all the authors and their affiliations were extracted and saved to a database. Each field was being extracted by first analyzing a sample webpage for research papers belonging to the venue. Filters were implemented to extract the desired data. Once the data from all the journals is gathered into the database, various analyses can be easily undertaken on the data.

The overall process for gathering data involves sending many network requests which is likely to encounter rate limiting and blocking. To efficiently handle a large number of requests and speed up the data gathering process, we sent asynchronous requests. This non-blocking approach significantly reduced the overall processing time, particularly when dealing with large datasets or multiple web pages. Additionally, asynchronous programming allows for better resource management and improved error handling, ensuring that the crawler continues functioning even if individual requests fail or are delayed.

However, after designing the web crawler, soon as we started running them, and automatically accessing bulk of web pages of research journals, the Web of Science (WoS) approached HEC fearing of a suspicious activity going on. On the interference of HEC, we had to stop running our web crawlers and visited HEC for clarification.

We continued using these web crawlers for conferences whose data is not generally available in Web of Science (WoS).

7.2. The WoS Subscription

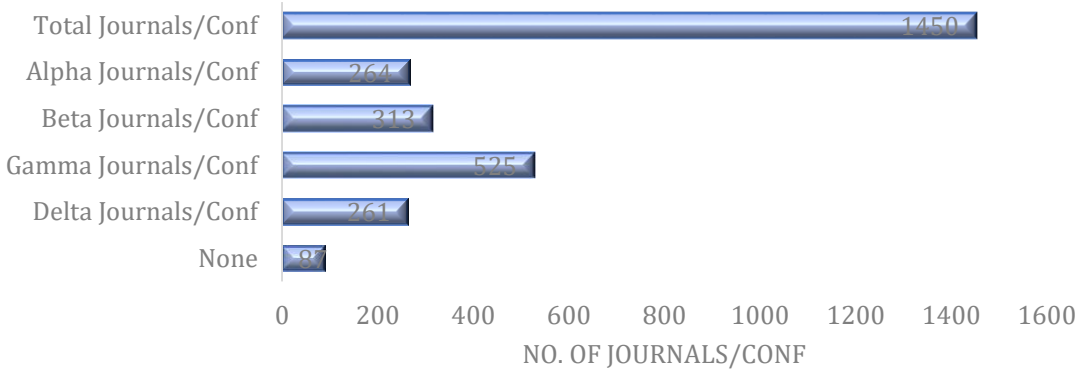
Subsequently, HEC advised us to use WoS software subscription to collect the required data as bulk access to research journals' websites via automated crawling violates HEC's subscription agreement with the Web of Science. HEC officials were gracious enough to grant us access to WoS software in their own premises.

The WoS software contains data of all journals of our interest. However, collecting affiliations data from the software required manual querying, journal by journal. This is a tedious manual process, but we continue to collect the required data.

HOW EFFECTIVE IS PPI?

We have collected and successfully analyzed data for 1450 journals and conferences. We have been able to calculate PPI score for each of 1450 venues, categorize them based on PPI score into four categories (Fig. 1). Interestingly, there are 87 journals which have PPI lower than 2.00, being placed in none of the categories.

Figure 1: Distribution of Journals in Categories based on Peer Perception Index



Source: Authors' computations.

To see the effectiveness of PPI and our categorization system, Table 1 shows a small list of journals which are highly regarded within the respective academic community as elite journals, and have high traditional metrics such as impact factor, and quartile ranking. The PPI scores and associated category of these journals is also high, indicating our ranking process is effective.

Table 1 shows the list of journals which are highly regarded as top journals, have high traditional metrics (impact factor, quartile), and also turn out to be at the top in PPI scores and categories. The list is not exhaustive; only few journals are shown for comparison.

Table 1: List of Top Journals

Journal Name	Impact Factor	Quartile	Quartile Rank	PPI	PPI-Category
Nature Electronics	40.9	Q1	1/352 (Engg., Electrical & Electronics)	21.5	Alpha
Science Robotics	27.5	Q1	1/46 (Robotics)	23.7	Alpha
Foundations and Trends in Machine Learning	25.4	Q1	1/197 (Computer Science, AI)	27.4	Alpha
Nature Machine Intelligence	23.9	Q1	1/169 (CS, Interdisciplinary Applications)	23.7	Alpha
T-PAMI	18.6	Q1	3/352 (Engg., Electrical & Electronics)	16.6	Alpha
Foundations and Trends in Information Retrieval	12.9	Q1	8/247 (CS, Information Systems)	16.9	Alpha
IEEE Transactions on Robotics	10.5	Q1	4/46 (Robotics)	17.8	Alpha

Source: Authors' computations.

There is other side of the picture too. There are many journals which are regarded highly within the community, often considered as top venues, but have low impact factors and quartiles. The traditional metrics cannot capture their true prestige. This is where our PPI score comes in. Table 2 shows some of such journals, where impact factor and quartile ranking fail, our PPI scores keep them in the Alpha category.

Table 2 shows the list of known and highly regarded journals which have low impact factors and quartile ranking. They are aptly placed in Alpha category by our ranking system.

Table 2: Well-known and Highly regarded Journals

Journal Name	Impact Factor	Quartile	Quartile Rank	PPI	PPI-Category
IEEE Computer Architecture Letters	1.4	Q4	48/59 (CS, Hardware & Architecture)	16.8	Alpha
ACM Transactions on Algorithms	1.4	Q3	200/331 (Mathematics, Applied)	15.7	Alpha
SIAM Journal on Computing	1.6	Q2	140/331 (Mathematics, Applied)	21.7	Alpha
SIAM Journal of Financial Mathematics	1.8	Q3	36/67 (Mathematical Methods)	20.3	Alpha
IEEE Solid-state Circuit Letters	2.0	Q3	183/352 (Engg., Electrical & Electronics)	22.3	Alpha
Journal of the ACM	2.5	Q2	52/143 (CS, Theory & Methods)	23.2	Alpha
Mathematical Programming	2.5	Q2	45/106 (Operations Research)	17.5	Alpha
IEEE JxCDC	2.7	Q3	39/59 (CS, Hardware & Architecture)	22.2	Alpha
Cambridge Journal of Mathematics	2.8	Q1	39/489 (Mathematics)	23.2	Alpha
ACM TRETS	2.8	Q2	19/59 (CS, Hardware & Architecture)	17.0	Alpha
IEEE Transactions on Information Theory	2.9	Q3	183/352 (Engg., Electrical & Electronics)	18.1	Alpha
IEEE TCAD	2.9	Q2	154/352 (Engg., Electrical & Electronics)	17.3	Alpha
IEEE Security & Privacy	3.0	Q2	40/131 (CS, Software Engineering)	17.2	Alpha
Autonomous Robots	4.3	Q2	17/46 (Robotics)	15.3	Alpha
IEEE Trans. Biomed. Circuits Syst.	4.9	Q2	107/352 (Engg., Electrical & Electronics)	18.5	Alpha
Journal of Machine Learning Research	5.2	Q2	54/197 (Computer Science, AI)	23.0	Alpha
IEEE Robotics & Automation Letters	5.3	Q2	12/46 (Robotics)	17.5	Alpha
ACM Transactions on Human-Robot Interaction	5.5	Q2	14/46 (Robotics)	16.7	Alpha

IEEE Journal of Solid-state Circuits	5.6	Q1	74/352 (Engg., Electrical & Electronics)	23.5	Alpha
Journal of Mechanics and Physics of Solids	6.0	Q2	21/79 (Physics, Condensed Matter)	18.3	Alpha
IEEE Control Systems Magazine	6.3	Q2	24/84 (Automation, Control Systems)	20.2	Alpha

Source: Authors' computations.

The story is not over yet. The traditional metrics place some journals in high rankings (high impact factors, Q1) while the community does not rate them very high. Our ranking system works perfectly in that scenario as well. Table 3 shows some of these journals, with inflated impact factors, and quartile ranking. Our ranking system gives them low PPI scores and place them in lower categories. In conclusion, our ranking system has the ability to distinguish the good, the bad, and the ugly.

Table 3 shows list of journals with high impact factor and low prestige, aptly being placed in lower categories by our ranking system.

Table 3: Journals with High Impact Factor and Low Prestige

Journal Name	Impact Factor	Quartile	Quartile Rank	PPI	PPI-Category
Nano – Micro Letters	36.3	Q1	4/179 (Physics, Applied)	8.8	Gamma
International Journal of Information Mgmt.	27.0	Q1	1/160 (Information and Library Science)	4.5	Delta
Carbon Energy	24.2	Q1	6/140 (Nanoscience and Nanotechnology)	5.6	Gamma
Materials Today	22.0	Q1	16/438 (Material Science, Multidisciplinary)	7.0	Gamma
Applied Catalysis B-Environment and Energy	21.1	Q1	1/81 (Engineering, Environmental)	5.8	Gamma
Environmental Chemistry Letters	20.4	Q1	8/358 (Environmental Sciences)	3.5	Delta
Information Fusion	15.5	Q1	2/143 (CS, Theory & Methods)	5.3	Gamma
Artificial Intelligence Review	13.9	Q1	9/197 (Computer Science, AI)	2.8	Delta
International Journal of Mining Science and Tech.	13.7	Q1	1/31 (Mining and Mineral Processing)	3.0	Delta
Artificial Intelligence in Agriculture	12.4	Q1	19/197 (Computer Science, AI)	3.5	Delta
Sustainable Cities and Society	12.0	Q1	10/91 (Green & Sustainable Science)	7.3	Gamma
Protection and Control of Modern Power Systems	11.9	Q1	16/352 (Engg., Electrical & Electronics)	3.2	Delta
IEEE Transactions on Fuzzy Systems	11.9	Q1	10/352 (Engg., Electrical & Electronics)	6.7	Gamma
IEEE Transactions on Cybernetics	10.5	Q1	2/32 (CS, Cybernetics)	7.0	Gamma
Journal of Energy Storage	9.8	Q1	29/170 (Energy & Fuels)	3.7	Delta
JESTECH	5.4	Q1	18/171 (Engg., Multidisciplinary)	0.7	None
IEEE Access	3.6	Q2	47/119 (Telecommunication)	4.2	Delta

Source: Authors' computations.

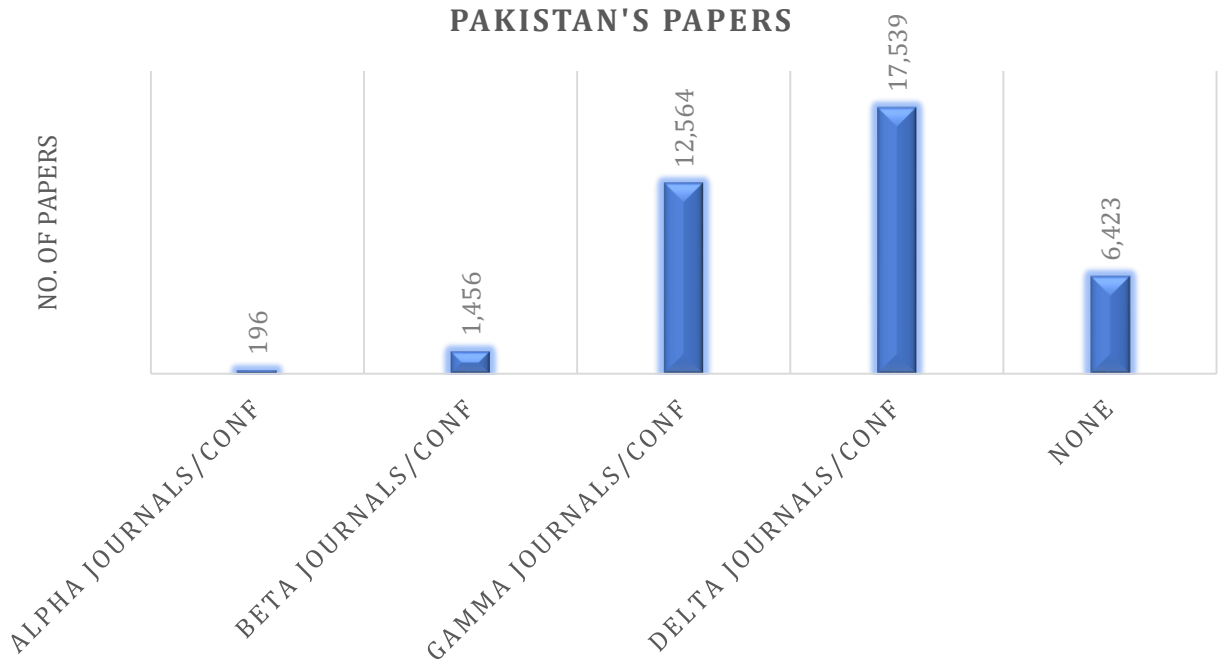
RESUTLS

9.1. Distribution of Papers from Pakistan

The papers with first author affiliation from Pakistan have appeared in all four PPI categories as well as in journals not categorized by the PPI (category: None). Since 2008, there are 38,178 journal papers with first author affiliation from Pakistan in 1450 engineering and computer science journals. While this looks like a good number, the depressing situation is that only 196 (0.51%) of these papers have been published in Alpha category journals. Figure 2 shows the distribution in each category. Unfortunately, most of these papers (17,539) have appeared in the last category (Gamma), while 6,423 papers have appeared in 'None' category.

Figure 2 shows distribution of Pakistani papers in PPI categories. Unfortunately, only 196 papers appeared in Alpha category, and 1,456 in Beta category over the past 18 years. The numbers are significantly large in lower categories.

Figure 2: Distribution of Pakistani Papers in PPI Categories



Source: Authors' computations.

Digging deeper into the distribution, we find that maximum number of Pakistani papers in an Alpha ranked journal is only 15, in Journal of Nuclear Medicine. Table 4 shows top five journals (category-wise) where Pakistani papers have appeared the most. While the situation is abysmal in top categories (Alpha and Beta), one journal stands out; **Physics of Plasmas**. This is the only well – reputed, Beta category journal with respectable Pakistani representation (453 papers). Research groups working in plasma physics in Pakistan, notably in Quaid-e-Azam university, are to be commended for consistently publishing in quality journals. Interestingly, favorite journals of

Pakistanis, across categories, is IEEE Access (3,071 papers) which is ranked in the lowest category (Delta).

Table 4: Journals with Highest Number of Papers from Pakistan in Each Category

Journal Name	PPI	PPI-Category	No. of Pakistani Papers
Journal of Nuclear Medicine	15.74	Alpha	15
IEEE Tran. on Computer-Aided Design of Integrated Circuits and Systems	17.26	Alpha	10
American Journal of Human Genetics	18.95	Alpha	9
ACS Nano	15.04	Alpha	7
IEEE Transactions on Biomedical Circuits and Systems	18.52	Alpha	6
Physics of Plasmas	10.57	Beta	453
Applied Energy	10.02	Beta	55
Energy Policy	11.07	Beta	50
Journal of Plasma Physics	11.55	Beta	40
IEEE Communications Magazine	11.23	Beta	26
PLoS ONE	9.98	Gamma	1,972
Scientific Reports	7.73	Gamma	1,941
Sensors	5.06	Gamma	714
Journal of Cleaner Production	5.72	Gamma	289
Renewable & Sustainable Energy Reviews	6.04	Gamma	246
IEEE Access	4.20	Delta	3,071
Sustainability	3.44	Delta	1,199
Heliyon	3.14	Delta	815
Results in Physics	2.04	Delta	639
Energies	3.70	Delta	602
Arabian Journal for Science and Engineering	1.07	None	719
Alexandria Engineering Journal	0.73	None	557
Desalination and Water Treatment	1.65	None	493
Case Studies in Thermal Engineering	1.79	None	487
Journal of Intelligent & Fuzzy Systems	1.21	None	403

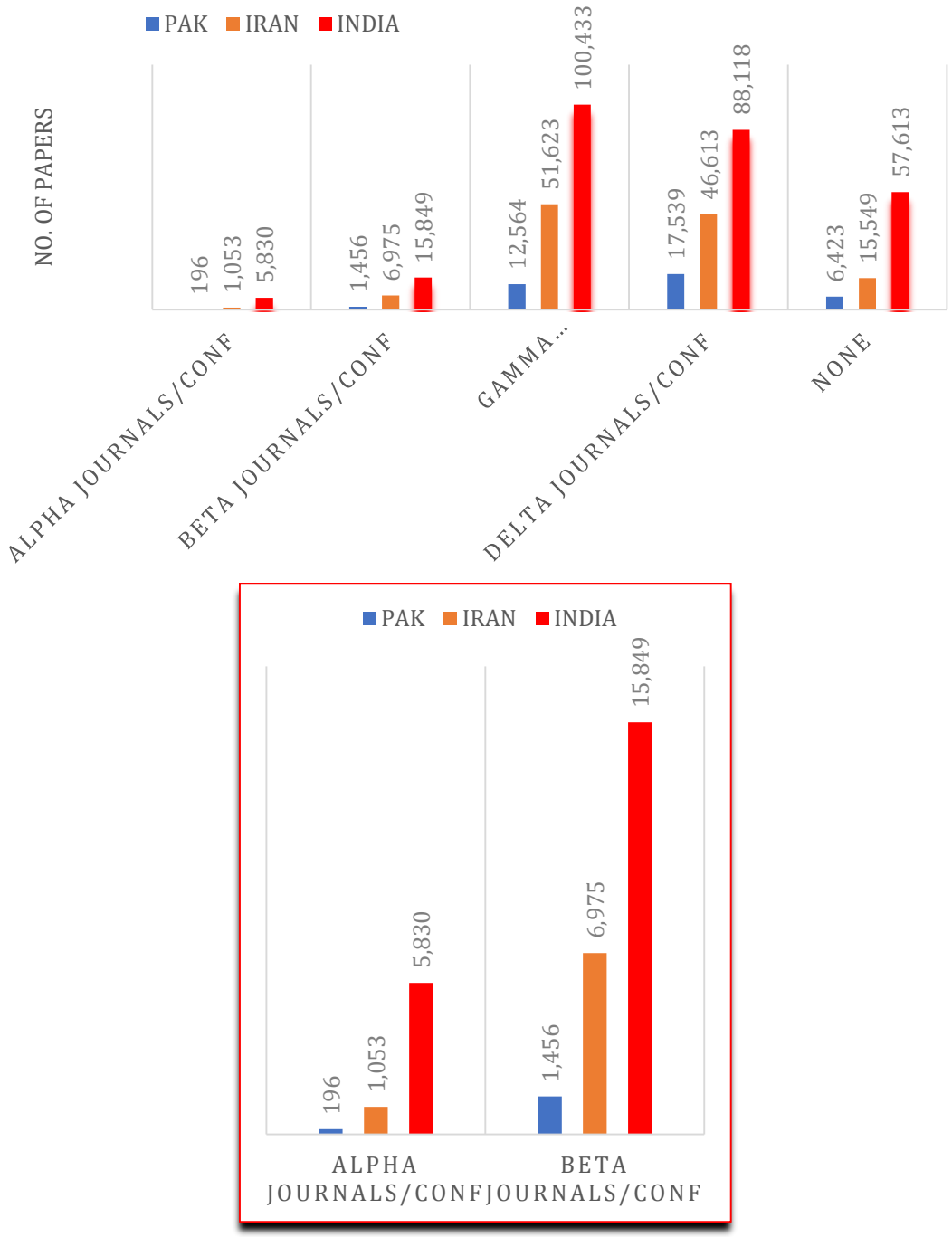
Source: Authors' computations.

9.2. Pakistan's Comparison with Neighboring Countries

We compare performance of Pakistan with neighboring countries i.e., India and Iran. Both of these countries have similar socio-economic conditions and similar research challenges. Figure 3 shows number of first author papers from each country in all PPI categories. Unfortunately, Pakistan lags behind each neighbor in number of papers in each category by a significant margin.

We would like to especially focus on top two categories (Alpha and Beta). While Pakistan has little to no representation in these categories (especially Alpha category), both India and Iran have significantly higher number of papers in both categories (enlarged section in Figure 3).

Figure 3: Comparison of Pakistan, India and Iran in terms of Number of Papers in each Category



Note: Comparison in Alpha and Beta categories is enlarged in the bottom figure for impact.
Source: Authors' computations.

While India and Iran publish more papers than Pakistan, their researchers are also aiming for the representation at the top; we on the other hand, are only focusing on the bottom.

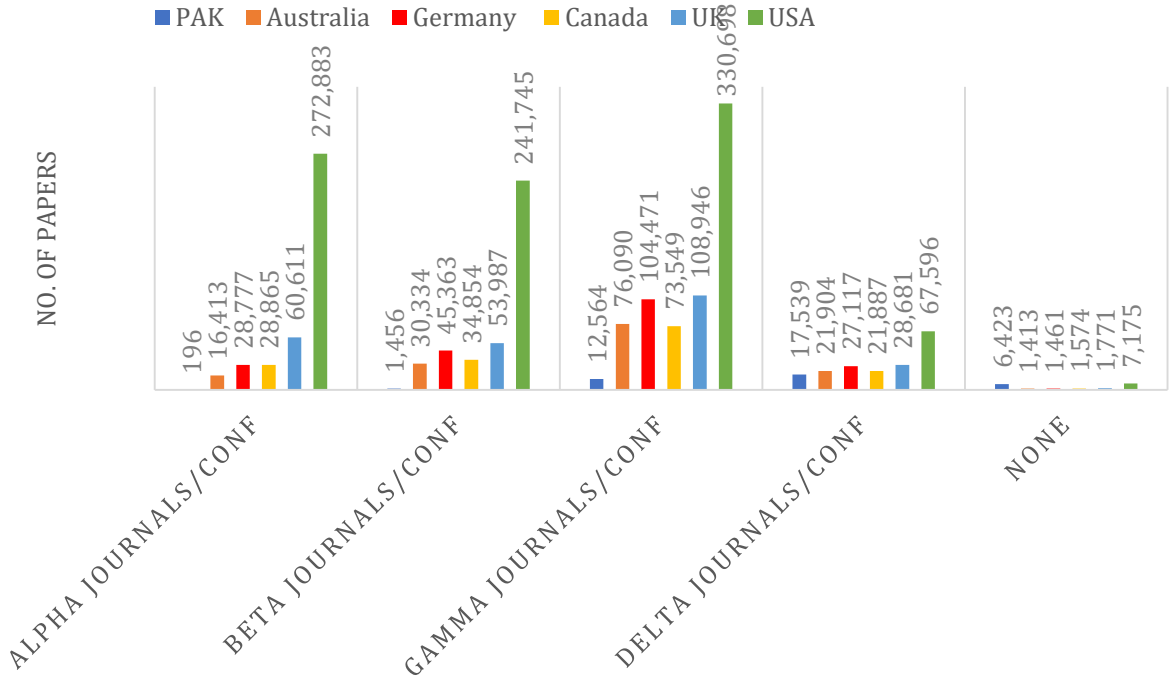
9.3. Pakistan's Comparison with Technologically Advanced Countries

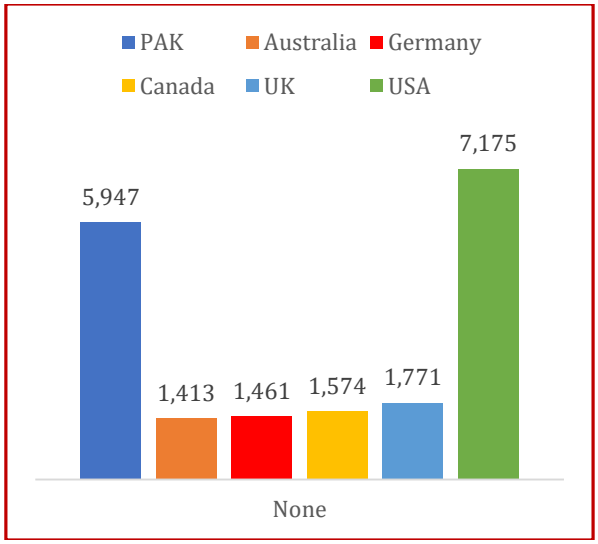
The stark difference in publishing patterns is clearly visible when we compare Pakistan's publishing patterns with those of technologically advanced countries. It must be noted that we do not expect Pakistan to compete with these countries; these countries having high research spending are expected to publish much more than Pakistan. However, the interesting fact to note is the difference in publishing pattern i.e., the focus of technologically advanced countries on publishing in top categories (Alpha, Beta) versus the focus on Pakistan on publishing in low categories. Figure 4 shows the comparison of Pakistan with USA, UK, Germany, Australia and Canada.

The data appears more relevant and easier to understand when represented in terms of percentage i.e., percentage of papers in each category by respective countries. While Pakistan publishes only 0.51% of its papers in Alpha category, technologically advanced countries have this number well above 10%, with USA topping at 29.66% (Figure 5). The situation reverses if we compare these countries in bogus journals in 'None' category. While other countries publish less than 1% of their papers in this category, Pakistan publish a whopping 16.82% of its papers in these journals (Figure 5).

Our policies need to change to avert this situation; we need to increase our representation at Alpha journals.

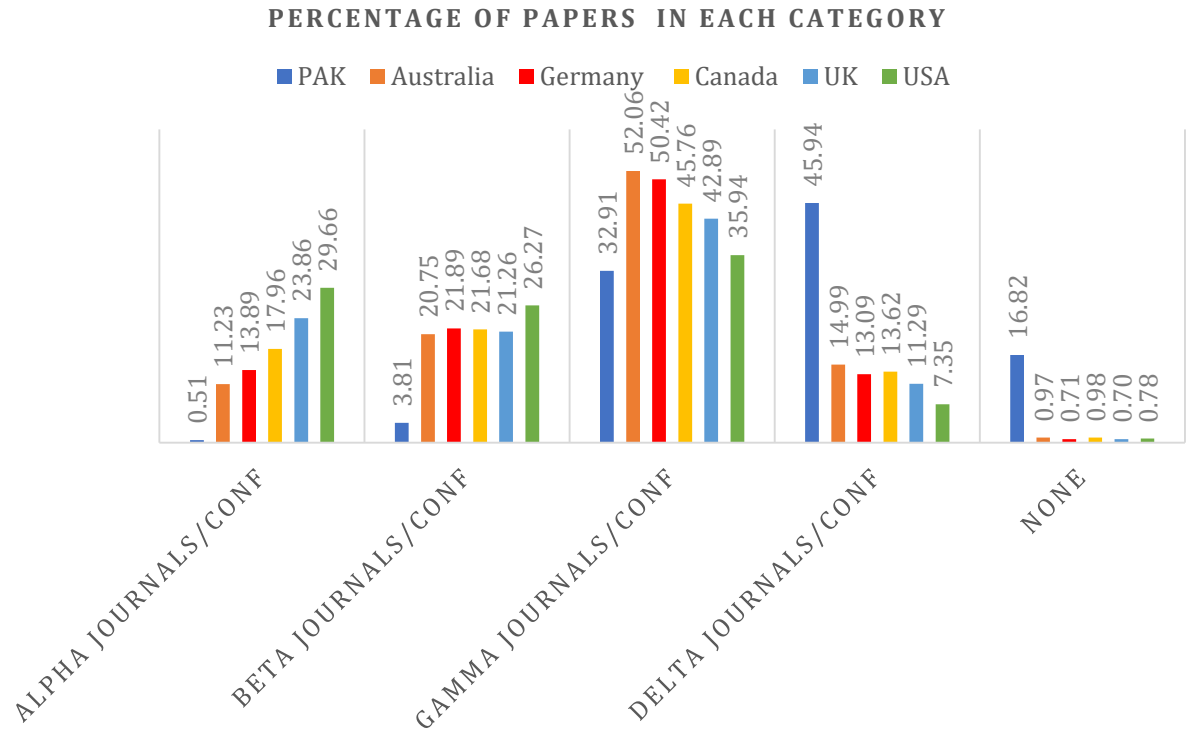
Figure 4: Comparison of Total Papers from Pakistan with Those from Technologically Advanced Countries





Note: The comparison in 'None' category is enlarged for emphasis where it can be seen that Pakistan publishes almost 4 times more than UK, Germany, Australia and Canada in this category.
Source: Authors' computations.

Figure 5: Pakistan's Comparison with Technologically Advanced Countries in Terms of Percentage of Their Papers in Each Category



Note: See the inverse nature of data in Alpha and None category. While we publish nothing compared to these countries in Alpha category, we are miles ahead of them in 'None' category.
Source: Authors' computations.

9.4. Big Journals with Zero Pakistani Papers

Very interesting, there is a long list of world's most respected and top journals (in Alpha and Beta category) where not even a single paper from Pakistan has been published in past 18 long years. This is, in our opinion, the most astonishing result of our study. These are 267 journals which we have listed down in Annex – I attached at the end of this report. This list alone speaks volumes about our research priorities. It is also reiterated that the data spans 18 years which is a considerably long period not to have been able to publish even a single paper in 267 journals. A similar list at Annex-II lists Alpha and Beta category journals with each having 1 – 5 papers from Pakistan.

9.5. Pakistan's Favorite Journals

Table 5 shows journals where first author papers from Pakistan are more than 500. There are 11 such journals with all of them unfortunately ranked in low categories (3 Gamma, 6 Delta, and 2 None). Apart from PPI categories, all of them are well – known predatory, bogus journals. More interestingly, 10 out of these 11 journals are fully open – access, meaning that you have to pay significant amount of money in the name of Article Processing Charges (APCs) to publish each journal. The only non – open – access journal in the list is 'Arabian Journal of Science and Engineering', that too is very low quality with PPI score of 1.07 (None category).

Table 5: Journals with Number of First Author Publications from Pakistan Greater than 500

Sr. No.	Name of the Journal	PPI	PPI-Category	No. of First Author Papers from Pakistan
1	IEEE Access	4.20	Delta	3,071
2	PLoS ONE	9.98	Gamma	1,972
3	Scientific Reports	7.73	Gamma	1,941
4	Sustainability (MDPI)	3.44	Delta	1,199
5	Heliyon	3.14	Delta	815
6	Arabian Journal for Science and Engineering	1.07	None	719
7	Sensors (MDPI)	5.06	Gamma	714
8	Results in Physics	2.04	Delta	639
9	Energies (MDPI)	3.70	Delta	602
10	Alexandria Engineering Journal	0.73	None	557
11	Mathematics (MDPI)	2.60	Delta	506

Note: All except 'Arabian Journal of Science and Engineering' are open – access.
Source: Authors' computations.

9.6. Understanding Financial Impact on Government's Exchequer

Understanding financial impact of these open – access publications is a challenging task. There are many open – access journals, with a lot of papers from Pakistan published every year. Exact financial data can be obtained from individual institutions.

To estimate the impact of open access publications on the exchequer, we selected all open access journals where there are at least 25 first author papers from Pakistan. There are 61 such open access journals with 18,559 papers from Pakistan. We traced the publication year of each paper, and the associated APC charges (per article) for the year of publication staring 2008 until 2025. This helped

us find out exact amount of APC charges for all these papers. The total amount turns out to be **US $36,860,579.** This is a staggering amount of money, sent out to very low-quality journals. The process continues.

The exact data is this respect is available in Annex – IV. It must be noted that there are still other open access journals where number of papers from Pakistan is less than 25 (which have not been included in this study). It must also be noted that it is assumed that APC charges of all articles were paid from Pakistan which is a reasonable assumption since all papers have first authors affiliated with a Pakistani institution. Some exceptions to this assumption may exist, and it is nearly impossible to trace back who actually paid the APC charges.

9.7. A Look at National Centers' (NCs) Performance

Govt. of Pakistan, through Higher Education Commission (HEC), launched and funded seven National Centers on various emerging technologies in 2018. These centers are funded through Public Sector Development Program (PSDP), with each center receiving hundreds of millions of budgets each year with a focus on developing market-ready technologies in their respective domains. Each center has a headquarter in a university (e.g., National Center of AI is headquartered in NUST), with multiple labs associated with the center. These labs are located at different universities across the country. It must be noted that these National Centers are not degree awarding institutions on their own, the only purpose of their existence is to focus on new research avenues produce market-ready technologies.

Producing high quality research publications, appearing in top journals/conferences, and thereby positively affecting our university ranking is the key responsibility of these centers. Unfortunately, despite millions in funding, these centers remain unable to produce any significant research papers in Alpha category journals in their respective fields.

For each National Center, we select a list of journals relevant to the domain of the center, and see the number of papers in each journal (since 2008). Annex – III shows the data for each National Center. For perspective, we show the performance of the USA in the same journals, over the same period. It must be noted that number of Pakistani papers appearing at Annex – III are not necessarily coming out of these National Centers. They could be from Pakistanis not affiliated with these centers. However, the fact that there is no representation in top venues across Pakistan is the most striking outcome.

9.8. The Conference Conundrum

The Higher Education Commission (HEC) does not accept a conference publication as a valid paper for faculty promotion, and other faculty evaluation mechanisms (e.g., grant applications). It only accepts W category journal articles. However, the world is changing, and researchers from across the world, especially in computer science and electrical engineering domains, are focusing more and more on conferences.

Fortunately, our Peer Perception Index (PPI) does not differentiate between a conference or a journal. If a conference's scores PPI $\geq$ 15.00, it is placed in Alpha category, and is as prestigious as Alpha journals. Similar is the case with the conferences lying in other categories. We have scanned through 40 well – known conferences, and some of them have been placed in Alpha and Beta

categories. Table 6 shows the list of these conferences. Some of these conferences have PPI score well above the best journals in the world, indicating top universities publish in these conferences. We, therefore, give our recommendation in the Policy Intervention section to include Alpha and Beta conferences in HEC criteria and consider their papers equal to corresponding category journal.

Table 6: Conferences Which Have Been Placed in Alpha and Beta Category

Sr. No.	Conference	PPI	PPI-Category
1	USENIX Symposium on Networked Systems Design and Implementation (NSDI)	30.82	Alpha
2	ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)	27.80	Alpha
3	Annual International Symposium on Computer Architecture (ISCA)	25.15	Alpha
4	IEEE ACM International Symposium on Microarchitecture (MICRO)	24.35	Alpha
5	Conference on Empirical Methods in Natural Language Processing (EMNLP)	23.80	Alpha
6	Conference on Neural Information Processing Systems (NeurIPS)	23.65	Alpha
7	IEEE Symposium on Foundations of Computer Science	22.44	Alpha
8	IEEE Symposium on Security and Privacy	22.29	Alpha
9	USENIX Conference on Security Symposium	20.39	Alpha
10	IEEE Conference on Computer Vision and Pattern Recognition (CVPR)	19.21	Alpha
11	Annual Meeting of the Association for Computational Linguistics (ACL)	19.08	Alpha
12	IEEE International Conference on Computer Vision (ICCV)	18.87	Alpha
13	International Conference on 3D vision (3DV)	17.36	Alpha
14	ACM Conference on Embedded Networked Sensor Systems	16.21	Alpha
15	ACM Conference on Computer and Communications Security (CCS)	15.92	Alpha
16	ACM International Conference on Web Search and Data Mining (WSDM)	15.79	Alpha
17	IEEE European Symposium on Security and Privacy (EuroS&P)	15.51	Alpha
18	The ACM web Conference	14.60	Beta
19	Annual Computer Security Applications Conference	14.15	Beta
20	International Conference on Visualisation, VIS	13.98	Beta
21	International Conference on Mobile Computing and Networking (MobiCom)	13.97	Beta
22	IEEE International Conference on Human-Robot Interaction	13.59	Beta
23	IEEE International Conference on Solid-State Circuits (ISSCC)	13.43	Beta
24	IEEE Workshop on Applications of Computer Vision (WACV)	13.11	Beta
25	Pacific (formerly Asia-Pacific APVIS) Visualization Symposium	12.50	Beta
26	American Control Conference (ACC)	12.49	Beta
27	International Conference on Extending Database Technology (EDBT)	12.47	Beta
28	International Conference on Computer Vision Workshops (ICCVW)	11.44	Beta
29	ACM Asia Conference on Computer and Communications Security (Asia-CCS)	11.43	Beta
30	Real-Time Systems Symposium (RTSS)	11.40	Beta
31	International Symposium on Mixed and Augmented Reality (ISMAR)	10.07	Beta

Note: Some of these conferences have PPI scores well above the top journals.
Source: Authors' computations.

THE NATIONAL LIVE PORTAL

As per the requirement of the project, we have built a national live portal to track the publication of Pakistani research papers in top quality research journals and conferences. The weblink of the portal is given below:

https://www.peerperceptionindex.com/

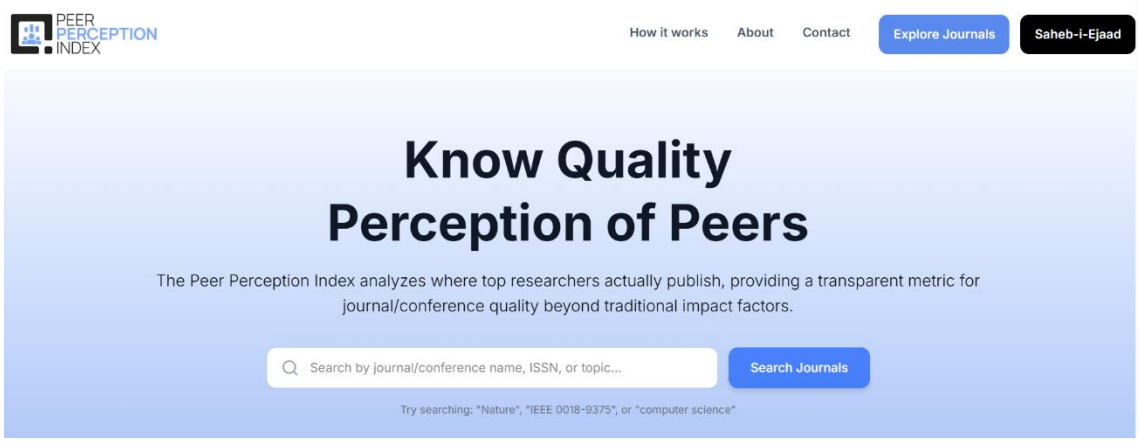
https://ppi-iota.vercel.app/

The first link is where we will eventually host the portal. Currently, due to domain name purchase hosting issues, we have not activated that link. The portal is temporarily hosted and accessible via the second link.

10.1. Peer Perception Index Portal

This is the main portal which contains information about all journals and conferences we have included in our study. Each journal or conferences, when searched via a search bar, generate key publication data for that specific journal or conferences, its PPI score as well as its PPI – category. Figure 6 shows the interface of the portal.

Figure 6: Interface of Peer Perception Index portal



Source: Authors' computations.

10.2. Saheb-i-Ejaad Portal

The Saheb-i-Ejaad portal which can be accessed by clicking the respective tab on the main portal is developed to access Pakistani papers published in Alpha and Beta category journals or conferences. When a specific journal or conference is searched on that portal, it lists all Pakistani papers published in that journal or conference. Figure 7 shows interface of Saheb-i-Ejaad portal.

Figure 7: The interface of Saheb-i-Ejaad Portal

Source: Authors' computations.

CONCLUSION

Over the past 18 years, the number of research publications coming out of Pakistan is steadily increasing under the research policies introduced by the HEC. Unfortunately, the focus on these policies is on increasing the number (quantity) of publications, and not on the quality of these papers. Our study shows a dismal picture when looked through quality. Out of 38,178 research papers originating from Pakistan in engineering and computer science over the past 18 years, only 196 (0.51%) have appeared in top category (Alpha) journals. The bulk of these papers, 17,539 (45.94%), have appeared in the lowest category i.e., Beta. Journals where Pakistanis have published the most during this period are all open – access and of extremely low quality. These research practices exact inverse of research practices in technologically advanced countries which focus more on top category journals. Even our neighbors i.e., India and Iran, publish significantly higher number of papers in top categories than us.

The situation requires immediate policy interventions from the responsible bodies, specifically the HEC. The policy should incentivize publications in top categories, and discourage mass publications in low and extremely low categories.

POLICY RECOMMENDATIONS

Our research shows closer to absolutely on representation of papers from Pakistan in top category of elite journals (Alpha), and very low representation in the next category, Beta. We believe this is due to HEC policies focusing on quantity rather than quality. We recommend following policy changes.

12.1. Way Forward – Paper Recognition Policy

HEC currently recognizes only W – category journal papers for Engineering, Computing and IT disciplines. There is absolutely no distinction between W – category papers. The 1450 journals we have analyzed are all W – category journals as per the HEC criteria. It is pertinent to mention that many journals, especially those categorized as Delta journals in our method, have a very negative perception and extremely low quality.

It is strongly recommended that HEC adopts a clearer quality metric for journal paper evaluation. Our Peer Perception Index can be expanded to include all journals, related to social sciences and medical research. This quality index serves the purpose and should be adopted for evaluation of papers. Below we propose key changes in relevant policies considering adoption of our PPI quality index.

12.2. Faculty Promotion Policy

HEC's Current promotion policy from Assistant Professor to Associate Professor in Engineering, Information Technology, and Computing disciplines requires following two eligibility conditions:

- PhD in relevant discipline
- Five years of post – PhD teaching/research experience (six years for TTS)
- 10 research publications in W category journals, with at least 4 publications in last five years

The policy does not differentiate between papers in top journals or bottom category journals. There is absolutely no reward/incentive for publishing in high quality journals.

Promotion from Assistant Professor to Associate Professor

Based on our study, we propose following eligibility requirement for promotion to Associate Professor.

1. PhD in the relevant discipline
2. Five years of post – PhD teaching/research experience (six years for TTS)
3. At least 10 research publication points. These points can be obtained based on the following criteria:
    - 3 points each for a paper published in Alpha category journal or conference (as first author, corresponding, or co – author)
    - 2 points each for a paper published in Beta category journals or conference (as

first author, corresponding, or co – author)

- 1 point each for a paper published in Gamma category journal or conference (as first author, corresponding, or co – author)
- 0.5 point each for a paper published in Delta category journal or conference (as first author, corresponding, or co – author)
- Zero point for a paper published in 'None' categorized journal or conference (as first author, corresponding, or co – author)

4. At least one post – PhD paper as first or corresponding author in Alpha or Beta journal or conference. In papers where first and corresponding authors are both faculty member, only first author will get the credit.

Promotion from Associate Professor to Professor

Similar to this, we propose changes in promotion policy from Associate Professor to Professor cadre. Each applicant for promotion to Professor should meet the following eligibility criteria:

1. PhD in the relevant discipline
2. Ten years of post – PhD teaching/research experience
3. At least 15 research publication points. These points can be obtained based on the following criteria:
    - 3 points each for a paper published in Alpha category journal or conference (as first author, corresponding, or co – author)
    - 2 points each for a paper published in Beta category journals or conference (as first author, corresponding, or co – author)
    - 1 point each for a paper published in Gamma category journal or conference (as first author, corresponding, or co – author)
    - 0.5 point each for a paper published in Delta category journal or conference (as first author, corresponding, or co – author)
    - Zero point for a paper published in 'None' categorized journal or conference (as first author, corresponding, or co – author)
4. At least one post – PhD paper as first/corresponding author in Alpha category journal or conference. In papers where first and corresponding authors are both faculty member, only first author will get the credit.
5. At least two post – PhD papers as first/corresponding author in Alpha or Beta category journal or conference. In papers where first and corresponding authors are both faculty member, only first author will get the credit.

These policy interventions will incentivize top quality publications, and faculty will be more inclined to publish their work in Alpha, Beta categories.

12.3. PhD Graduation Policy (Research Requirement)

Current HEC policy (Policy on PhD Degree Programs) requires each PhD student to publish at least on first author paper in HEC category Y or above journals. Some universities e.g., NUST, have increased that number to two journal papers. HEC Y category journals are extremely low category journals which have not even received impact factor. For engineering and computing disciplines, we recommend the following research requirement for each PhD student:

- At least one first author paper in Gamma (or above) category journal or conference

We strongly disagree with some universities internally requiring PhD students to publish two W category papers. This puts a lot of pressure on PhD students and they are forced to publish in extremely low W category, open access to fulfill the requirement. A PhD student who is forced to publish in low category journals is certainly not expected to publish in top quality when he/she becomes a faculty member.

12.4. Open Access Journals APC Payment

Our study shows that all journals where Pakistanis have published the most are open access requirement a significant amount of payment (in US dollars) for each published paper in the name of Article Processing Charges (APCs). This payment is made by universities under HEC policies. Unfortunately, all of these journals are ranked in very low categories (Gamma, Delta, None). We recommend following changes to APC payment:

- Article Processing Charges (APCs) for open access journals will be paid by the university only if the journal is ranked in Alpha or Beta category.

This will not only lower a significant load on national exchequer, it will deter the researchers from excessively publishing in low quality journals.

12.5. Travel Funding for Conferences

Currently, conference papers are not considered for faculty promotion under the HEC's policy. Our proposed promotion criteria do not differentiate between a journal or a conference paper. It ranks conferences in categories along with the journals.

HEC and universities do have a travel/registration funding schemes to attend conferences. However, unfortunately, the funding is not enough, and many request are not entertained. We propose the following changes to the policy:

- HEC will ensure travel/registration funding to attend a conference ranked in Alpha or Beta category if first author of the paper is affiliated with an institution based in Pakistan.
- Conferences ranked in other categories will not funded for travel/registration.

The amount of funding saved from the changes in open access payment policy can be diverted towards funding travel to the conferences. Conferences ranked in Alpha or Beta category are well – respected by the research community. Well – known and active researchers from around the world attend these conferences. Attending these conferences will give Pakistani researchers a platform to connect with world top researchers, which will eventually lead towards collaboration. It must also be noted that a significant weightage in university ranking comes directly or indirectly from the 'research reputation' of the universities. Conference papers and the event present a unique opportunity to advertise/market the university in front of the academic fraternity which eventually vote on the 'research reputation' in ranking system.

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APPENDICES

Annex – I: Alpha and Beta Category Journals with Zero Pakistani Papers

Sr. No.	Name of the Journal	PPI	PPI-Category	No. of First Author Papers from Pakistan
1	Quarterly Journal of Economics	30.91	Alpha	0
2	Journal of Causal Inference	28.96	Alpha	0
3	Foundations and Trends in Machine Learning	27.43	Alpha	0
4	Architectural Design	26.87	Alpha	0
5	Econometrica	25.59	Alpha	0
6	Trends in Cognitive Sciences	25.15	Alpha	0
7	Annual Review of Control Robotics and Autonomous Systems	25.08	Alpha	0
8	Annual Review of Statistics and Its Application	24.93	Alpha	0
9	Phenomics	24.64	Alpha	0
10	Neuron	24.33	Alpha	0
11	ACM Transactions on Graphics (TOG)	24.31	Alpha	0
12	Nature Biomedical Engineering	24.23	Alpha	0
13	Annals of Statistics	24.12	Alpha	0
14	Science Robotics	23.73	Alpha	0
15	Journal of Economic Perspectives	23.72	Alpha	0
16	Annual Review of Medicine	23.69	Alpha	0
17	Nature Machine Intelligence	23.69	Alpha	0
18	Statistical Science	23.45	Alpha	0
19	Annual Review of Genomics and Human Genetics	23.42	Alpha	0
20	Nature Machine Intelligence	23.41	Alpha	0
21	Nature Human Behaviour	23.38	Alpha	0
22	Annual Review of Biomedical Engineering	23.32	Alpha	0
23	Journal of the ACM	23.25	Alpha	0
24	Cambridge Journal of Mathematics	23.22	Alpha	0
25	Annual Review of Genetics	23.14	Alpha	0
26	Transactions of the Association for Computational Linguistics	22.96	Alpha	0
27	Journal of the Royal Statistical Society Series B-Statistical Methodology	22.82	Alpha	0
28	Annual Review of Neuroscience	22.63	Alpha	0
29	Annual Review of Linguistics	22.60	Alpha	0
30	Manufacturing & Service Operations Management	22.53	Alpha	0
31	Annual Review of Public Health	22.38	Alpha	0
32	ACTA Mathematica	22.36	Alpha	0
33	IEEE Solid-State Circuits Letters	22.33	Alpha	0
34	Cell Genomics	22.27	Alpha	0
35	IEEE Journal on Exploratory Solid-State Computational Devices and Circuits	22.15	Alpha	0
36	Biometrika	22.09	Alpha	0
37	Annual Review of Economics	22.07	Alpha	0
38	Nature Methods	21.93	Alpha	0
39	Journal of the American Statistical Association	21.88	Alpha	0
40	Journal of Economic Literature	21.70	Alpha	0

41	Nature Reviews Materials	21.70	Alpha	0
42	SIAM Journal on Computing	21.70	Alpha	0
43	Annual Review of Biomedical Data Science	21.63	Alpha	0
44	Nature Electronics	21.52	Alpha	0
45	eLight	21.31	Alpha	0
46	Nature Reviews Neuroscience	21.29	Alpha	0
47	Journal of the American Mathematical Society	21.24	Alpha	0
48	Annals of Mathematics	21.17	Alpha	0
49	Annual Review of Environment and Resources	21.07	Alpha	0
50	Theoretical Economics	20.99	Alpha	0
51	Organizational Behavior and Human Decision Processes	20.98	Alpha	0
52	BME Frontiers	20.88	Alpha	0
53	npj Digital Medicine	20.87	Alpha	0
54	Nature Reviews Genetics	20.82	Alpha	0
55	Mathematical Finance	20.67	Alpha	0
56	Genes & Development	20.57	Alpha	0
57	NBER Macroeconomics Annual	20.42	Alpha	0
58	ACM Transactions on Computer-Human Interaction	20.42	Alpha	0
59	Nature Materials	20.37	Alpha	0
60	SIAM Journal on Financial Mathematics	20.33	Alpha	0
61	Annual Review of Fluid Mechanics	20.29	Alpha	0
62	IEEE Control Systems Magazine	20.18	Alpha	0
63	Duke Mathematical Journal	19.95	Alpha	0
64	Health Technology Assessment	19.93	Alpha	0
65	Nature Nanotechnology	19.89	Alpha	0
66	Journal of Finance	19.67	Alpha	0
67	Trends in Neuroscience	19.64	Alpha	0
68	Journal of Environmental Law	19.57	Alpha	0
69	Nature Genetics	19.39	Alpha	0
70	Law Probability & Risk	19.37	Alpha	0
71	Random Structures & Algorithms	19.35	Alpha	0
72	Journal of Personality and Social Psychology	19.23	Alpha	0
73	Genome Research	19.22	Alpha	0
74	Progress in Planning	19.18	Alpha	0
75	Foundations and Trends in Computer Graphics and Vision	19.15	Alpha	0
76	Advances in Applied Energy	19.08	Alpha	0
77	Computational Linguistics	19.02	Alpha	0
78	Radiology-Imaging Cancer	18.92	Alpha	0
79	Joule	18.80	Alpha	0
80	Inventiones Mathematicae	18.70	Alpha	0
81	Current Opinion in Biomedical Engineering	18.62	Alpha	0
82	Annual Review of Resource Economics	18.60	Alpha	0
83	Publications Mathematiques de l IHES	18.58	Alpha	0
84	Social Issues and Policy Review	18.44	Alpha	0
85	Nature Aging	18.42	Alpha	0
86	Big Data & Society	18.41	Alpha	0
87	Cellular and Molecular Bioengineering	18.36	Alpha	0
88	Genome Medicine	18.34	Alpha	0

89	Journal of the Mechanics and Physics of Solids	18.29	Alpha	0
90	Nature Protocols	18.28	Alpha	0
91	Med	18.25	Alpha	0
92	Journal of American Planning Association	18.14	Alpha	0
93	Circulation-Genomic and Precision Medicine	18.11	Alpha	0
94	Journal of Econometrics	17.84	Alpha	0
95	ILR Review	17.82	Alpha	0
96	Genome Biology	17.64	Alpha	0
97	Environment and Planning B-Urban Analytics and City Science	17.57	Alpha	0
98	Journal of Labor Economics	17.55	Alpha	0
99	Mathematical Programming	17.52	Alpha	0
100	Journal of Financial Economics	17.48	Alpha	0
101	Current Opinion in Systems Biology	17.46	Alpha	0
102	Annual Review of Marine Science	17.41	Alpha	0
103	Studies in Science Education	17.25	Alpha	0
104	Soft Robotics	17.22	Alpha	0
105	IEEE Security & Privacy	17.15	Alpha	0
106	Review of Environmental Economics and Policy	17.15	Alpha	0
107	Nature Energy	17.11	Alpha	0
108	Review of Economics & Statistics	17.05	Alpha	0
109	Current Environmental Health Reports	17.04	Alpha	0
110	ACM Transactions on Reconfigurable Technology and Systems	16.99	Alpha	0
111	IEEE Transactions on Medical Imaging	16.92	Alpha	0
112	Planning Theory & Practice	16.91	Alpha	0
113	Personality and Social Psychology Review	16.91	Alpha	0
114	Foundations and Trends in Information Retrieval	16.88	Alpha	0
115	American Journal of Bioethics	16.78	Alpha	0
116	City & Community	16.71	Alpha	0
117	Hague Journal on the Rule of Law	16.69	Alpha	0
118	ACM Transactions on Human-Robot Interaction	16.69	Alpha	0
119	European Business Organization Law Review	16.65	Alpha	0
120	Acta Numerica	16.63	Alpha	0
121	Communications in Transportation Research	16.58	Alpha	0
122	BMJ Health & Care Informatics	16.56	Alpha	0
123	Journal of Experimental Medicine	16.42	Alpha	0
124	Neurophotonics	16.40	Alpha	0
125	Radiology	16.36	Alpha	0
126	Cell Reports Medicine	16.25	Alpha	0
127	Econometrics Journal	16.12	Alpha	0
128	Transport Reviews	15.97	Alpha	0
129	One Earth	15.96	Alpha	0
130	Statistics Surveys	15.95	Alpha	0
131	Transnational Environmental Law	15.85	Alpha	0
132	Circulation-Cardiovascular Imaging	15.83	Alpha	0
133	Nature Water	15.77	Alpha	0
134	ACM Transactions on Algorithms	15.74	Alpha	0
135	npj Regenerative Medicine	15.72	Alpha	0
136	Psychometrika	15.72	Alpha	0

137	Optica	15.67	Alpha	0
138	Journal of Mixed Methods Research	15.59	Alpha	0
139	Progress in Energy	15.50	Alpha	0
140	Statistics Surveys	15.48	Alpha	0
141	International Data Privacy Law	15.44	Alpha	0
142	Géotechnique	15.39	Alpha	0
143	Journal of Human Resources	15.33	Alpha	0
144	Environmental Science & Technology Letters	15.28	Alpha	0
145	IEEE Robotics & Automation Magazine	15.18	Alpha	0
146	Multivariate Behavioral Research	15.17	Alpha	0
147	Internet Policy Review	15.11	Alpha	0
148	eTransportation	15.08	Alpha	0
149	JMIR Aging	15.04	Alpha	0
150	ACM Transactions on Interactive Intelligent	15.01	Alpha	0
151	JACC-Cardiovascular Imaging	14.95	Beta	0
152	Journal of the Astronautical Sciences	14.92	Beta	0
153	Advances in Optics and Photonics	14.91	Beta	0
154	Language Teaching	14.87	Beta	0
155	IEEE Journal on Emerging and Selected Topics in Circuits and Systems	14.87	Beta	0
156	Journal of Planning Literature	14.86	Beta	0
157	Lancet Regional Health-Americas	14.86	Beta	0
158	Perspectives on Medical Education	14.85	Beta	0
159	npj Urban Sustainability	14.79	Beta	0
160	IEEE Transactions on Visualization and Computer Graphics	14.79	Beta	0
161	Journal of Internal Medicine	14.69	Beta	0
162	International Journal of Artificial Intelligence in Education	14.51	Beta	0
163	ACM Transactions on Information Systems	14.50	Beta	0
164	IEEE Transactions on Haptics	14.49	Beta	0
165	Review of Education Research	14.41	Beta	0
166	Educational Psychologist	14.39	Beta	0
167	Educational Research Review	14.39	Beta	0
168	Computer Graphics Forum	14.32	Beta	0
169	Journal of Urban Economics	14.32	Beta	0
170	Lancet Regional Health-Western Pacific	14.32	Beta	0
171	Language Learning	14.20	Beta	0
172	Alzheimers Research & Therapy	14.12	Beta	0
173	Combinatorica	14.08	Beta	0
174	Journal of second language writing	14.06	Beta	0
175	Review of Finance	14.06	Beta	0
176	International Journal of Law and Information Technology	13.99	Beta	0
177	IEEE Transactions on Audio Speech and Language Processing	13.92	Beta	0
178	Journal of Guidance Control and Dynamics	13.80	Beta	0
179	Progress in Biomedical Engineering	13.76	Beta	0
180	Metabolic Engineering	13.76	Beta	0
181	Journal of Guidance, Control, and Dynamics	13.72	Beta	0
182	Journal of Cardiovascular Computed Tomography	13.69	Beta	0
183	European Review of Social Psychology	13.48	Beta	0

184	Earthquake Engineering & Structural Dynamics	13.46	Beta	0
185	Trends in Ecology and Evolution	13.46	Beta	0
186	IEEE Electron Device Letters	13.36	Beta	0
187	Brain Stimulation	13.32	Beta	0
188	Combustion Theory and Modelling	13.24	Beta	0
189	Photoacoustics	13.20	Beta	0
190	Computational Visual Media	13.19	Beta	0
191	Transportation Science	13.09	Beta	0
192	Journal of Industrial Relations	12.83	Beta	0
193	Oceanography	12.82	Beta	0
194	Journal of Behavioral Decision Making	12.80	Beta	0
195	Neuroscience and Biobehavioral Reviews	12.78	Beta	0
196	Seminars in Nuclear Medicines	12.72	Beta	0
197	IEEE Software	12.70	Beta	0
198	NAR Genomics and Bioinformatics	12.68	Beta	0
199	PhotoniX	12.65	Beta	0
200	IEEE Transactions on Intelligent Vehicles	12.63	Beta	0
201	npj Parkinsons Disease	12.51	Beta	0
202	Logical Methods in Computer Science	12.50	Beta	0
203	Wiley Interdisciplinary Reviews-Computational Statistics	12.49	Beta	0
204	Journal of Statistical Software	12.39	Beta	0
205	Computer Law & Security Review	12.39	Beta	0
206	_Metabolic Engineering Communications	12.39	Beta	0
207	Metabolic Engineering Communications	12.39	Beta	0
208	EPJ Data Science	12.38	Beta	0
209	Visual Informatics	12.31	Beta	0
210	Trauma Violence & Abuse	12.30	Beta	0
211	npj Systems Biology and Applications	12.28	Beta	0
212	IEEE Computer Graphics and Applications	12.27	Beta	0
213	Structural Equation Modeling-A Multidisciplinary Journal	12.26	Beta	0
214	Lancet Regional Health-Europe	12.25	Beta	0
215	Journal of Risk and Uncertainty	12.24	Beta	0
216	International Journal of Transgender Health	12.23	Beta	0
217	Cyborg and Bionic Systems	12.15	Beta	0
218	Quantitative Science Studies	12.09	Beta	0
219	Neurology-Neuroimmunology & Neuroinflammation	12.08	Beta	0
220	Studies in Second Language Acquisition	11.96	Beta	0
221	ACM Transactions on Computational Logic	11.92	Beta	0
222	Journal of Healthcare Informatics Research	11.88	Beta	0
223	Environmental Science and Ecotechnology	11.88	Beta	0
224	Australasian Journal of Logic	11.84	Beta	0
225	Translational Neurodegeneration	11.79	Beta	0
226	International Journal of Architectural Computing	11.78	Beta	0
227	JMIR Medical Informatics	11.76	Beta	0
228	Experimental Economics	11.74	Beta	0
229	Intelligent Buildings International	11.72	Beta	0
230	Structural Safety	11.72	Beta	0
231	Journal of Environmental Economics and Management	11.58	Beta	0

232	Journal of Remote Sensing	11.55	Beta	0
233	Computer aided infrastructure	11.43	Beta	0
234	Molecular Aspects of Medicine	11.40	Beta	0
235	Wiley Interdisciplinary Reviews-Computational Molecular Science	11.39	Beta	0
236	Social Choice and Welfare	11.39	Beta	0
237	International Labour Review	11.38	Beta	0
238	Nano Today	11.29	Beta	0
239	IEEE Transactions On Systems, Man And Cybernetics Part B, Cybernetics	11.25	Beta	0
240	Frontiers in Virtual Reality	11.17	Beta	0
241	Machine Intelligence Research	11.11	Beta	0
242	Progress in Aerospace Sciences	11.07	Beta	0
243	Journal of Applied Econometrics	11.05	Beta	0
244	Ultrasound in Obstetrics & Gynecology	11.04	Beta	0
245	Risk Analysis	11.01	Beta	0
246	Planning Practice and Research	11.01	Beta	0
247	IEEE MultiMedia	10.99	Beta	0
248	GigaScience	10.79	Beta	0
249	Adolescent Research Review	10.76	Beta	0
250	Environmental Innovation and Societal Transitions	10.72	Beta	0
251	Journal of Economic Behavior &	10.64	Beta	0
252	Global Change Biology	10.63	Beta	0
253	Journal of Geophysical Research-Oceans	10.60	Beta	0
254	Methods Data Analyses	10.55	Beta	0
255	Journal of Risk Research	10.50	Beta	0
256	Virtual and Physical Prototyping	10.46	Beta	0
257	Journal of Documentation	10.42	Beta	0
258	Journal of Regional Science	10.42	Beta	0
259	InMining Technology-Transactions of the Institutions of Mining and Metallurgy cites	10.42	Beta	0
260	Journal of Computer and System Sciences	10.35	Beta	0
261	Transfer-European Review of Labour and Research	10.27	Beta	0
262	Matter and Radiation at Extremes	10.21	Beta	0
263	Bioactive Materials	10.19	Beta	0
264	Opto-Electronic Advances	10.19	Beta	0
265	Friction	10.17	Beta	0
266	Architectural Science Review	10.12	Beta	0
267	Journal of Logic and Analysis	10.05	Beta	0

Source: Authors' compilations.

Annex- II: Alpha and Beta Category Journals with 1 – 5 Pakistani Papers

Sr. No.	Name of the Journal	PPI	PPI-Category	No. of First Author Papers from Pakistan
1	Operations Research	24.30	Alpha	1
2	IEEE Journal of Solid-State Circuits	23.55	Alpha	2

3	Nature Neuroscience	23.48	Alpha	1
4	American Economic Review	23.11	Alpha	1
5	Journal of Machine Learning Research	23.00	Alpha	1
6	Nature Biotechnology	21.77	Alpha	1
7	Journal of the American Medical Informatics Association	19.40	Alpha	1
8	Science Translational Medicine	19.26	Alpha	1
9	Patterns	19.17	Alpha	2
10	JAMA Internal Medicine	19.12	Alpha	3
11	Nature Medicine	18.97	Alpha	5
12	Asian Economic Policy Review	18.85	Alpha	1
13	American Journal of Public Health	18.58	Alpha	1
14	Journal of Clinical Investigation	18.48	Alpha	1
15	Joint Commission Journal on Quality and Patient Safety	18.36	Alpha	1
16	IEEE Transactions on Information Theory	18.06	Alpha	4
17	Annual Review of Applied Linguistics	17.90	Alpha	1
18	PLOS Computational Biology	17.90	Alpha	2
19	Brain	17.79	Alpha	1
20	Journal of Spacecraft and Rockets	17.64	Alpha	1
21	IEEE Robotics and Automation Letters	17.50	Alpha	4
22	IEEE Transactions on Control of Network Systems	17.38	Alpha	3
23	Housing Policy Debate	17.29	Alpha	1
24	Nature Sustainability	17.28	Alpha	2
25	Social Science & Medicine	17.21	Alpha	2
26	Learning Media and Technology	17.19	Alpha	1
27	Canadian Medical Association Journal	17.01	Alpha	1
28	Lancet Planetary Health	16.96	Alpha	2
29	BMJ Evidence-Based Medicine	16.94	Alpha	1
30	Journal of Fluid Mechanics	16.90	Alpha	5
31	Nano Letters	16.89	Alpha	4
32	IEEE Computer Architecture Letters	16.80	Alpha	1
33	Trends in Genetics	16.63	Alpha	2
34	Bio-Design and Manufacturing	16.60	Alpha	1
35	International Journal of Computer Vision	16.58	Alpha	3
36	IEEE Transactions on Pattern Analysis and Machine Intelligence	16.57	Alpha	5
37	Journal of Aerospace Information Systems	16.43	Alpha	1
38	IEEE Signal Processing Magazine	16.39	Alpha	3
39	Medical Image Analysis	15.91	Alpha	4
40	Transportation Research Part B-Methodological	15.79	Alpha	1
41	Transportation	15.74	Alpha	1
42	IEEE Journal on Selected Areas in Communications	15.72	Alpha	4
43	Bioengineering & Translational Medicine	15.68	Alpha	1
44	Policy and Society	15.68	Alpha	1
45	Journal of Cardiovascular Magnetic Resonance	15.65	Alpha	1
46	IEEE Reviews in Biomedical Engineering	15.59	Alpha	3
47	IEEE Journal of Selected Topics in Signal Processing	15.58	Alpha	2
48	Proceedings of the Combustion Institute	15.53	Alpha	2
49	Autonomous Robots	15.33	Alpha	5

50	Games and Economic Behavior	15.32	Alpha	1
51	Medical Image Analysis	15.27	Alpha	4
52	Journal of Neural Engineering	15.23	Alpha	5
53	Journal of Turbomachinery	15.23	Alpha	2
54	Physical Review Fluids	15.20	Alpha	2
55	Genetics in Medicine	15.18	Alpha	4
56	Journal of Automated Reasoning	15.16	Alpha	2
57	JMIR Formative Research	15.15	Alpha	4
58	Light-Science & Applications	15.15	Alpha	1
59	Biomaterials	15.08	Alpha	2
60	ACS Synthetic Biology	15.05	Alpha	2
61	BMC Medicine	15.00	Alpha	1
62	Journal of Physical Oceanography	14.98	Beta	1
63	Advanced Materials	14.94	Beta	2
64	Advanced Intelligent Systems	14.86	Beta	1
65	Production and Operations Management	14.84	Beta	2
66	EClinicalMedicine	14.83	Beta	3
67	Trends in Molecular Medicine	14.79	Beta	1
68	Journal of Aircraft	14.74	Beta	1
69	IEEE Transactions on Biomedical Engineering	14.73	Beta	4
70	Transportation Research Part C- Emerging Technologies	14.72	Beta	1
71	Journal of Social Issues	14.52	Beta	2
72	Journal of Intellectual Property Law & Practice	14.47	Beta	3
73	Energy & Environmental Science	14.39	Beta	1
74	IEEE Control Systems Letters	14.38	Beta	3
75	Journal of Mechanical Design	14.38	Beta	1
76	Molecular Neurodegeneration	14.38	Beta	1
77	NAVIGATION Journal of the Institute of Navigation	14.34	Beta	1
78	Advances in Health Sciences Education	14.20	Beta	3
79	Nature Reviews Disease Primers	14.16	Beta	1
80	Combustion and Flame	14.16	Beta	3
81	Journal of Propulsion and Power	14.09	Beta	2
82	IIC-International Review of Intellectual Property and Competition Law	13.98	Beta	1
83	AIAA Journal	13.96	Beta	1
84	Biomicrofluidics	13.93	Beta	1
85	IEEE Transactions on Computational Imaging	13.82	Beta	1
86	Environment and Planning C-Politics and Space	13.72	Beta	1
87	JMIR mHealth and uHealth	13.59	Beta	5
88	ACM Transactions on Software Engineering and Methodology	13.54	Beta	1
89	Transportation Research Part A- Policy and Practice	13.43	Beta	4
90	Frontiers in Digital Health	13.37	Beta	3
91	Travel Behaviour and Society	13.29	Beta	2
92	Computers Environment and Urban Systems	13.19	Beta	3
93	ACS Energy Letters	13.17	Beta	2
94	Information and Learning Sciences	13.06	Beta	2
95	EBioMedicine	12.85	Beta	5
96	Journal of Field Robotics	12.80	Beta	2

97	Journal of the Association for Information Science and Technology	12.69	Beta	3
98	IEEE Geoscience and Remote Sensing Magazine	12.68	Beta	2
99	International Journal for Numerical Methods in Engineering	12.56	Beta	3
100	IEEE Transactions on Software Engineering	12.50	Beta	5
101	Annual Reviews in Control	12.49	Beta	2
102	Journal of Transport Geography	12.48	Beta	3
103	Theoretical and Computational Fluid Dynamics	12.47	Beta	1
104	IEEE Transactions on Automation Science and Engineering	12.45	Beta	3
105	BMC Medical Research Methodology	12.40	Beta	5
106	IEEE Transactions on Mechatronics	12.39	Beta	5
107	Energy Research & Social Science	12.39	Beta	1
108	Frontiers in Robotics and AI	12.29	Beta	3
109	IEEE Transactions on Power Systems	12.18	Beta	4
110	Habitat International	12.18	Beta	3
111	Journal of Infrastructure Systems	12.10	Beta	2
112	Investigative Radiology	12.09	Beta	1
113	IEEE Transactions on Computers	12.09	Beta	5
114	Biofabrication	12.08	Beta	1
115	IEEE Journal of Translational Engineering in Health and Medicine	12.04	Beta	3
116	Progress in Energy and Combustion Science	12.04	Beta	2
117	Nanophotonics	12.01	Beta	5
118	Sleep Medicine Reviews	11.98	Beta	1
119	IEEE Aerospace and Electronic Systems Magazine	11.96	Beta	4
120	Cement and Concrete Research	11.93	Beta	1
121	ACM Transactions on Intelligent Systems and Technology	11.90	Beta	2
122	Applications in Energy and Combustion Science	11.88	Beta	2
123	Assessing Writing	11.86	Beta	1
124	Journal of Structural Engineering	11.81	Beta	2
125	ACM Transactions on Privacy and Security	11.77	Beta	1
126	IEEE Transactions on Circuits and Systems I-Regular Papers	11.77	Beta	3
127	System Dynamics Review	11.74	Beta	1
128	ACM Transactions on Knowledge Discovery from Data	11.64	Beta	2
129	IEEE Transactions on Multimedia	11.54	Beta	4
130	Landscape and Urban Planning	11.47	Beta	2
131	Algorithmica	11.43	Beta	1
132	International Journal of Human-Computer Studies	11.42	Beta	2
133	IEEE Transactions on Parallel and Distributed Systems	11.39	Beta	1
134	Journal of Electronic Packaging	11.39	Beta	2
135	Computer-Aided Civil and Infrastructure Engineering	11.37	Beta	1
136	Remote Sensing of Environment	11.37	Beta	5
137	Computer-Aided Civil and Infrastructure Engineering	11.36	Beta	1
138	Data Mining and Knowledge Discovery	11.36	Beta	1
139	IEEE Transactions on Affective Computing	11.30	Beta	1
140	Genomics Proteomics & Bioinformatics	11.23	Beta	1
141	IEEE Journal of Oceanic Engineering	11.22	Beta	1
142	Journal of Space Safety Engineering	11.20	Beta	1

143	Transportation Research Part D-Transport and Environment	11.17	Beta	1
144	Telemedicine and e-Health	11.17	Beta	3
145	Energy and AI	11.16	Beta	2
146	Journal of Computational Social Science	11.10	Beta	4
147	Advanced Science	11.08	Beta	3
148	Genomics, Proteomics & Bioinformatics	11.06	Beta	1
149	System	11.02	Beta	2
150	Journal of the Medical Library Association	10.99	Beta	1
151	IEEE Transactions on Component Packaging and Manufacturing Technology	10.97	Beta	2
152	Journal of Management in Engineering	10.97	Beta	4
153	Journal of Engineering for Gas Turbines and Power	10.97	Beta	3
154	Journal of Telemedicine and Telecare	10.95	Beta	2
155	International Journal of Solids and Structures	10.94	Beta	1
156	IEEE Transactions on Mobile Computing	10.91	Beta	5
157	Nanoscale Horizons	10.90	Beta	3
158	Journal of Human Rights and the Environment	10.76	Beta	1
159	Frontiers in Bioinformatics	10.72	Beta	2
160	Natural Language Engineering	10.71	Beta	3
161	Theranostics	10.70	Beta	2
162	Lighting Research & Technology	10.70	Beta	1
163	Journal of Mathematical Biology	10.65	Beta	4
164	Journal of Urban Technology	10.64	Beta	1
165	Transport Policy	10.63	Beta	2
166	Journal of Quality Technology	10.61	Beta	1
167	Briefings in Bioinformatics	10.55	Beta	5
168	Journal of Public Administration and Theory	10.55	Beta	4
169	IEEE Transactions on Circuits and Systems for Video Technology	10.52	Beta	3
170	Frontiers in Climate	10.49	Beta	3
171	Additive Manufacturing	10.47	Beta	3
172	Building Simulation	10.46	Beta	3
173	Computer Animation and Virtual Worlds	10.46	Beta	2
174	EPJ Nuclear Sciences & Technologies	10.42	Beta	2
175	Nuclear Fusion	10.41	Beta	1
176	JMIR Serious Games	10.40	Beta	2
177	Nuclear Materials and Energy	10.38	Beta	1
178	Human Relations	10.38	Beta	5
179	Journal of Comparative Effectiveness Research	10.32	Beta	1
180	Learned Publishing	10.26	Beta	2
181	Learning and Individual Differences	10.26	Beta	3
182	Journal of Cheminformatics	10.23	Beta	4
183	International Journal for Uncertainty Quantification	10.17	Beta	1
184	Nano Research	10.12	Beta	2
185	Journal of Environmental Policy & Planning	10.01	Beta	1

Source: Authors' compilations.

Annex- III: Pakistan's Performance in Journals/Conferences Related to National Centers

National Center for Cyber Security (NCCS)					
Sr. No.	Journal/Conference Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	IEEE Symposium on Security and Privacy	22.29	Alpha	0	236
2	IEEE Security & Privacy	17.15	Alpha	1	608
3	IEEE European Symposium on Security and Privacy (EuroS&P)	15.51	Alpha	0	42
4	IEEE Transactions on Haptics	14.49	Beta	0	246
5	Annual Computer Security Applications Conference	14.15	Beta	0	80
6	ACM Transactions on Privacy and Security	11.77	Beta	1	77
7	IEEE Transactions on Affective Computing	11.30	Beta	1	183
8	IEEE Transactions on Information Forensics and Security	9.83	Gamma	4	753
9	Journal of Computer Security	9.73	Gamma	0	121
10	IEEE Transactions on Dependable and Secure Computing	9.72	Gamma	7	465
11	IEEE Transactions on Human-Machine Systems	9.02	Gamma	1	266
12	International Journal of Mobile Human Computer Interaction	9.02	Gamma	0	21
13	International Conference on Computer Communications and Networks (ICCCN)	8.58	Gamma	3	747
14	User Modeling and User-Adapted Interaction	8.48	Gamma	0	47
15	Journal on Multimodal User Interfaces	7.63	Gamma	1	34
16	IEEE Transactions on Cybernetics	6.99	Gamma	5	265
17	IEEE Systems Man and Cybernetics Magazine	6.34	Gamma	2	42
18	Annual Review of CyberTherapy and Telemedicine	5.65	Gamma	0	101
19	IEEE Transactions on Systems Man Cybernetics-Systems	5.62	Gamma	9	256
20	Computers & Security	5.17	Gamma	49	395
21	International Journal of Information Security	4.34	Delta	13	87
22	Cryptography and Communications	4.25	Delta	0	44
23	Security and Communication Networks	3.09	Delta	90	203
24	Journal of Information Security and Applications	2.50	Delta	30	52
25	International Journal of Intelligent Computing and Cybernetics	2.34	Delta	8	37
26	KYBERNETIKA	2.00	Delta	6	14

27	KYBERNETES	1.84	None	82	70
28	Cybernetics & Systems	1.83	None	5	15

National Center of Robotics and Automation (NCRA)					
Sr. No.	**Journal/Conf Name**	**PPI**	**PPI-Category**	**No. of First Author Papers from Pakistan**	**No. of First Author Papers from USA**
1	Annual Review of Control Robotics and Autonomous Systems	25.08	Alpha	0	38
2	Science Robotics	23.73	Alpha	0	395
3	IEEE Control Systems Magazine	20.18	Alpha	0	268
4	IEEE Transactions on Robotics	17.85	Alpha	1	872
5	IEEE Robotics and Automation Letters	17.50	Alpha	4	1,935
6	Soft Robotics	17.22	Alpha	0	164
7	ACM Transactions on Human-Robot Interaction	16.69	Alpha	0	149
8	Autonomous Robots	15.33	Alpha	5	386
9	IEEE Robotics & Automation Magazine	15.18	Alpha	0	178
10	Advanced Intelligent Systems	14.86	Beta	1	267
11	IEEE Control Systems Letters	14.38	Beta	3	938
12	IEEE International Conference on Human-Robot Interaction	13.59	Beta	0	539
13	Journal of Field Robotics	12.80	Beta	2	300
14	Annual Reviews in Control	12.49	Beta	2	124
15	American Control Conference (ACC)	12.49	Beta	14	694
16	IEEE Transactions on Automation Science and Engineering	12.45	Beta	3	679
17	IEEE Transactions on Mechatronics	12.39	Beta	5	685
18	Frontiers in Robotics and AI	12.29	Beta	3	411
19	Cyborg and Bionic Systems	12.15	Beta	0	7
20	Unmanned Systems	9.83	Gamma	1	57
21	International Journal of Social Robotics	9.71	Gamma	0	153
22	Advanced Robotics	9.00	Gamma	3	85
23	Robotics and Autonomous Systems	7.80	Gamma	8	225
24	Robotics and Computer-Integrated Manufacturing	7.79	Gamma	5	130
25	INTERNATIONAL JOURNAL OF CONTROL	6.38	Gamma	19	330
26	Journal of Intelligent & Robotic Systems	5.92	Gamma	7	462
27	Robotics	5.65	Gamma	3	139
28	IEEE-CAA Journal of Automatica Sinica	5.36	Gamma	6	94

29	International Journal of Control, Automation and Systems	4.38	Delta	22	96
30	Asian Journal of Control	3.88	Delta	17	86
31	International Journal of Control, Automation and Systems	3.18	Delta	22	97
32	Systems Science & Control Engineering	1.42	None	6	25
33	Control Engineering and Applied Informatics	1.17	None	18	0
34	Journal of Control Automation and Electrical Systems	0.31	None	6	13

National Center in Big Data and Cloud Computing (NCBC)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Annual Review of Biomedical Data Science	21.63	Alpha	0	44
2	Foundations and Trends in Information Retrieval	16.88	Alpha	0	15
3	ACM Transactions on Information Systems	14.50	Beta	0	103
4	Computer Graphics Forum	14.32	Beta	0	866
5	ACM Transactions on Software Engineering and Methodology	13.54	Beta	1	146
6	Computational Visual Media	13.19	Beta	0	14
7	IEEE Software	12.70	Beta	0	447
8	EPJ Data Science	12.38	Beta	0	139
9	Visual Informatics	12.31	Beta	0	24
10	IEEE Computer Graphics and Applications	12.27	Beta	0	366
11	ACM Transactions on Intelligent Systems and Technology	11.90	Beta	2	258
12	Data Mining and Knowledge Discovery	11.36	Beta	1	195
13	IEEE Transactions on Affective Computing	11.30	Beta	1	183
14	IEEE MultiMedia	10.99	Beta	0	116
15	BioData Mining	9.51	Gamma	3	213
16	ACM Computing Surveys	9.44	Gamma	20	288
17	IEEE Transactions on Big Data	9.33	Gamma	1	129
18	IEEE Transactions on Services Computing	8.62	Gamma	9	183
19	Database-The Journal of Biological Databases and Curation	8.56	Gamma	11	449
20	Theoretical Computer Science	8.45	Gamma	8	752
21	Information Processing & Management	7.15	Gamma	29	178
22	Journal of Parallel and Distributed Computing	6.99	Gamma	20	514

23	Knowledge and Information Systems	6.14	Gamma	41	278
24	Journal of Systems and Software	5.96	Gamma	22	283
25	International Journal of Data Science and Analytics	5.79	Gamma	12	93
26	IEEE Internet of Things Journal	5.74	Gamma	109	943
27	Big Data Mining and Analytics	5.29	Gamma	1	32
28	CONCURRENCY AND COMPUTATION-PRACTICE & EXPERIENCE	4.56	Delta	68	515
29	Journal of Network and Computer Applications	3.90	Delta	78	145
30	Cluster Computing	2.10	Delta	112	195

National Center of Artificial Intelligence (NCAI)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Foundations and Trends in Machine Learning	27.43	Alpha	0	33
2	Science Robotics	23.73	Alpha	0	395
3	Nature Machine Intelligence	23.69	Alpha	0	344
4	Journal of Machine Learning Research	23.00	Alpha	1	1,512
5	IEEE Conference on Computer Vision and Pattern Recognition	19.21	Alpha	4	1,453
6	IEEE International Conference on Computer Vision	18.87	Alpha	2	524
7	IEEE Transactions on Robotics	17.85	Alpha	0	872
8	International Conference on 3D vision	17.36	Alpha	1	89
9	International Journal of Computer Vision	16.58	Alpha	3	439
10	IEEE Transactions on Pattern Analysis and Machine Intelligence	16.57	Alpha	5	1,152
11	International Conference on Visualisation, VIS	13.98	Beta	3	9
12	IEEE TRANSACTIONS ON AUDIO SPEECH AND LANGUAGE PROCESSING	13.92	Beta	0	234
13	IEEE International Conference on Human-Robot Interaction	13.59	Beta	0	539
14	IEEE Workshop on Applications of Computer Vision (WACV)	13.11	Beta	7	522
15	Pacific (formerly Asia-Pacific APVIS) Visualization Symposium	12.50	Beta	0	76
16	IEEE Transactions on Knowledge and Data Engineering	12.18	Beta	6	679
17	International Conference on Computer Vision Workshops (ICCVW)	11.44	Beta	2	287
18	Machine Intelligence Research	11.11	Beta	0	5
19	IEEE Transactions on Neural Networks and Learning Systems	9.10	Gamma	1	591

20	IEEE international conference on image processing	9.03	Gamma	25	1,920
21	Pattern Recognition	7.93	Gamma	25	422
22	CAAI Transactions on Intelligence Technology	6.84	Gamma	20	10
23	Neurocomputing	6.54	Gamma	50	534
24	Pattern Recognition Letters	6.44	Gamma	34	304
25	International Journal of Approximate Reasoning	5.62	Gamma	10	123
26	International Conference on Machine Learning and Applications (ICMLA)	5.53	Gamma	20	987
27	Information Fusion	5.34	Gamma	17	113
28	Knowledge-Based Systems	4.47	Delta	34	213
29	Expert Systems with Applications	4.25	Delta	133	845
30	Information Sciences	3.69	Delta	72	347
31	ACM Transactions on Asian and Low-Resource Language Information Processing	3.49	Delta	43	14
32	Artificial Intelligence Review	2.79	Delta	73	69
33	Evolutionary Intelligence	1.78	None	10	30
34	Complex & Intelligent Systems	1.62	None	57	17
35	Journal of Intelligent & Fuzzy Systems	1.21	None	403	86

National Center for Livestock Breeding, Genetics & Genomics (NCLBG&G)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Phenomics	24.64	Alpha	0	6
2	Annual Review of Genomics and Human Genetics	23.42	Alpha	0	56
3	Annual Review of Genetics	23.14	Alpha	0	74
4	Cell Genomics	22.27	Alpha	0	209
5	Annual Review of Biomedical Data Science	21.63	Alpha	0	44
6	NATURE REVIEWS GENETICS	20.82	Alpha	0	566
7	GENES & DEVELOPMENT	20.57	Alpha	0	1,952
8	NATURE GENETICS	19.39	Alpha	0	1,853
9	GENOME RESEARCH	19.22	Alpha	0	1,579
10	AMERICAN JOURNAL OF HUMAN GENETICS	18.95	Alpha	9	1,520
11	Genome Medicine	18.34	Alpha	0	799
12	Circulation-Genomic and Precision Medicine	18.11	Alpha	0	321
13	PLOS Computational Biology	17.90	Alpha	2	4,408
14	GENOME BIOLOGY	17.64	Alpha	0	1,879

15	GENETIC EPIDEMIOLOGY	17.61	Alpha	4	2,118
16	Current Opinion in Systems Biology	17.46	Alpha	0	66
17	TRENDS IN GENETICS	16.63	Alpha	2	664
18	GENETICS IN MEDICINE	15.18	Alpha	4	2,441
19	Bioinformatics	14.68	Beta	7	4,731
20	NAR Genomics and Bioinformatics	12.68	Beta	0	207
21	GENOMICS PROTEOMICS & BIOINFORMATICS	11.23	Beta	1	85
22	Journal of Theoretical Biology	10.94	Beta	29	1,321
23	BMC Bioinformatics	10.78	Beta	17	3,392
24	Frontiers in Bioinformatics	10.72	Beta	2	141
25	Journal of Mathematical Biology	10.65	Beta	4	493
26	Briefings in Bioinformatics	10.55	Beta	5	646
27	Mathematical Biosciences	9.07	Gamma	6	516
28	Database-The Journal of Biological Databases and Curation	8.56	Gamma	11	449
29	Genes & Diseases	7.44	Gamma	6	225
30	Molecular Informatics	7.39	Gamma	3	88
31	Computers in Biology and Medicine	6.51	Gamma	107	685
32	INTERDISCIPLINARY SCIENCES-COMPUTATIONAL LIFE SCIENCES	3.13	Delta	10	30
33	JOURNAL OF MOLECULAR GRAPHICS & MODELLING	3.07	Delta	139	235

National Center of GIS and Space Applications (NCGSA)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Annual Review of Environment and Resources	21.07	Alpha	0	66
2	Current Environmental Health Reports	17.04	Alpha	0	227
3	One Earth	15.96	Alpha	0	295
4	Environmental Science & Technology Letters	15.28	Alpha	0	739
5	Earthquake Engineering & Structural Dynamics	13.46	Beta	0	496
6	ENVIRONMENTAL SCIENCE & TECHNOLOGY	13.30	Beta	12	10,590
7	COMPUTERS ENVIRONMENT AND URBAN SYSTEMS	13.19	Beta	3	368
8	IEEE Geoscience and Remote Sensing Magazine	12.68	Beta	2	106
9	HABITAT INTERNATIONAL Organizations	12.18	Beta	0	0
10	Frontiers of Environmental Science & Engineering	12.00	Beta	6	110

11	Journal of Remote Sensing	11.55	Beta	0	26
12	LANDSCAPE AND URBAN PLANNING	11.47	Beta	2	910
13	Remote Sensing of Environment	11.37	Beta	5	2,313
14	CITIES	11.08	Beta	9	552
15	RESOURCES CONSERVATION AND RECYCLING	10.78	Beta	12	673
16	ENVIRONMENT INTERNATIONAL	10.51	Beta	9	1,381
17	ISPRS Journal of Photogrammetry and Remote Sensing	9.69	Gamma	6	350
18	IEEE Transactions on Geoscience and Remote Sensing	8.47	Gamma	10	2,026
19	International Journal of Applied Earth Observation and Geoinformation	7.40	Gamma	10	374
20	IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing	7.27	Gamma	23	876
21	International Journal of Digital Earth	7.21	Gamma	6	170
22	IEEE Geoscience and Remote Sensing Letters	6.86	Gamma	15	665
23	Science of The Total Environment	6.76	Gamma	221	5,780
24	Soil Dynamics and Earthquake Engineering	6.65	Gamma	9	491
25	Remote Sensing	6.65	Gamma	58	4,010
26	Current Pollution Reports	6.35	Gamma	6	81
27	Journal of Geovisualization and Spatial Analysis	6.25	Gamma	4	24
28	International Journal of Remote Sensing	6.05	Gamma	22	857
29	Bulletin of Earthquake Engineering	5.44	Gamma	14	125
30	Journal of Environmental Management	5.14	Gamma	159	2,076
31	Drones	3.86	Delta	29	224
32	Environmental Technology	3.78	Delta	51	145
33	REMOTE SENSING APPLICATIONS-SOCIETY AND ENVIRONMENT	3.02	Delta	14	122
34	European Journal of Remote Sensing	2.53	Delta	5	16

National Center of Industrial Biotechnology

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Nature Biomedical Engineering	24.23	Alpha	0	788
2	Nature Biotechnology	21.77	Alpha	1	2,165
3	Annual Review of Biomedical Data Science	21.63	Alpha	0	44
4	PLOS Computational Biology	17.90	Alpha	2	4,408
5	GENETIC EPIDEMIOLOGY	17.61	Alpha	4	2,118

6	Current Opinion in Systems Biology	17.46	Alpha	0	66
7	Bioinformatics	14.68	Beta	7	4,731
8	Metabolic Engineering	13.76	Beta	0	644
9	Current Opinion in Biotechnology	12.91	Beta	15	1,059
10	NAR Genomics and Bioinformatics	12.68	Beta	0	207
11	Trends in Biotechnology	12.45	Beta	9	507
12	npj Systems Biology and Applications	12.28	Beta	0	203
13	Journal of Theoretical Biology	10.94	Beta	29	1,321
14	BMC Bioinformatics	10.78	Beta	17	3,392
15	Frontiers in Bioinformatics	10.72	Beta	2	141
16	Journal of Mathematical Biology	10.65	Beta	4	493
17	Briefings in Bioinformatics	10.55	Beta	5	646
18	Mathematical Biosciences	9.07	Gamma	6	516
19	Database-The Journal of Biological Databases and Curation	8.56	Gamma	11	449
20	Biotechnology Advances	8.18	Gamma	16	190
21	Frontiers in Bioengineering and Biotechnology	7.48	Gamma	41	1,094
22	Microbial Cell Factories	6.62	Gamma	8	201
23	Computers in Biology and Medicine	6.51	Gamma	107	685
24	Applied Microbiology and Biotechnology	6.38	Gamma	44	853
25	Algal Research-Biomass Biofuels and Bioproducts	5.82	Gamma	14	552
26	Bioresource Technology	5.69	Gamma	63	1,946
27	New Biotechnology	5.64	Gamma	27	145
28	ENZYME AND MICROBIAL TECHNOLOGY	4.72	Delta	15	142
29	Current Research in Biotechnology	4.67	Delta	8	28
30	JOURNAL OF BIOTECHNOLOGY	4.39	Delta	44	405
31	BIORESOURCES AND BIOPROCESSING	4.30	Delta	8	26
32	Critical Reviews in Biotechnology	4.19	Delta	7	46
33	AMB Express	4.05	Delta	28	81
34	JOURNAL OF MOLECULAR GRAPHICS & MODELLING	3.07	Delta	139	235
35	WORLD JOURNAL OF MICROBIOLOGY & BIOTECHNOLOGY	2.62	Delta	63	117
36	Biocatalysis and Agricultural Biotechnology	0.99	None	100	103

Source: Authors' compilations.

Annex – IV: Article Processing Charges (APCs) of Open – Access Publications from Pakistan

Only open access journals where No. of papers from Pakistan (first author) are greater than or equal to 25 are considered. All APCs in US dollars.

Sr. No.	Journal/Conference Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	IEEE Symposium on Security and Privacy	22.29	Alpha	0	236
2	IEEE Security & Privacy	17.15	Alpha	1	608
3	IEEE European Symposium on Security and Privacy (EuroS&P)	15.51	Alpha	0	42
4	IEEE Transactions on Haptics	14.49	Beta	0	246
5	Annual Computer Security Applications Conference	14.15	Beta	0	80
6	ACM Transactions on Privacy and Security	11.77	Beta	1	77
7	IEEE Transactions on Affective Computing	11.3	Beta	1	183
8	IEEE Transactions on Information Forensics and Security	9.83	Gamma	4	753
9	Journal of Computer Security	9.73	Gamma	0	121
10	IEEE Transactions on Dependable and Secure Computing	9.72	Gamma	7	465
11	IEEE Transactions on Human-Machine Systems	9.02	Gamma	1	266
12	International Journal of Mobile Human Computer Interaction	9.02	Gamma	0	21
13	International Conference on Computer Communications and Networks (ICCCN)	8.58	Gamma	3	747
14	User Modeling and User-Adapted Interaction	8.48	Gamma	0	47
15	Journal on Multimodal User Interfaces	7.63	Gamma	1	34
16	IEEE Transactions on Cybernetics	6.99	Gamma	5	265
17	IEEE Systems Man and Cybernetics Magazine	6.34	Gamma	2	42
18	Annual Review of CyberTherapy and Telemedicine	5.65	Gamma	0	101
19	IEEE Transactions on Systems Man Cybernetics-Systems	5.62	Gamma	9	256
20	Computers & Security	5.17	Gamma	49	395
21	International Journal of Information Security	4.34	Delta	13	87
22	Cryptography and Communications	4.25	Delta	0	44
23	Security and Communication Networks	3.09	Delta	90	203
24	Journal of Information Security and Applications	2.5	Delta	30	52
25	International Journal of Intelligent Computing and Cybernetics	2.34	Delta	8	37
26	KYBERNETIKA	2	Delta	6	14
27	KYBERNETES	1.84	None	82	70
28	Cybernetics & Systems	1.83	None	5	15
National Center of Robotics and Automation (NCRA)					
Sr. No.	**Journal/Conf Name**	**PPI**	**PPI-Category**	**No. of First Author Papers from Pakistan**	**No. of First Author Papers from USA**
1	Annual Review of Control Robotics and Autonomous Systems	25.08	Alpha	0	38
2	Science Robotics	23.73	Alpha	0	395
3	IEEE Control Systems Magazine	20.18	Alpha	0	268
4	IEEE Transactions on Robotics	17.85	Alpha	1	872
5	IEEE Robotics and Automation Letters	17.5	Alpha	4	1,935
6	Soft Robotics	17.22	Alpha	0	164
7	ACM Transactions on Human-Robot Interaction	16.69	Alpha	0	149
8	Autonomous Robots	15.33	Alpha	5	386
9	IEEE Robotics & Automation Magazine	15.18	Alpha	0	178
10	Advanced Intelligent Systems	14.86	Beta	1	267
11	IEEE Control Systems Letters	14.38	Beta	3	938
12	IEEE International Conference on Human-Robot Interaction	13.59	Beta	0	539
13	Journal of Field Robotics	12.8	Beta	2	300
14	Annual Reviews in Control	12.49	Beta	2	124
15	American Control Conference (ACC)	12.49	Beta	14	694
16	IEEE Transactions on Automation Science and Engineering	12.45	Beta	3	679
17	IEEE Transactions on Mechatronics	12.39	Beta	5	685
18	Frontiers in Robotics and AI	12.29	Beta	3	411
19	Cyborg and Bionic Systems	12.15	Beta	0	7
20	Unmanned Systems	9.83	Gamma	1	57
21	International Journal of Social Robotics	9.71	Gamma	0	153
22	Advanced Robotics	9	Gamma	3	85
23	Robotics and Autonomous Systems	7.8	Gamma	8	225
24	Robotics and Computer-Integrated Manufacturing	7.79	Gamma	5	130

25	INTERNATIONAL JOURNAL OF CONTROL	6.38	Gamma	19	330
26	Journal of Intelligent & Robotic Systems	5.92	Gamma	7	462
27	Robotics	5.65	Gamma	3	139
28	IEEE-CAA Journal of Automatica Sinica	5.36	Gamma	6	94
29	International Journal of Control, Automation and Systems	4.38	Delta	22	96
30	Asian Journal of Control	3.88	Delta	17	86
31	International Journal of Control, Automation and Systems	3.18	Delta	22	97
32	Systems Science & Control Engineering	1.42	None	6	25
33	Control Engineering and Applied Informatics	1.17	None	18	0
34	Journal of Control Automation and Electrical Systems	0.31	None	6	13

National Center in Big Data and Cloud Computing (NCBC)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Annual Review of Biomedical Data Science	21.63	Alpha	0	44
2	Foundations and Trends in Information Retrieval	16.88	Alpha	0	15
3	ACM Transactions on Information Systems	14.5	Beta	0	103
4	Computer Graphics Forum	14.32	Beta	0	866
5	ACM Transactions on Software Engineering and Methodology	13.54	Beta	1	146
6	Computational Visual Media	13.19	Beta	0	14
7	IEEE Software	12.7	Beta	0	447
8	EPJ Data Science	12.38	Beta	0	139
9	Visual Informatics	12.31	Beta	0	24
10	IEEE Computer Graphics and Applications	12.27	Beta	0	366
11	ACM Transactions on Intelligent Systems and Technology	11.9	Beta	2	258
12	Data Mining and Knowledge Discovery	11.36	Beta	1	195
13	IEEE Transactions on Affective Computing	11.3	Beta	1	183
14	IEEE MultiMedia	10.99	Beta	0	116
15	BioData Mining	9.51	Gamma	3	213
16	ACM Computing Surveys	9.44	Gamma	20	288
17	IEEE Transactions on Big Data	9.33	Gamma	1	129
18	IEEE Transactions on Services Computing	8.62	Gamma	9	183
19	Database-The Journal of Biological Databases and Curation	8.56	Gamma	11	449
20	Theoretical Computer Science	8.45	Gamma	8	752
21	Information Processing & Management	7.15	Gamma	29	178
22	Journal of Parallel and Distributed Computing	6.99	Gamma	20	514
23	Knowledge and Information Systems	6.14	Gamma	41	278
24	Journal of Systems and Software	5.96	Gamma	22	283
25	International Journal of Data Science and Analytics	5.79	Gamma	12	93
26	IEEE Internet of Things Journal	5.74	Gamma	109	943
27	Big Data Mining and Analytics	5.29	Gamma	1	32
28	CONCURRENCY AND COMPUTATION-PRACTICE & EXPERIENCE	4.56	Delta	68	515
29	Journal of Network and Computer Applications	3.9	Delta	78	145
30	Cluster Computing	2.1	Delta	112	195

National Center of Artificial Intelligence (NCAI)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Foundations and Trends in Machine Learning	27.43	Alpha	0	33
2	Science Robotics	23.73	Alpha	0	395
3	Nature Machine Intelligence	23.69	Alpha	0	344
4	Journal of Machine Learning Research	23	Alpha	1	1,512
5	IEEE Conference on Computer Vision and Pattern Recognition	19.21	Alpha	4	1,453
6	IEEE International Conference on Computer Vision	18.87	Alpha	2	524
7	IEEE Transactions on Robotics	17.85	Alpha	0	872
8	International Conference on 3D vision	17.36	Alpha	1	89
9	International Journal of Computer Vision	16.58	Alpha	3	439
10	IEEE Transactions on Pattern Analysis and Machine Intelligence	16.57	Alpha	5	1,152

11	International Conference on Visualisation, VIS	13.98	Beta	3	9
12	IEEE TRANSACTIONS ON AUDIO SPEECH AND LANGUAGE PROCESSING	13.92	Beta	0	234
13	IEEE International Conference on Human-Robot Interaction	13.59	Beta	0	539
14	IEEE Workshop on Applications of Computer Vision (WACV)	13.11	Beta	7	522
15	Pacific (formerly Asia-Pacific APVIS) Visualization Symposium	12.5	Beta	0	76
16	IEEE Transactions on Knowledge and Data Engineering	12.18	Beta	6	679
17	International Conference on Computer Vision Workshops (ICCVW)	11.44	Beta	2	287
18	Machine Intelligence Research	11.11	Beta	0	5
19	IEEE Transactions on Neural Networks and Learning Systems	9.1	Gamma	1	591
20	IEEE international conference on image processing	9.03	Gamma	25	1,920
21	Pattern Recognition	7.93	Gamma	25	422
22	CAAI Transactions on Intelligence Technology	6.84	Gamma	20	10
23	Neurocomputing	6.54	Gamma	50	534
24	Pattern Recognition Letters	6.44	Gamma	34	304
25	International Journal of Approximate Reasoning	5.62	Gamma	10	123
26	International Conference on Machine Learning and Applications (ICMLA)	5.53	Gamma	20	987
27	Information Fusion	5.34	Gamma	17	113
28	Knowledge-Based Systems	4.47	Delta	34	213
29	Expert Systems with Applications	4.25	Delta	133	845
30	Information Sciences	3.69	Delta	72	347
31	ACM Transactions on Asian and Low-Resource Language Information Processing	3.49	Delta	43	14
32	Artificial Intelligence Review	2.79	Delta	73	69
33	Evolutionary Intelligence	1.78	None	10	30
34	Complex & Intelligent Systems	1.62	None	57	17
35	Journal of Intelligent & Fuzzy Systems	1.21	None	403	86

National Center for Livestock Breeding, Genetics & Genomics (NCLBG&G)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Phenomics	24.64	Alpha	0	6
2	Annual Review of Genomics and Human Genetics	23.42	Alpha	0	56
3	Annual Review of Genetics	23.14	Alpha	0	74
4	Cell Genomics	22.27	Alpha	0	209
5	Annual Review of Biomedical Data Science	21.63	Alpha	0	44
6	NATURE REVIEWS GENETICS	20.82	Alpha	0	566
7	GENES & DEVELOPMENT	20.57	Alpha	0	1,952
8	NATURE GENETICS	19.39	Alpha	0	1,853
9	GENOME RESEARCH	19.22	Alpha	0	1,579
10	AMERICAN JOURNAL OF HUMAN GENETICS	18.95	Alpha	9	1,520
11	Genome Medicine	18.34	Alpha	0	799
12	Circulation-Genomic and Precision Medicine	18.11	Alpha	0	321
13	PLOS Computational Biology	17.9	Alpha	2	4,408
14	GENOME BIOLOGY	17.64	Alpha	0	1,879
15	GENETIC EPIDEMIOLOGY	17.61	Alpha	4	2,118
16	Current Opinion in Systems Biology	17.46	Alpha	0	66
17	TRENDS IN GENETICS	16.63	Alpha	2	664
18	GENETICS IN MEDICINE	15.18	Alpha	4	2,441
19	Bioinformatics	14.68	Beta	7	4,731
20	NAR Genomics and Bioinformatics	12.68	Beta	0	207
21	GENOMICS PROTEOMICS & BIOINFORMATICS	11.23	Beta	1	85
22	Journal of Theoretical Biology	10.94	Beta	29	1,321
23	BMC Bioinformatics	10.78	Beta	17	3,392
24	Frontiers in Bioinformatics	10.72	Beta	2	141
25	Journal of Mathematical Biology	10.65	Beta	4	493
26	Briefings in Bioinformatics	10.55	Beta	5	646
27	Mathematical Biosciences	9.07	Gamma	6	516
28	Database-The Journal of Biological Databases and Curation	8.56	Gamma	11	449
29	Genes & Diseases	7.44	Gamma	6	225
30	Molecular Informatics	7.39	Gamma	3	88

31	Computers in Biology and Medicine	6.51	Gamma	107	685
32	INTERDISCIPLINARY SCIENCES-COMPUTATIONAL LIFE SCIENCES	3.13	Delta	10	30
33	JOURNAL OF MOLECULAR GRAPHICS & MODELLING	3.07	Delta	139	235

National Center of GIS and Space Applications (NCGSA)

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Annual Review of Environment and Resources	21.07	Alpha	0	66
2	Current Environmental Health Reports	17.04	Alpha	0	227
3	One Earth	15.96	Alpha	0	295
4	Environmental Science & Technology Letters	15.28	Alpha	0	739
5	Earthquake Engineering & Structural Dynamics	13.46	Beta	0	496
6	ENVIRONMENTAL SCIENCE & TECHNOLOGY	13.3	Beta	12	10,590
7	COMPUTERS ENVIRONMENT AND URBAN SYSTEMS	13.19	Beta	3	368
8	IEEE Geoscience and Remote Sensing Magazine	12.68	Beta	2	106
9	HABITAT INTERNATIONAL Organizations	12.18	Beta	0	0
10	Frontiers of Environmental Science & Engineering	12	Beta	6	110
11	Journal of Remote Sensing	11.55	Beta	0	26
12	LANDSCAPE AND URBAN PLANNING	11.47	Beta	2	910
13	Remote Sensing of Environment	11.37	Beta	5	2,313
14	CITIES	11.08	Beta	9	552
15	RESOURCES CONSERVATION AND RECYCLING	10.78	Beta	12	673
16	ENVIRONMENT INTERNATIONAL	10.51	Beta	9	1,381
17	ISPRS Journal of Photogrammetry and Remote Sensing	9.69	Gamma	6	350
18	IEEE Transactions on Geoscience and Remote Sensing	8.47	Gamma	10	2,026
19	International Journal of Applied Earth Observation and Geoinformation	7.4	Gamma	10	374
20	IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing	7.27	Gamma	23	876
21	International Journal of Digital Earth	7.21	Gamma	6	170
22	IEEE Geoscience and Remote Sensing Letters	6.86	Gamma	15	665
23	Science of The Total Environment	6.76	Gamma	221	5,780
24	Soil Dynamics and Earthquake Engineering	6.65	Gamma	9	491
25	Remote Sensing	6.65	Gamma	58	4,010
26	Current Pollution Reports	6.35	Gamma	6	81
27	Journal of Geovisualization and Spatial Analysis	6.25	Gamma	4	24
28	International Journal of Remote Sensing	6.05	Gamma	22	857
29	Bulletin of Earthquake Engineering	5.44	Gamma	14	125
30	Journal of Environmental Management	5.14	Gamma	159	2,076
31	Drones	3.86	Delta	29	224
32	Environmental Technology	3.78	Delta	51	145
33	REMOTE SENSING APPLICATIONS-SOCIETY AND ENVIRONMENT	3.02	Delta	14	122
34	European Journal of Remote Sensing	2.53	Delta	5	16

National Center of Industrial Biotechnology

Sr. No.	Journal/Conf Name	PPI	PPI-Category	No. of First Author Papers from Pakistan	No. of First Author Papers from USA
1	Nature Biomedical Engineering	24.23	Alpha	0	788
2	Nature Biotechnology	21.77	Alpha	1	2,165
3	Annual Review of Biomedical Data Science	21.63	Alpha	0	44
4	PLOS Computational Biology	17.9	Alpha	2	4,408
5	GENETIC EPIDEMIOLOGY	17.61	Alpha	4	2,118
6	Current Opinion in Systems Biology	17.46	Alpha	0	66
7	Bioinformatics	14.68	Beta	7	4,731
8	Metabolic Engineering	13.76	Beta	0	644
9	Current Opinion in Biotechnology	12.91	Beta	15	1,059
10	NAR Genomics and Bioinformatics	12.68	Beta	0	207
11	Trends in Biotechnology	12.45	Beta	9	507
12	npj Systems Biology and Applications	12.28	Beta	0	203
13	Journal of Theoretical Biology	10.94	Beta	29	1,321

14	BMC Bioinformatics	10.78	Beta	17	3,392
15	Frontiers in Bioinformatics	10.72	Beta	2	141
16	Journal of Mathematical Biology	10.65	Beta	4	493
17	Briefings in Bioinformatics	10.55	Beta	5	646
18	Mathematical Biosciences	9.07	Gamma	6	516
19	Database-The Journal of Biological Databases and Curation	8.56	Gamma	11	449
20	Biotechnology Advances	8.18	Gamma	16	190
21	Frontiers in Bioengineering and Biotechnology	7.48	Gamma	41	1,094
22	Microbial Cell Factories	6.62	Gamma	8	201
23	Computers in Biology and Medicine	6.51	Gamma	107	685
24	Applied Microbiology and Biotechnology	6.38	Gamma	44	853
25	Algal Research-Biomass Biofuels and Bioproducts	5.82	Gamma	14	552
26	Bioresource Technology	5.69	Gamma	63	1,946
27	New Biotechnology	5.64	Gamma	27	145
28	ENZYME AND MICROBIAL TECHNOLOGY	4.72	Delta	15	142
29	Current Research in Biotechnology	4.67	Delta	8	28
30	JOURNAL OF BIOTECHNOLOGY	4.39	Delta	44	405
31	BIORESOURCES AND BIOPROCESSING	4.3	Delta	8	26
32	Critical Reviews in Biotechnology	4.19	Delta	7	46
33	AMB Express	4.05	Delta	28	81
34	JOURNAL OF MOLECULAR GRAPHICS & MODELLING	3.07	Delta	139	235
35	WORLD JOURNAL OF MICROBIOLOGY & BIOTECHNOLOGY	2.62	Delta	63	117
36	Biocatalysis and Agricultural Biotechnology	0.99	None	100	103

Source: Authors' compilations.