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Pakistan research and innovation landscape report





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Executive Summary

The Web of Science combination of world-class data, tools and expertise creates a mission critical research ecosystem closely aligned with Pakistan's research productivity and quality growth.

Pakistan has witnessed a rapid increase in its scientific research productivity and impact that is highlighted by three indicators:

- In 2019, Pakistan produced 300% more publications indexed in the Web of Science Core Collection than in 2010.
- In the last 10 years, more than half of Pakistan's research was published in journals with Impact Factor. Global influence of Pakistan's research is increasing as scientists in the country are publishing more in top quartile journals.
- The Category Normalized Citation Impact of Pakistan's publications (which measures publications' impact against their peers worldwide) has risen from 0.67 to 1.03.

These trends demonstrate the potential of Pakistan's research and development (R&D).

Effective discovery of the most relevant and in-demand scholarly content has always been a hallmark of the Web of Science. With the rapidly growing numbers of Open Access sources, Web of Science has become a major conduit for free and legal access to full texts of publications.

In 2018, 31% of all Pakistan publications in the Web of Science were published in Open Access publications.

The Web of Science offers access to the highest quality data and metrics. In addition, it provides instruments which greatly facilitate the research workflow at the organization and individual researcher level in order to create consistent scientific visibility.

Pakistan has an increased number of Web of Science ResearcherID profiles: over 9,300 of such profiles have been created.

The power of Web of Science ResearcherID has been enhanced by a merger with the Publons profiles, a unique tool for making peer reviews and journal editing contributions visible.

The Web of Science Group is committed to fostering its long-standing partnership with Pakistan's scientific community, promoting quality research and supporting the country's national research and innovation goals to place Pakistan's research on the global scientific map.

44th

Global ranking for the total number of publications

43rd

Global ranking for the number of Highly Cited Papers (1%)

Introduction

The *Web of Science Group* organizes the world's research information and data to enable academia, corporations, publishers, and governments to accelerate the pace of research. It is home to the *Web of Science* – the world's most trusted and largest publisher-neutral citation index and independent research intelligence platform. Its many well-known

brands also include *EndNote*, *Converis*, *ScholarOne*, *Publons*, *Kopernio* and the *Institute for Scientific Information (ISI)*. The “university” of the *Web of Science Group*, *ISI* maintains and advances the knowledge corpus upon which the index and related information and analytical content, products, and services are built.



What powers the Web of Science Group?

The foundation of our Group is built upon the *Web of Science Core Collection*, the world's only true citation index.

Data structure

Meticulous Data Construction and Curation

- Complete unified affiliations data
- Accurate metrics
- Cover to cover indexing
- Complete author names data
- Meaningful subject categories
- Uniform document classification

Editorial integrity

The *Web of Science Core Collection* is unique: our expert in-house editors have no affiliations to publishing houses or research institutions, free from any potential bias or conflict of interest. Each editor is focused on specific subject categories enabling them to gain a deep, nuanced knowledge of the journals in that field that cannot be replicated by purely algorithmic approaches and/or outsourcing aspects of editorial decision-making.

The basic principles of our selection process remain constant: objectivity, selectivity and collection dynamics. We use a single set of 28 criteria to evaluate journals; these are divided into 24 'quality criteria' designed to select for editorial rigor and best practice at the journal level, and 4 'impact criteria' designed to select the most influential journals in their respective fields using citation activity as the primary indicator of impact. Journals that meet the quality criteria enter **Emerging Sources Citation Index (ESCI)** in the *Web of Science Core Collection*. Journals that meet the additional impact criteria enter **Science Citation Index Expanded (SCIE)**, **Social Sciences Citation Index (SSCI)** or **Arts & Humanities Citation Index (AHCI)** depending on their subject area.

These are dynamic collections subject to continuous curation to ensure journals are in the appropriate collection. ESCI journals that gain impact move to SCIE, SSCI or AHCI. SCIE, SSCI and AHCI journals that decrease in impact move to ESCI. Any journal that decreases in quality will be removed from the *Web of Science Core Collection*.

Guided by the legacy of Dr Eugene Garfield and adapted to respond to technological advances and changes in the publishing landscape, our robust evaluation and curation makes the *Web of Science Core Collection* the most authoritative global citation database.

4K+

publishing partners

12M

peer-reviewed full text
Open Access versions

Without the depth, breadth and quality of content, research impact is at risk. World class research needs world class information.

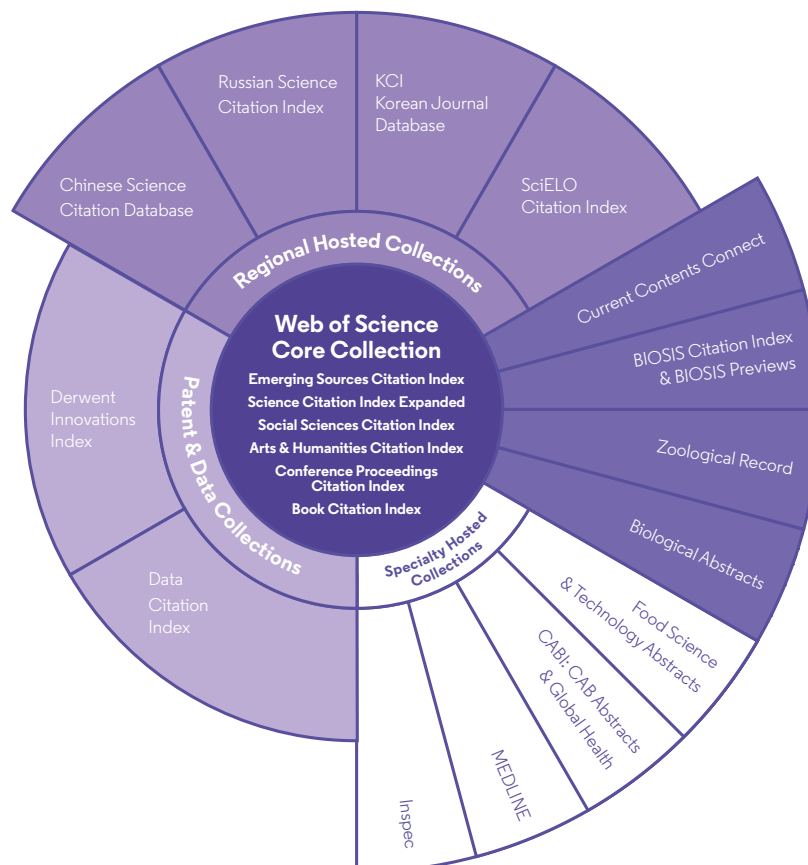
Comprehensive content

- 254 subject categories
- 34k+ total journals across the full platform
- 21k total journals in select Core Collection
- 1.6B cited references
- 155M records – patents, data sets, articles, and proceedings
- 11.2M records with funding data
- 80M patents for over 40 million inventions
- Backfiles to 1900 with cover-to-cover indexing

- Independent, regional indexes covering China, Korea, Russia, and Latin America
- World-class subject specialized indexes in biology, medicine, engineering and zoology
- Research data from the groundbreaking Data Citation Index
- Patent indexes covering inventions from over 50 patent issuing authorities

...to the backbone of our editorially curated Web of Science Core Collection, the world's only true citation index.

Web of Science platform is much more than just science. Providing a truly multidisciplinary research experience across science, social sciences, and arts and humanities, connecting...



Pakistan's place in the global research landscape

Pakistan's research productivity is on the rise

Pakistan's overall research productivity, as measured by the publications indexed in the Web of Science Core Collection has risen impressively.

Pakistan's publications indexed in the Web of Science Core Collection increased by 300% from 2010 to 2019. This massive increase also resulted in a substantial growth in Category Normalized Citation Impact (CNCI).

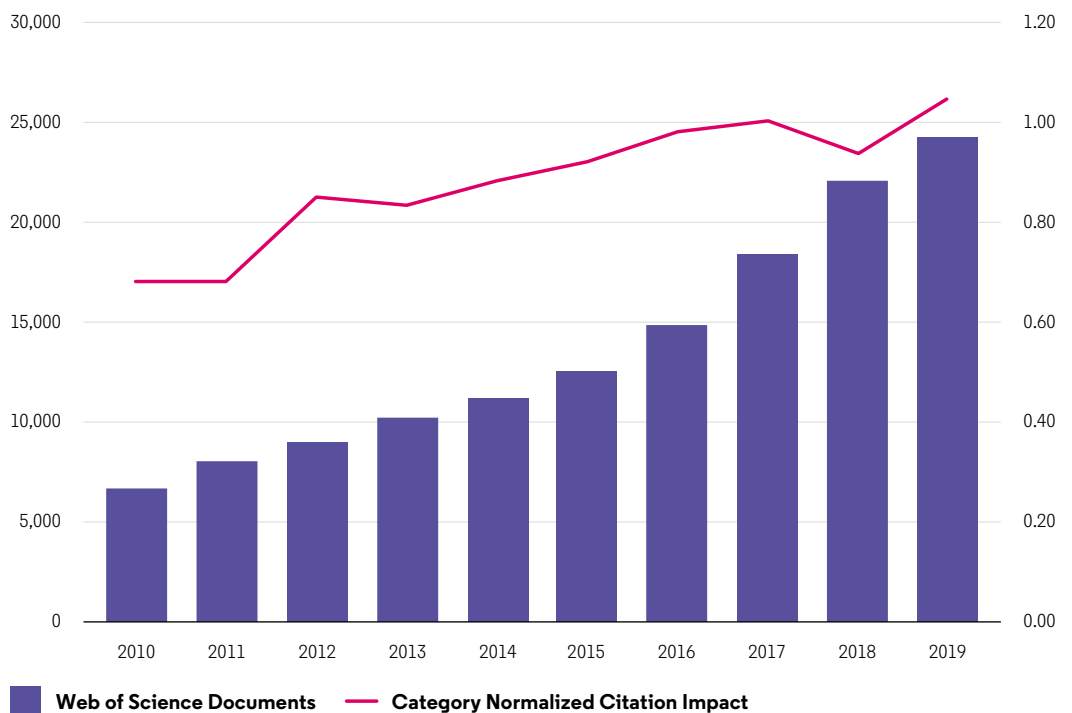
Despite this, on average, Pakistan's normalized research impact (CNCI) was below the world average. 2019 was the first year in which the normalized impact was slightly higher than the world average.

300%

growth in all types of research publications

Pakistan's publications indexed in Web of science are on the rise

Figure 1. Pakistan's publications and CNCI in Web of Science



Pakistan's impact in comparison to other countries

Monitor your changing position in the global research landscape

The data from the Web of Science Core Collection is analysed with Incites Benchmarking & Analytics, which allows one to monitor scholarly publication trends against any selected group of countries.

This graph is showing the contextualized impact of research for all disciplines by normalizing data for subject area, publication date and types of documents of selected countries versus Pakistan for the time period 2010-2019.

CNCI minimizes the effect of a country's size on its scientific productivity and provides an image of citation performance of the entire productivity regardless of the volume.

With the field world average being yearly normalized to 1, we gain a more accurate understanding of how countries are performing against each other and the world.

The above chart shows the evolution of Pakistan's research impact that peaked in 2019 with a Category Normalized Citation Impact (CNCI) of 1.03.

Increasing the citation footprint will have a positive influence on the Category Normalized Citation Impact. The main drivers of this growth are the percentage of Highly Cited Publications (top 1% in their field) and more importantly the percentage of documents in quartile 1 (Q1) journals.

Figure 2. Category normalized citation impact

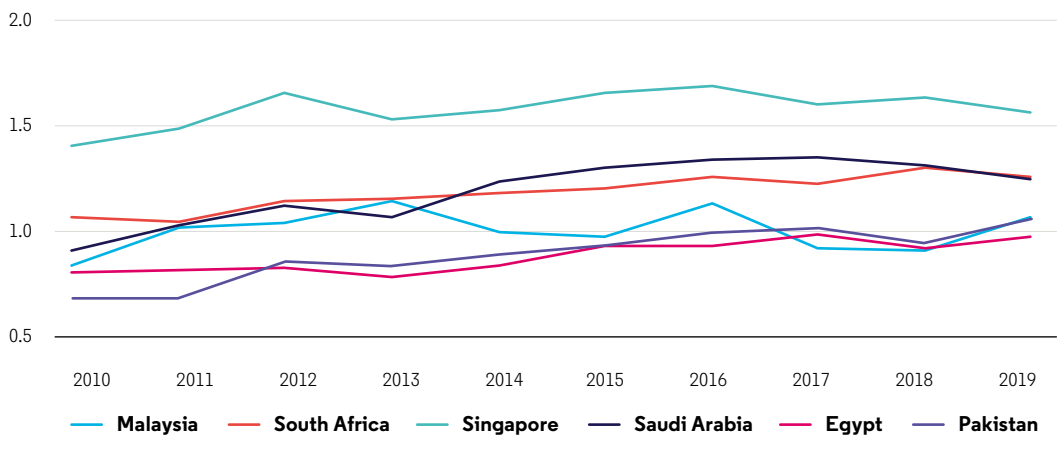
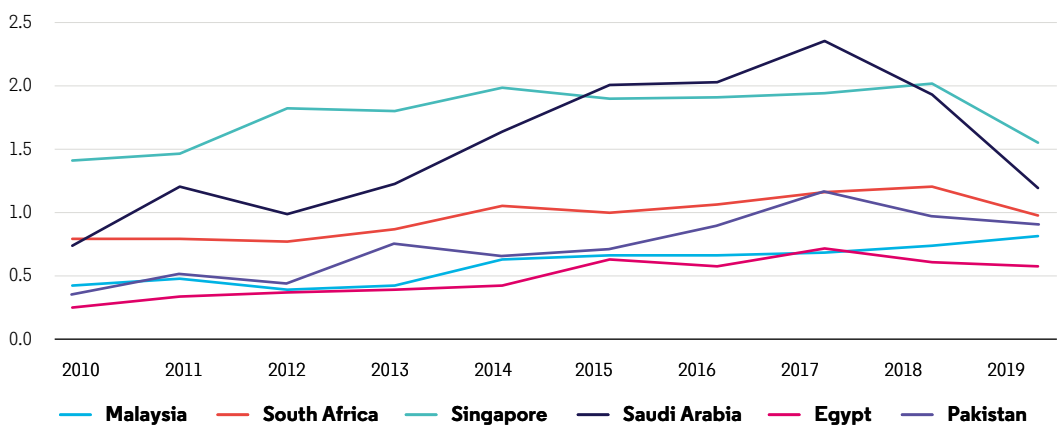


Figure 3. % Highly Cited Papers from total productivity



Although Highly Cited Papers (HCP) represent less than 0.02% of Pakistan's total productivity, they bring more than 25% of total citations received by the country between 2010-2019.

Highly Cited Papers are indicators of scientific excellence and top performance, and can be used to benchmark research performance against field baselines worldwide.

The highest percentage of HCP was in 2017, but we've seen a decline as a result of increasing productivity among other reasons.

The fact that HCP receive so many citations might be a sign of too much focus on fundamental research, although this would need further investigation.

In many countries, we usually see a balance where fundamental research would be the starting point leading to applied research.

The below graph shows that Pakistan has the lowest percentage of documents in Q1 Journals when compared to the set of other countries chosen. This might be a confirmation of the dynamics described

previously, where concentration of citations in top publications (Highly Cited Papers) in the latest years leads to a citation gap from the rest of the research published by Pakistani authors.

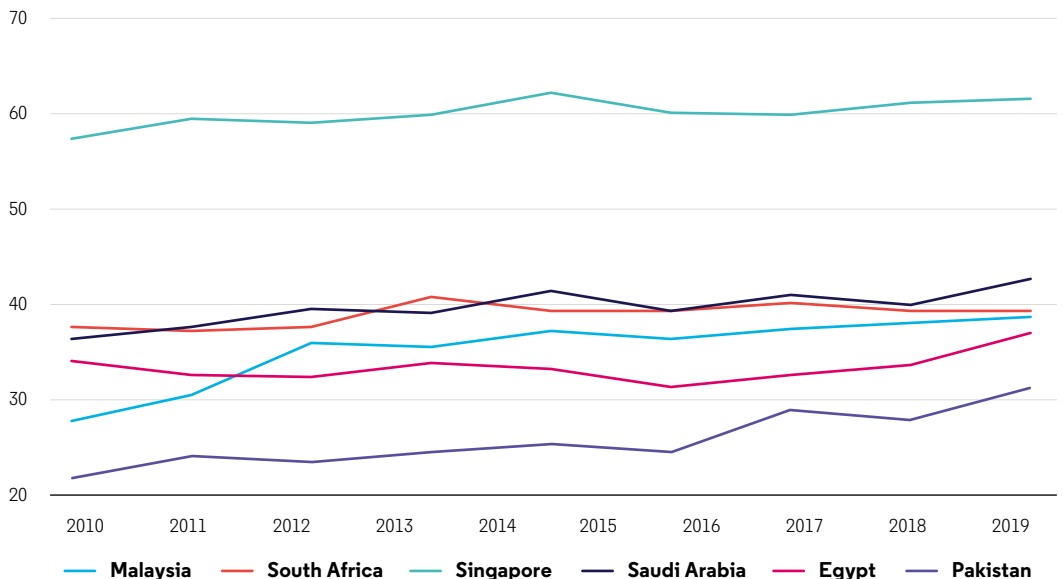
This might affect the overall citations of Pakistan's research because more than half of the productivity is published in Q3, Q4 journals and publications without Journal Impact Factor, which generally have a lower expected citation rate.

In recent years, we are seeing a shift to a more balanced research focus, which might lead to a gradual increase in the overall citation footprint.

The percentage of publications in Q1 is increasing in recent years and this coincides with the increase of the country's CNCI.

One of the indicators that might increase the country's CNCI is the percentage of documents cited. It is worth mentioning that Pakistan has considerable room for improvement when it comes to this indicator, and if Pakistan manages to slightly improve on this indicator, it will reflect positively on the overall country's research impact.

Figure 4. % Documents in Q1 Journals



A second area for improvement is the percentage of documents in top 10% in their field. A good example is Singapore, where we see a high percentage of Highly Cited Papers, but also a high percentage of documents in top 10% in their fields.

Figure 5. % Documents Cited

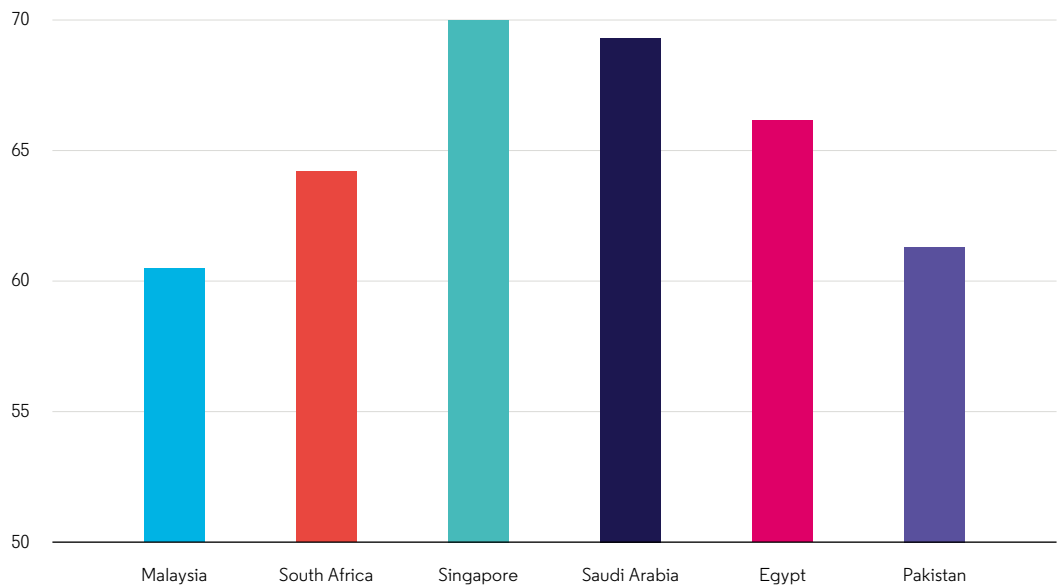
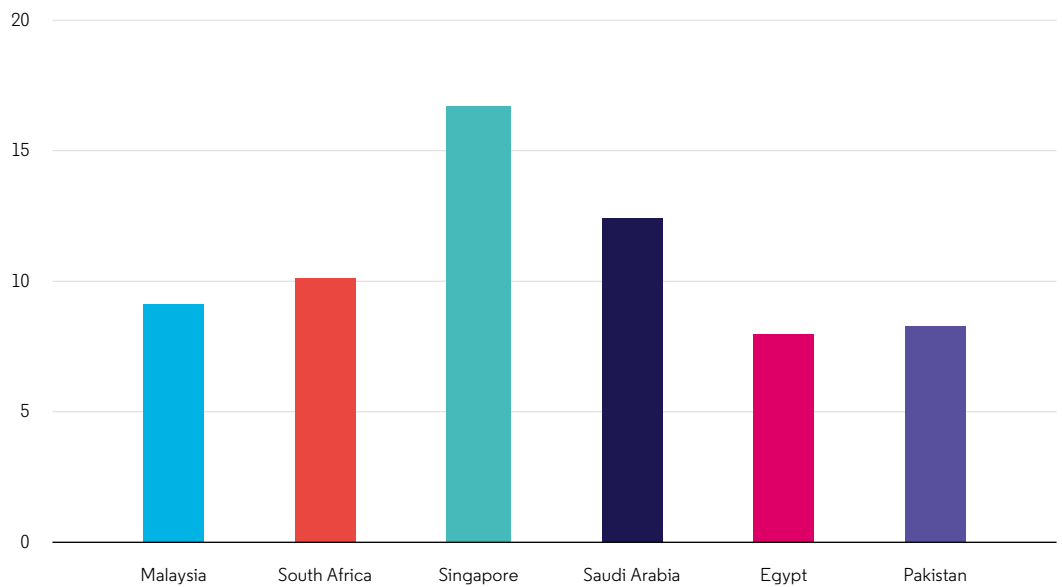
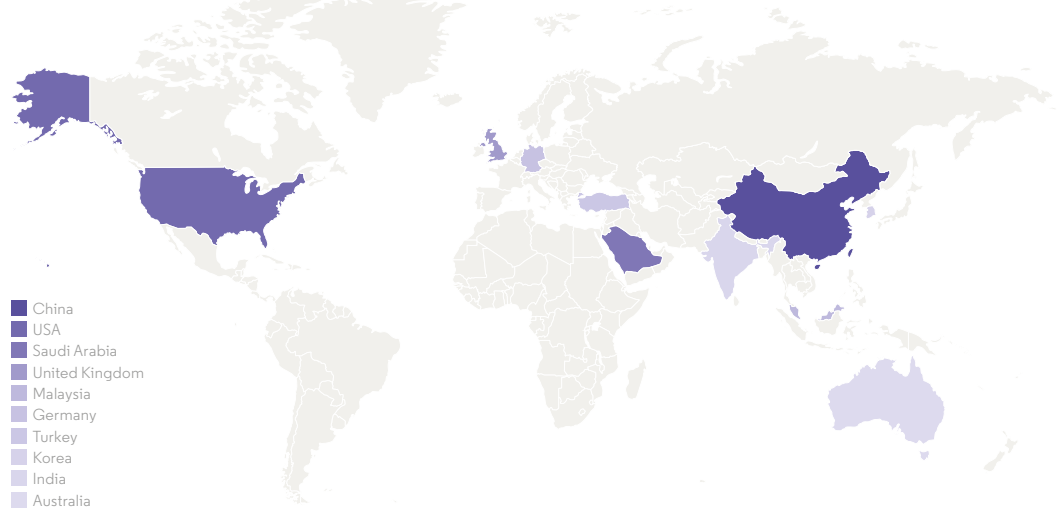


Figure 6. % Documents in Top 10%



International research collaborations are pivotal for the increase of Pakistan's research impact

Figure 7. Pakistan's international collaborations



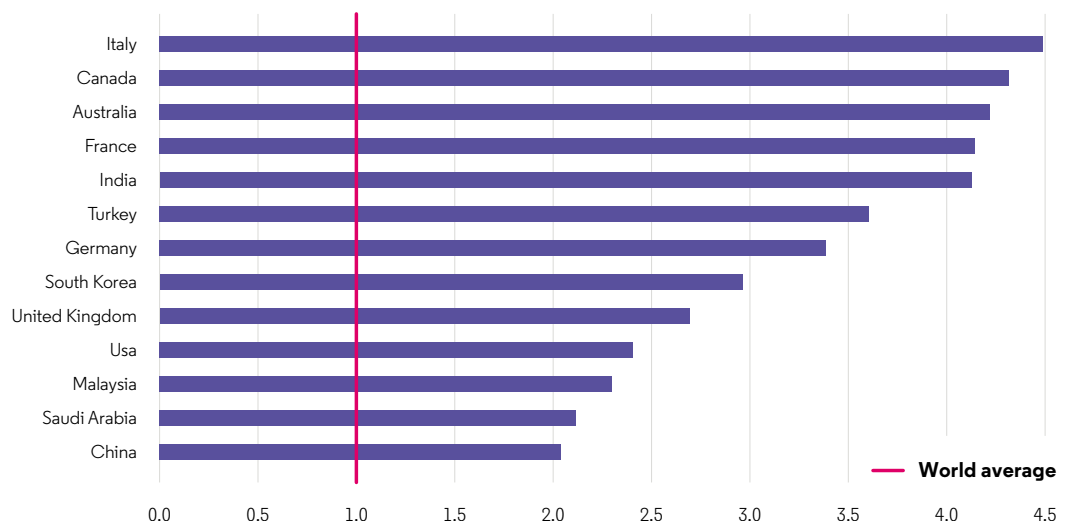
Pakistan has partnered with **China** the most, as indicated by with the highest number of collaborative publications (**14,356**).

USA (11,333) ranked second followed by **Saudi Arabia (10,441)** and **United Kingdom (8,255)**. The following countries also published a substantial amount of publications with Pakistan: **Malaysia (5,947)**, **Germany (4,926)**, **Turkey (3,563)**, **Korea (5,462)**, **India (3,972)**, **Australia (3,352)**.

Category Normalized Citation Impact of Pakistan's international collaborations in the last ten years is higher than the world average, as seen in the graph below.

This is a sign of the quality of research undertaken via international collaborations with Pakistan and a further analysis can help identify areas that can be supported for an increased ROI.

Figure 8. Category Normalized Citation Impact of Pakistan's collaborations



Pakistan's publications in the top global research journals

Pakistan's publications in top quartile journals are on the rise

Web of Science platform indexes all types of scientific publications: journals, proceedings, data sets etc. Approximately 22,000 journals can be found on the platform with half of them having a Journal Impact Factor (JIF).

66% of Pakistan's scientific publications are published in Journals with Impact Factor (JIF).

Journal Impact Factor is a proxy indicator for the importance (impact) of a journal in a field by measuring the citation frequencies. We can rank the journals in a field by comparing journals by Impact Factor.

A simplified ranking system can be obtained by using journal's quartile ranking. If a journal falls in quartile (Q1), it means that the journal performs better than 75% of journals in that category, based on its Impact Factor score.

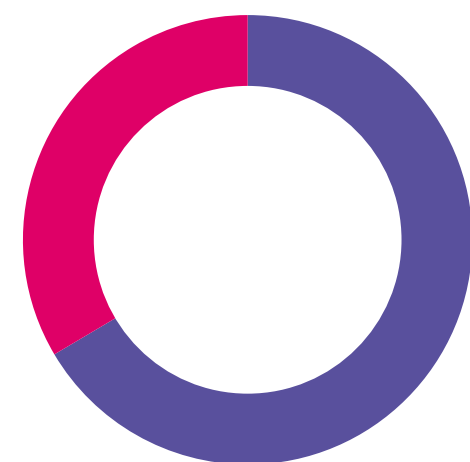
In the last 10 years, more than half of the Pakistan's research was published in journals with Impact Factor. More importantly, global influence of Pakistan's research seems to be increasing as Pakistan's scientists are now publishing in top quartile journals.

Between 2008- 2018, the number of Pakistan's publications in quartile 1 (Q1) and quartile 2 (Q2) journals has increased, while the percentage of publications in quartile 3 (Q3) and quartile 4 (Q4) journals is decreasing.

66%

of Pakistan's scientific papers are published in Journals with Impact Factor (JIF).

Figure 9. Pakistan's publication output across publications with JIF and without JIF

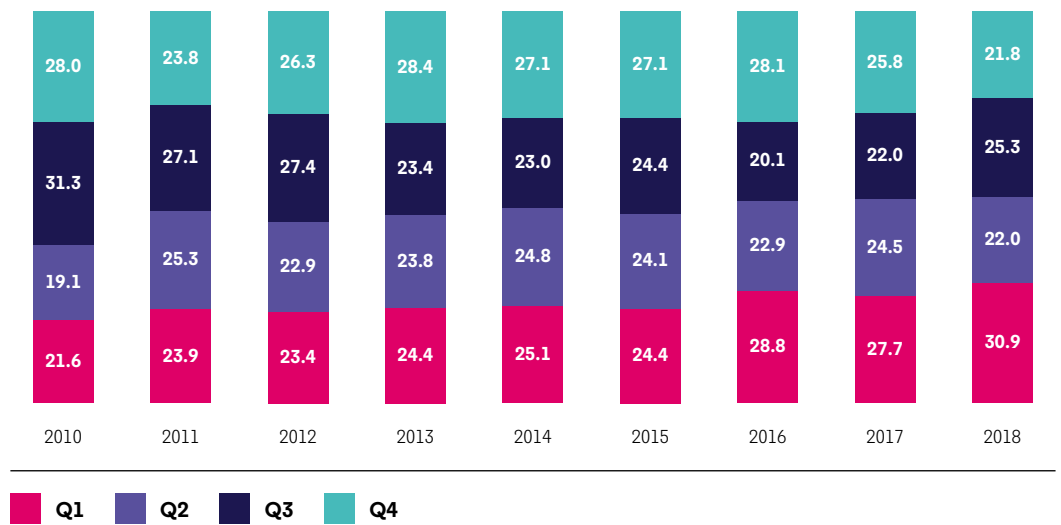


89,769 Documents in JIF Journals
45,254 Documents in non-JIF publications

Non-JIF documents are conference proceedings, books, books chapters and articles published in Emerging Sources Citation Index (ESCI).

Pakistan has a balanced coverage of documents in JIF and non-JIF journals. Part of the Web of Science Core Collection, Emerging Sources Citation Index contains quality publications, selected by our expert in-house editors for editorial rigor and best practice at a journal level. The ESCI journals do not have JIF, probably because of the local citation footprint, which often tends to be low. But with international exposure brought by WOS, we aim to enhance the journal visibility and ultimately support collaborations that will speed-up the impact of local research on the society.

Figure 10. Percentage of Pakistan's research publications published in JIF journals, in each of the four quartiles



Pakistan's productivity has increased annually - quality of the publications was not affected by this big push on quantity. Even better, the proportion of documents in Q1 journals increased, which is a great indication of the quality and potential of local research.

The following page lists the top 20 journals ranked by citations received by documents with Pakistani authors.

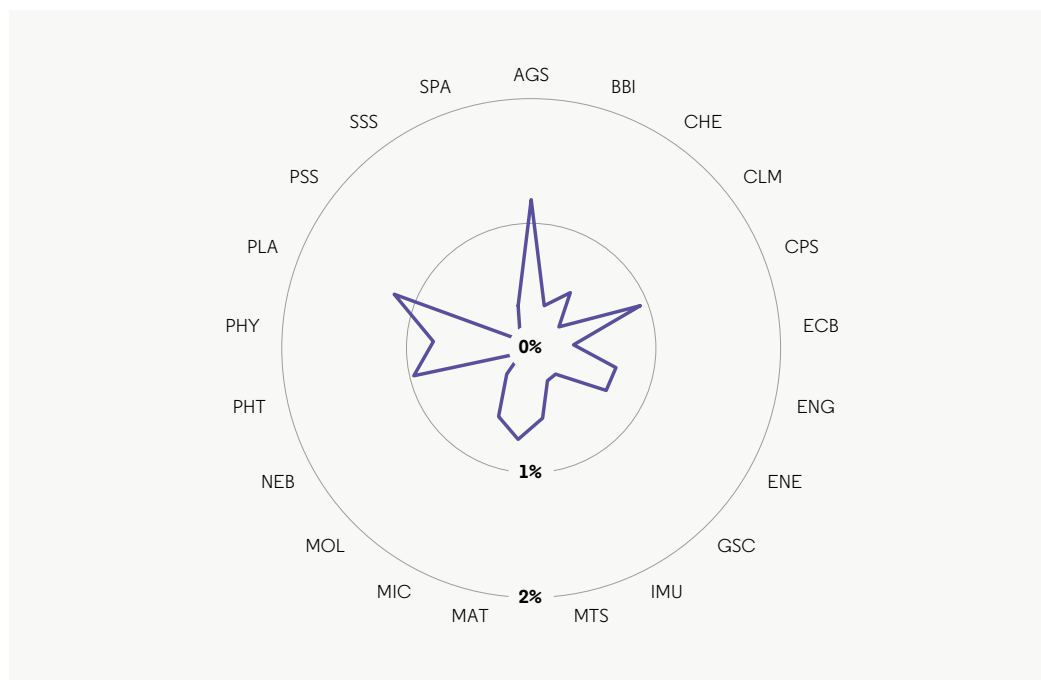
Majority of journals are Q1 and Q2 journals but looking at the number of documents published, we see that Q4 has a high coverage.

This could, however, lead to a diluted impact, signalling that the focus of current research might be to publish in order to meet the requirements. A deeper analysis of the publication dynamics by journals will help to build relevant policies that increase local scientific visibility without affecting quality.

Name	Web of Science Documents	Times Cited	% Documents Cited	Journal Impact Factor	Quartile	Category Normalized Citation Impact
Lancet	209	57,599	88.04	59.102	Q1	30.24
Nature	28	19,063	89.29	43.07	Q1	43.71
Physics Letters B	312	18,186	95.51	4.162	Q2	4.53
Pakistan Journal of Botany	2389	13,561	83.13	0.672	Q4	0.40
Physical Review Letters	210	10,937	93.33	9.227	Q1	4.12
Journal of High Energy Physics	380	10,553	90.26	5.833	Q1	2.07
International Journal of Heat and Mass Transfer	208	9,511	97.60	4.346	Q1	7.95
Renewable & Sustainable Energy Reviews	251	9,109	98.80	10.556	Q1	1.02
Plos One	767	8,921	86.18	2.776	Q2	1.12
European Physical Journal C	301	8,715	95.35	4.843	Q1	2.31
Nature Genetics	38	8,218	97.37	25.455	Q1	14.49
Journal of Molecular Liquids	364	8,197	92.31	4.561	Q1	3.01
Journal of the Pakistan Medical Association	2961	6,769	57.08	0.642	Q4	0.22
Journal of Magnetism and Magnetic Materials	255	6,204	90.59	2.683	Q2	1.62
Chemosphere	169	5,631	85.21	5.108	Q1	2.55

Disciplinary focus of Pakistan's research

Figure 11. Research Output by ESI field - Pakistan Relative Share vs the World



Pakistan had a relatively high share of research output in:

Pakistan had a relatively high share of research output in Agricultural Sciences is an area with high potential for increasing the impact of Pakistan's research, due to the high share of research output when compared with international trends in productivity.

It is worth mentioning that Agricultural Sciences research ranked 7th in terms of Pakistan's documents published in last 10 years.

For this analysis we used Essential Science Indicators (ESI) Research Areas which only includes those articles and reviews from Science Citation Index Expanded and Social Science Citation Index. Excluded from results are publications from Arts & Humanities, Conference Proceedings Citation Index, and Book Citation Index.

Pakistan had a relatively high share of research output in:

Share	Field
1.19%	Agricultural Sciences (AGS)
1.18%	Plant & Animal Science (PLA)
0.97%	Pharmacology & Toxicology (PHT)
0.94%	Computer Science (CPS)
0.79%	Physics (PHY)
0.75%	Mathematics (MAT)

Its relative share was low in the fields of:

Share	Field
0.09%	Neuroscience & Behavior (NEB)
0.11%	Psychiatry/Psychology (PSS)

Subject area comparison

Productivity vs Normalized Citation Impact

Web of Science platform indexes all types of scientific publications: journals, proceedings, data sets etc. Approximately 22,000 journals can be found on the platform with half of them having a Journal Impact Factor (JIF).

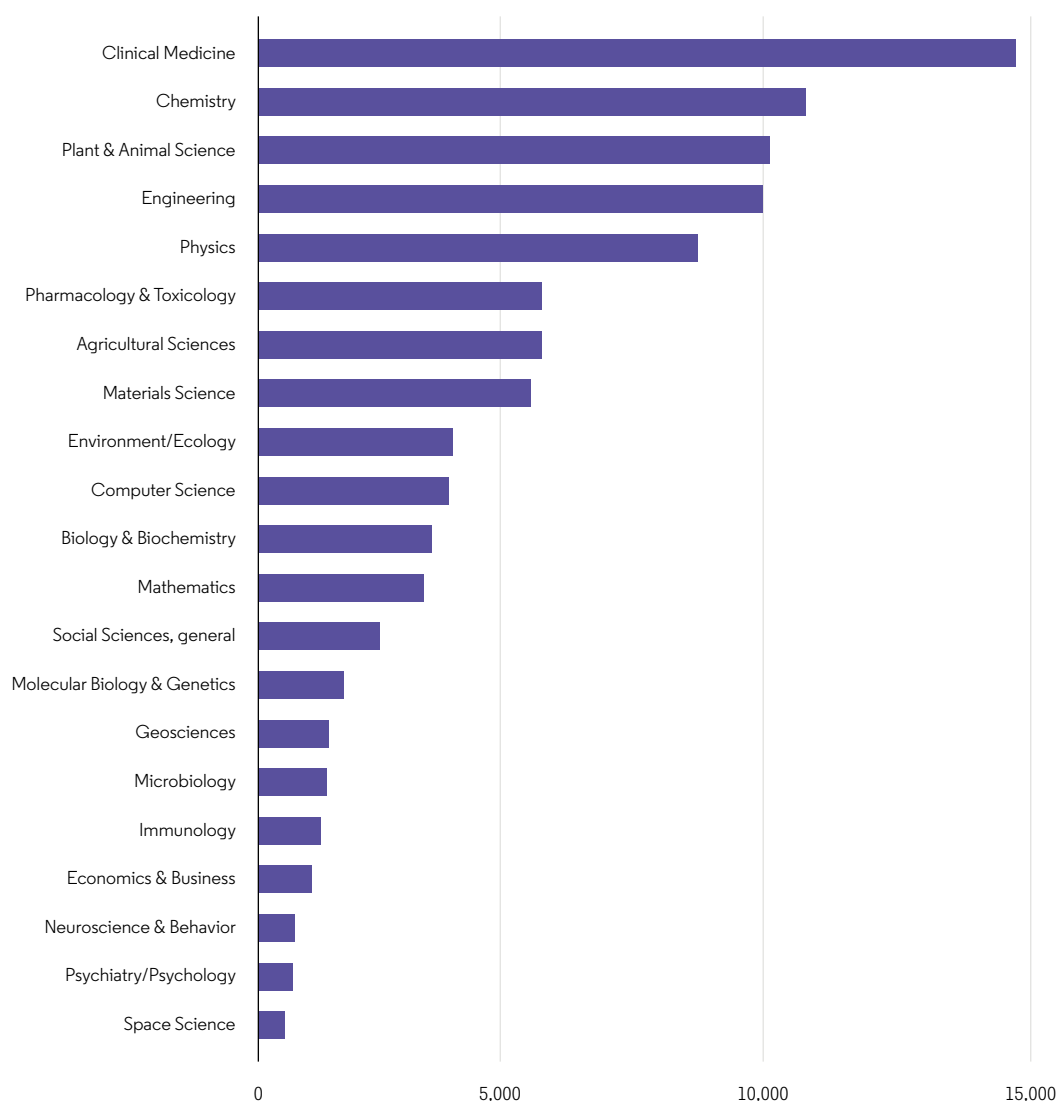
Pakistan published the highest number of publications in Clinical Medicine (14,752) and Chemistry (10,660). Publications in these two categories accounted for 19% of Pakistan's total output of publications between 2010 and 2019.

Pakistan also actively published in Plant & Animal Science (9,976), Engineering (9,804) and Physics (8,552).

Compared to the large output in Clinical Medicine, Pakistan published significantly less in research areas such as Geosciences, Economics & Business and Neuroscience & Behavior.

In addition to this, Pakistan's output in Space Science and Psychiatry/Psychology was relatively low, though it is also low worldwide in the case of space science.

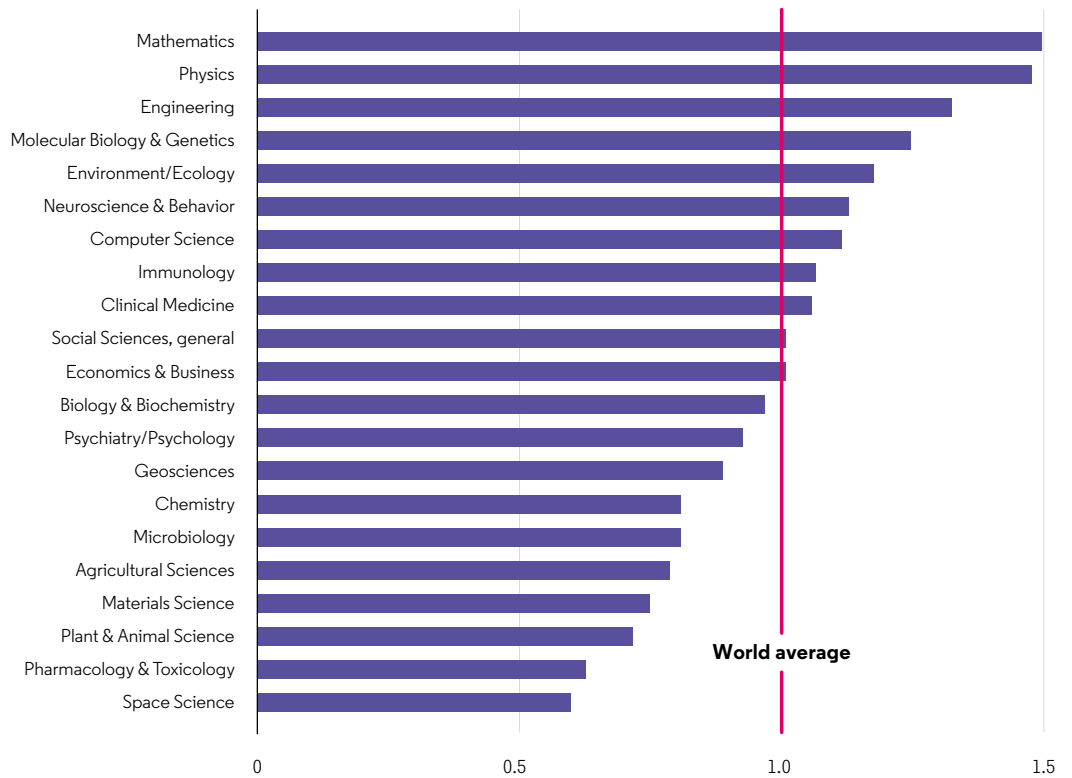
Figure 12. Pakistan's output by research areas



Pakistan has the best CNCI in Mathematics and Physics, showing a high performance in fundamental research. Also, we notice that Engineering and Economics & Business has an impact (CNCI) which is higher than the world average - this might be seen as a shift towards applied research.

Medical Sciences performed well, but due to the high productivity in Clinical Medicine, the impact is slightly diluted, but is still higher than the global average.

Figure 13. Pakistan's Normalized Impact by research areas

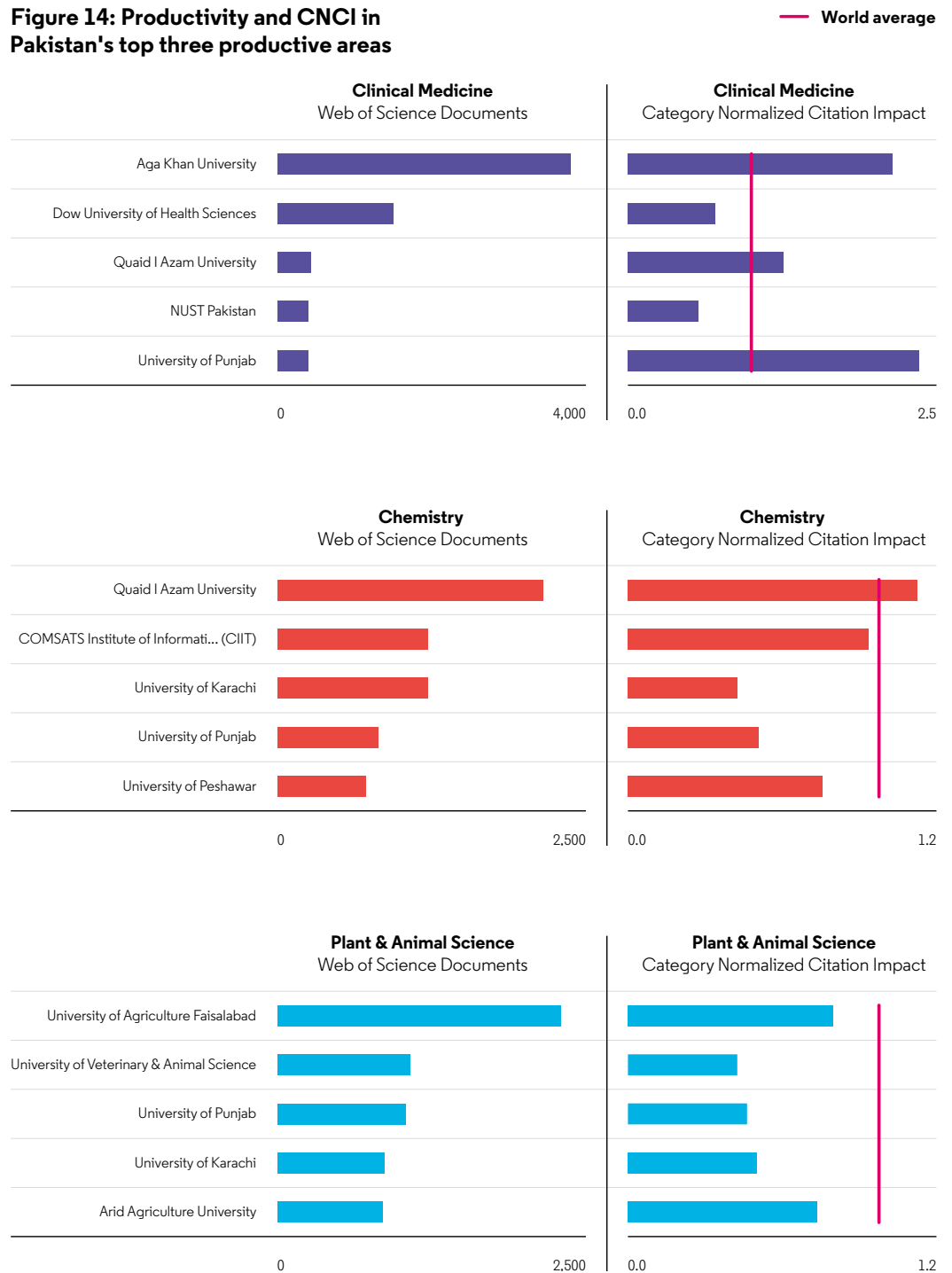


In the following graphs we look at Pakistan's three most productive areas from the institution's perspective and their impact. We can hence identify centres of excellence that could be pivotal in increasing the country's research impact and identify areas for improvement.

Below we see some institutions with high productivity, but with normalized impact lower than the world average.

This might be an indicator of the institution being in a growth period and research quality might improve in time. For example, the same is seen in Plant & Animal Science, where all top productive institutions' impact (CNCI) is lower than the world average. In Clinical Medicine, Aga Khan University owns a big proportion of the country's productivity and more importantly the impact is double the world's average impact.

Figure 14: Productivity and CNCI in Pakistan's top three productive areas



Pakistan's research institutions

Pakistan's top 20 universities and research organizations by number of publications

Figure 15.



Among Pakistani institutions, COMSATS Institute of Information Technology (CIIT), Quaid I Azam University and University of Agriculture Faisalabad led in terms of the number of publications published. Of these, Quaid I Azam University and COMSATS are institutions with over 9,000 publications published in the report period.

Pakistan's top 20 universities and research organizations by Normalized Impact (CNCI)

Figure 1 .



Six universities and research organizations had an impact (CNCI) higher than the world average:

- National Centre for Physics - Pakistan
- Aga Khan University
- Quaid I Azam University
- COMSATS Institute of Information Technology (CIIT)
- University of Peshawar
- Lahore University of Management Sciences (LUMS)

This clearly serves as a confirmation of the local research quality potential and a deeper analysis will discover pockets of excellence in universities and research organizations with CNCI lower than the world average. This can be an example of how best practice could lead to a relevant institutional R&D strategy which is more consistent with the national requirements.

Patent landscape overview

We used databases from World Intellectual Property Organization (WIPO) and a few IP offices, in addition to Derwent Innovation (DI) to analyse patenting activities in Pakistan and worldwide. Hopefully, we can in the future collaborate with Pakistan's patent office and include its database for future analyses.

Using patent and non-patent data sources, including the Derwent World Patents Index (DWPI) and Web of Science, enables us to have a comprehensive approach to the topic. In order to have accurate analysis counting inventions rather than individual patent documents, we have used Derwent Innovation that structures the patents into patent families.

Derwent Innovation is the world's leading proprietary patent research solution – connecting exclusive, curated patent data with authoritative research applications to support the commercial success of the world's most innovative institutions. It is the driving force behind confident, commercial decisions being made daily – technology trends and competitive intelligence, Freedom to Operate (FTO) opinions, patent filings, monetization and litigation defence activities. Derwent Innovation delivers trusted, commercial insights across the innovation lifecycle.

Pakistan is currently ranked 105th in the Global Innovation Index ranking, with a total score of 25.37 points on the 100-point scale.

Evaluating a total of 79 indicators, the Global Innovation Index covered 121 economies on “Effective Innovation Policies for Development” for the year 2019. It analysed the effectiveness of government efforts and their impact on the economy’s degree of development. The following activities would help in improving the innovation landscape in Pakistan.

- Target oriented approaches in R&D and innovation
- A focus on economic growth through innovation by creating a knowledge economy as part of the national strategy
- A focus on a shift to indigenous patenting, especially for technologies coming from government investment in research & development
- Support mechanism for the establishment of research, development institutes and universities

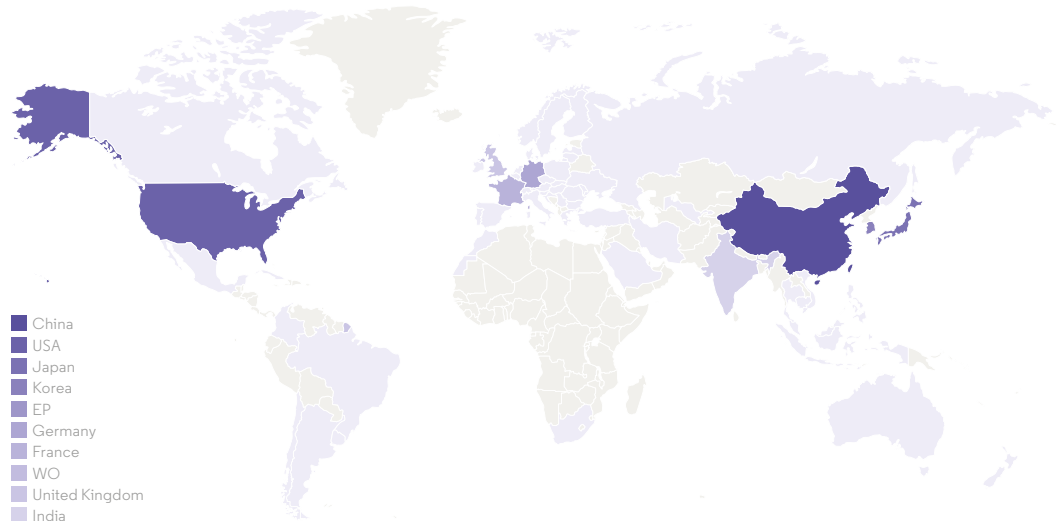
- Convert research results to commercial products

The Derwent Research analysis suggests that the current innovation landscape in Pakistan is focused significantly on the following technologies - Exercise Equipment / Games, Pharmaceuticals/Medical, and Computer Technology. However, very few innovations are protected in the field of Chemical Engineering such as Filtration and Gas Separation.

As we've seen in the scientific field analysis, Clinical Medicine is one of the top three most active research areas in Pakistan. The analysis below suggests potential markets for commercialization.

The figure shows that South Korea, Russia, United States, Japan, and Taiwan are the top 5 locations for geographic protection. Thus, these are the regions for targeting market and potential growth opportunities.

Figure 17. Worldwide patent filings in Medicine



The below figure highlights the top 5 players in the recent years in the field of Medicine. The innovation space is dominated heavily by Japanese innovators, including Olympus, Canon, and Fujifilm.

Figure 18. Number of patents filed by top 5 organizations

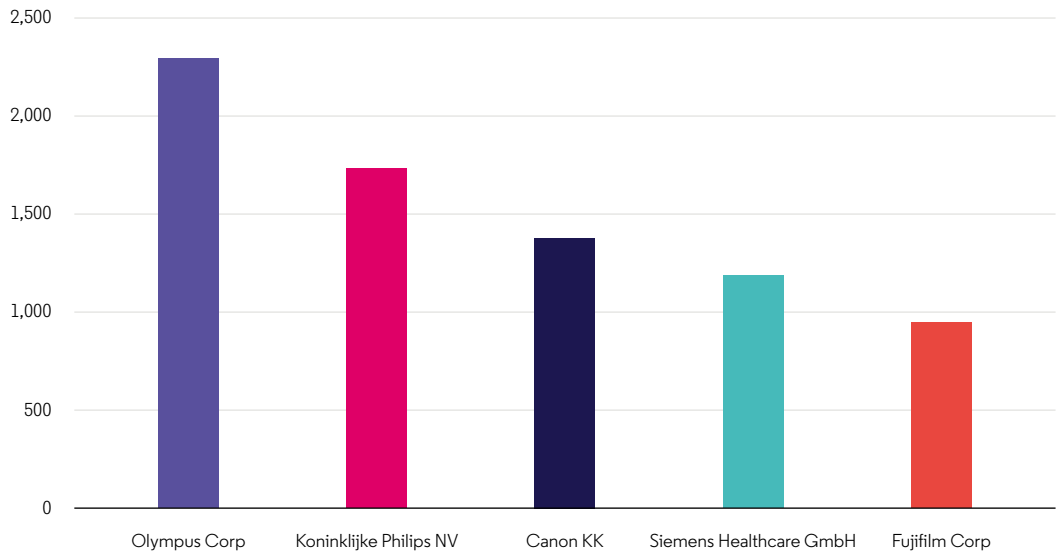


Figure 19. Pakistani patent applications



The chart shows that overall innovation activities from residents of Pakistan is generally improving every year.

However, it is quite critical to have a higher number of foreign filings to claim a broad protection of the technologies developed in Pakistan.

The statistics are based on data collected from IP offices or extracted from WIPO's operational databases. A resident filing refers to an application filed in the country by its own resident; whereas a non-resident filing refers to the one filed by a foreign applicant. An abroad filing refers to an application filed by this country's resident at a foreign office.

Pakistan's publications in the core of Research Fronts

Research Fronts are formed by clusters of high-impact publications (those in the world's top 1 % by citation counts taking their field and year of publication into account) that are frequently cited together.

Since the 1970s, it has been recognised that publications that are cited together (co-cited) often discuss related subject matter.

In Research Front analysis, these co-cited publications constitute the "core" of the front. Where these clusters of related publications received many citations, it can be assumed that they have had a large academic impact on the subject to which they relate.

Below, is a sampling of core publications whose authors include Pakistan-based researchers, in Research Fronts representing multiple subject fields.

Article name	Research field	Publication date
Modeling systemic risk and dependence structure between oil and stock markets using a variational mode decomposition-based copula method	Economics & Business	2017
The multiple pathways through which internal and external corporate social responsibility influence organizational identification and multifoci outcomes: The moderating role of cultural and social orientations	Economics & Business	2017
Drought stress in grain legumes during reproduction and grain filling	Agricultural Sciences	2017
Exogenously applied plant growth regulators affect heat-stressed rice pollens	Agricultural Sciences	2016
Microencapsulation of oils: A comprehensive review of benefits, techniques, and applications	Agricultural Sciences	2016
The CMS trigger system	Chemistry	2017

Article name	Research field	Publication date
Stagnation point flow with cattaneo-christov heat flux and homogeneous-heterogeneous reactions	Chemistry	2016
Performance of electron reconstruction and selection with the CMS detector in proton-proton collisions at $\sqrt{s}=8$ tev	Chemistry	2015
Aspirin in patients undergoing noncardiac surgery	Clinical Medicine	2014
Three dimensional mesoscopic simulation of magnetic field effect on natural convection of nanofluid	Engineering	2015
Urinary sodium and potassium excretion, mortality, and cardiovascular events	Clinical Medicine	2014
Precise determination of the mass of the Higgs Boson and tests of compatibility of its couplings with the standard model predictions using proton collisions at 7 and 8 tev	Physics	2015
Every newborn: progress, priorities, and potential beyond survival	Clinical Medicine	2014
Biochar as a sorbent for contaminant management in soil and water: A review	Environment/Ecology	2014
Trends in adult body-mass index in 200 countries from 1975 to 2014: A pooled analysis of 1698 population-based measurement studies with 19.2 million participants	Clinical Medicine	2016
Genetic studies of body mass index yield new insights for obesity biology	Molecular Biology & Genetics	2015
Comprehensive molecular profiling of lung adenocarcinoma	Clinical Medicine	2014
Analysis of protein-coding genetic variation in 60,706 humans	Molecular Biology & Genetics	2016

High value outcomes within our research ecosystem by Pakistan for 2019.

Prepare and access: formulate research strategy

Web of Science	352,219 queries
Web of Science	60,054 clicks to full-text
Open Access	8,717 clicks to OA full-text
Web of Science	15,092 Analyze Results
Records used	8,921,466 records used
API	25,765 queries

Fund: evaluate funding opportunities

Web of Science	17,617 Citation Reports created
Web of Science	15,092 Analyze Results
Journal Citation Reports	40,259 queries of Journal Impact Factor
InCites	B&A see funders that have supported previous work
Vivo	Showcase your work and find collaborators
CRIS system	To assist with grant management

Publish: prepare and submit manuscript

Web of Science	1,560 Analyze Results to find top journals
Journal Citation Report	38,359 views of Journal Impact Factor via overlay ScholarOne seamless workflow tool for manuscript submission & peer review

Assess and promote: measure research impact

Journal Citation Reports	19,921 sessions of Journal Impact Factor
API	25,765 queries to enrich your internal systems
Web of Science	3,160 uses of Organization-Enhanced
Web of Science	37,371 Citation events created
Web of Science	15,092 Analyze Results
	InCites benchmark against peers and evaluate internal performance
	Vivo showcase your work and find collaborators
	CRIS system to help you manage the entire research

Explore your contribution to Open Access publishing

The Web of Science supports research community goals of providing easier access to global scholarly literature across all research disciplines. Full text usage from the Web of Science platform significantly increased by including better identification of Open Access publications already indexed. Open Access has seen a high increase in the last 10 years and Pakistan is part of this trend even with a slightly higher percent of Open Access publication published in latest years.

- ✓ Which Pakistani authors publish Open Access most frequently?
- ✓ In which journals do Pakistan's authors publish Open Access?
- ✓ See the connections between funding, citations, and OA

Figure 20. Dynamic of world productivity

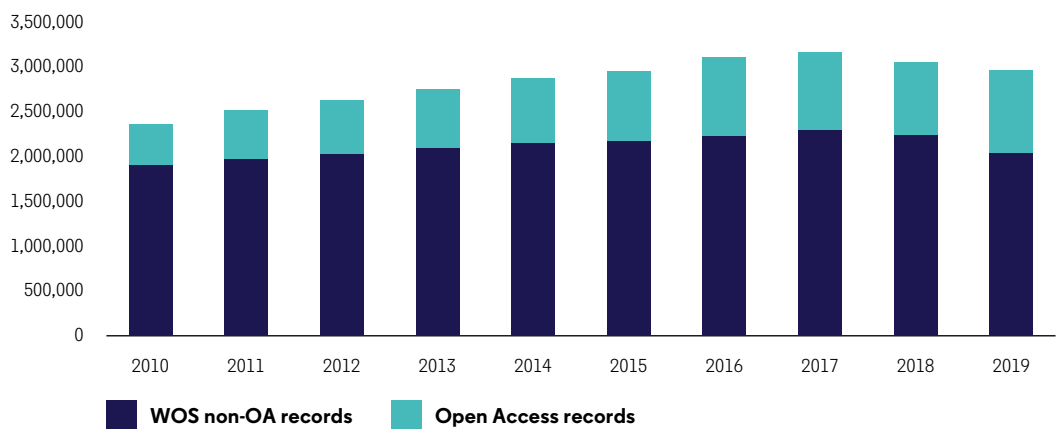
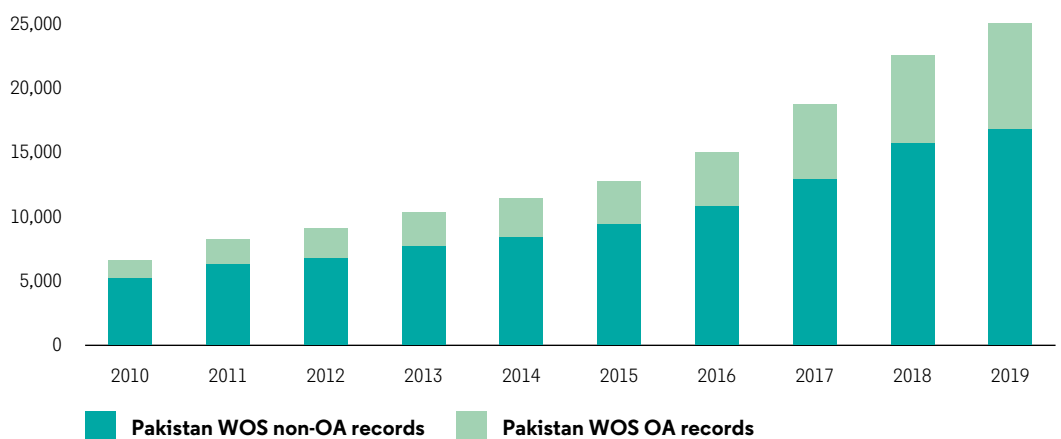
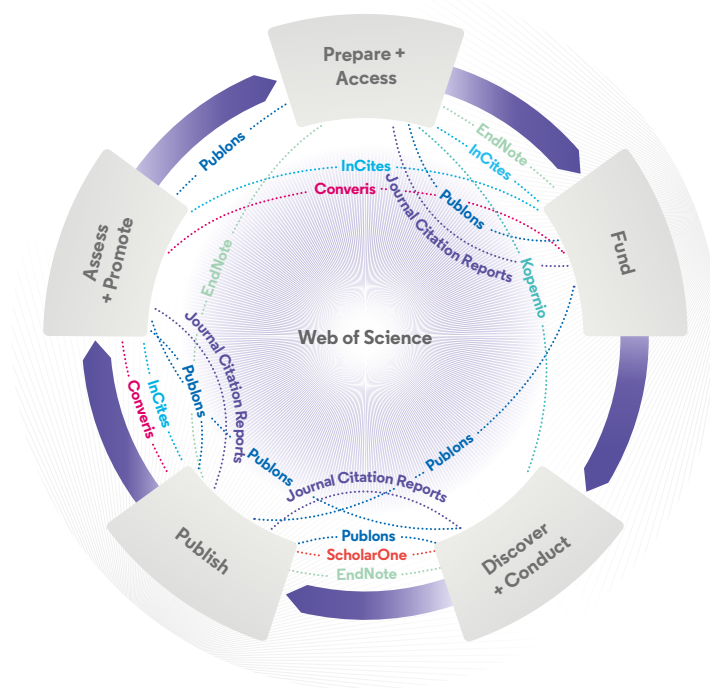


Figure 21. Dynamic of Pakistan productivity OA vs non-OA



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