

Science in Qatar- Annual Report of the Analysis of the Research Publications-2019

Report prepared by the Digital Information Research Labs, India & UK

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ABSTRACT: This report has been commissioned by the Digital Information Research Lab (India & UK) based on interaction with Virginia Commonwealth University of Qatar. This report is a basic reflection of the current research outcome of the Qatar. This work uses the bibliometric measures to outline the research carried out in Qatar. This report is only informative and reports the output. This report is neither strategic nor critical. However, we planned to do more detailed investigation and suggest the future possible S & T policy for Qatar. Qatar research is increasingly improving and cited internationally and Qatar is also initiating efforts to boost the research output. Taken together, these factors may serve to reinforce the Qatar's central position in the global collaboration network and also make the Qatar an attractive destination for researchers from other countries.

“Do international knowledge networks contribute to research excellence and can they address local needs and national capacity-building as well?”-OECD. This question perhaps is well answered by Qatar. Qatar is the illustrative example and can signal the world that scientific collaboration is fruitful for recording innovation.

1. Introduction

Progress in research is analogous to the scientific growth of nations, and the economic and technological prosperity. Hence, the science carried out in a country needs to be assessed and suitable policies should be framed to increase the science contribution of countries. Thus, many nations regularly carry out this exercise and stock take the scientific research environment. The big countries such as US, UK, Australia, China and others bring annual science growth measurements. In smaller countries, these kinds of activities are now started.

Science assessment reports usually provide a country's share of the world's indexed articles, citations and highly cited papers in addition to the same values per researcher and per unit research expenditure (Elsevier, 2013), as well as diagrams showing changes over time in the relationship between article share and average impact (Mike Thelwall, Ruth Fairclough).

In the middle-east countries, the regular compilation of research assessment is not yet begun. There are many individual studies that reported that research productivity of them in a given time. Qatar is no longer a small country in the world of big science. It is ascending in its capacity for scientific research, invention, contribution and global cooperation. Qatar is not depending on any one country for its science capacity building and tend to collaborate with many countries.

It is well understood that the major determinants of this century economic growth are not physical assets but intangibles such as education, knowledge and science. Qatar has a long tradition to carry research at universities and/or with a strong cooperation with higher education institutions. Even though the number of agents involved in the knowledge creation has risen, universities are present at all stages of knowledge creation- starting from the knowledge production, diffusion through the process of education and, finally, application. Academic research becomes even more important in the view of so-called 'third mission' of universities – collaboration of academia with business and environment – that can enhance knowledge spill over and its practical application. Consequently, research performed within higher education systems is an essential factor of scientific, economic and societal growth and progress.

Qatar to secure its aims, needs to overcome significant obstacles. Having started from a low base, Qatar's scientific capabilities are still far from world-class in most areas, while its capacity for technological innovation is far less robust than those of advanced industrial economies. Qatar's model of incentives for innovation in the educational and research sectors are rewarding, and an educational system more geared to test-taking than cultivating creative thinking of the researchers and lead the performance of the innovation system.

Qatar aims to create the world-class research universities; the best example is the new Hamad bin Khalifa University. The Qatar National Research Strategy (QNRS) of 2012 reflects extensive input from Qatar's research leadership, researchers and other stakeholders. The QNRS 2014 report additionally focussed on Qatar's Grand Challenges with farther details in Water Security, Energy Security, Cyber Security and Health. (<https://www.qnrf.org/en-us/About-Us/QNRS>). It outlined a few core programs such as the Networking Young Researchers, and Establishing national networks of young scientists via communication mechanisms such as CIT platforms and award schemes- (the Qatar Science Leadership Programme -QSLP).

In an interview to the OECD, Ahmad O. Hasnah of the Qatar Foundation viewed that building a true research culture is a lengthy and expensive investment but one which is essential to long-term growth and prosperity; finally, policy-makers must face this reality.

2. Mission of this Report

As outlined earlier, there is no regular research assessment indicators created in Qatar. To initiate these kind of efforts, we have conducted a macro level study of the Qatar's research productivity for a decade. However, detailed analyses are carried out only for the year 2019. The overall productivity earlier to this period is not analysed in detail and we have presented the total published papers in indexes and the growth.

3. Data Sources and Methodology

The majority of data presented in this report are derived from the two indexes, the Scopus published by Elsevier and Web of Science published by Clarivate Analytics. First to document the volume of the papers produced we took the base years from 2010 to 2019 and tabulated and we never indulged in any specific description except for the year 2019. We have downloaded the research papers produced by the authors with Qatar affiliations. For specific analyses, the year 2019 is only considered.

4. Measure of Growth

Throughout this report, a standard method of measuring change over time is used: Compound Annual Growth Rate (CAGR). CAGR is defined as the year-on-year constant growth rate over a specified period of time. Starting with the earliest value in any series and applying this rate for each of the time intervals yields the amount in the final value of the series.

| Year | No of papers in Scopus | % Increase | No of papers in WoS | % Increase |
|------|------------------------|------------|---------------------|------------|
| 2010 | 794 | | 448 | |
| 2011 | 962 | 21.15% | 563 | 25.66% |
| 2012 | 1348 | 40.12 | 809 | 43.69% |
| 2013 | 1920 | 42.43 | 1179 | 45.73% |
| 2014 | 2810 | 46.35 | 1722 | 46.05% |
| 2015 | 3260 | 15.61 | 2298 | 33.44 |
| 2016 | 3896 | 19.5 | 2896 | 26 |
| 2017 | 3863 | -0.84 | 2944 | 01.65 |
| 2018 | 4003 | 3.62 | 3100 | 5.29 |
| 2019 | 4461 | 11.44 | 3590 | 15.8% |

Table 1. Publication output of Qatar during the last ten years as viewed from WoS and Scopus

The total research papers produced by Qatar during the year 2010-2019 in two datasets Scopus and Web of Science are produced in the table 1 together with the percentile of increase/decrease. The differences in the scientific output in the two datasets are due to the inclusion of journals. The growth was not consistent as the period 2012-2014 was the best of science in Qatar. The year 2017 was not healthy for Qatar's research. In the last five years, Scopus reflected 50% growth whereas WoS reflected 80% increase. As a whole the growth and increase is significant. The data is also projected in the figures 1 and 2.

Qatar researchers published 27317 papers during the last decade, the period from 2010-2019 and this period experienced the total increase of 461% and a mean increase of 22.33% per year as viewed from Scopus. Only in 2017, there is a very minor decrease of 0.84%. As such, the Qatar's share of global article output has increased overall in the period. It should be noted that many European countries witnessed a kind of skewness in this period.

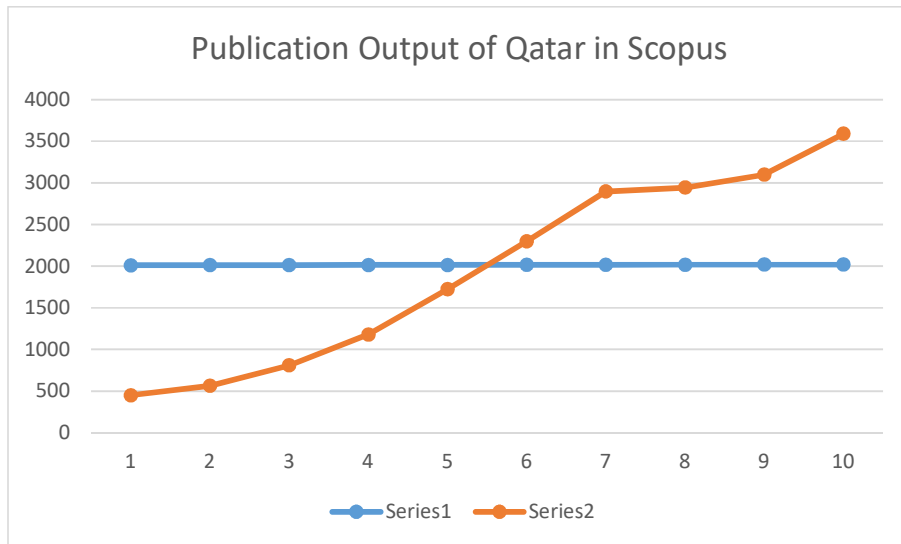


Figure 1. Growth of the total papers for the period 2010-2019 (Scopus data)

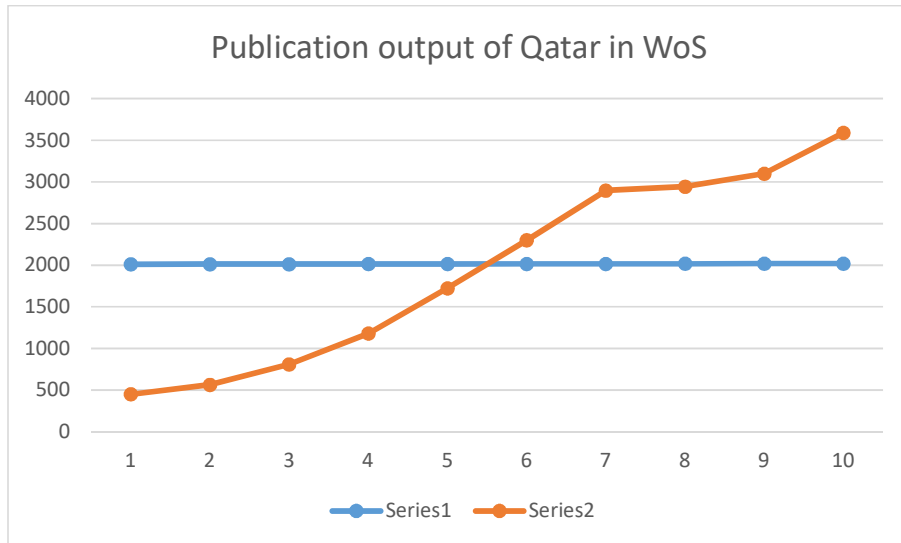


Figure 2. Growth of the total papers for the period 2010-2019 (WoS data)

| Year | Citations |
|------|-----------|
| | |

| | |
|--------------|---------------|
| 2015 | 3035 |
| 2016 | 15951 |
| 2017 | 34020 |
| 2018 | 55288 |
| 2019 | 78637 |
| Total | 186931 |

Table 2. Citations received by Qatar papers during 2015-2019 in Scopus

The number of citations received by individuals or groups or institutions or countries are for the articles from later-published papers is considered as a measure of the quality or importance of the research done. Hence many studies take efforts to record citations received in a given period. We have reported the citations received by Qatar papers for a five-year period from 2015-2019 and tabulated in the table 2. Just from 3035 citations in 2015, the total citations received in 2019 has increased remarkably to 78637 in 2019 which experienced an increase of more than 2500%. When we compare the citation scores of some other countries during the period 2008-12, we found some interesting insights.

In 2019, the Scopus indexed 4461 papers that listed at least one author address in Qatar. Of those papers, the highest percentage appeared in journals indexed under the main heading of Engineering, followed by Medicine and Computer Science. These three major subjects constitute nearly half of the total Qatar papers in 2019.

Qatar's relative publications were also notably significant in Biochemistry & Molecular Biology with 560 papers and shown 7.94% whereas in Materials Science, it was 502 papers with 7.16%. Social Sciences contributed approximately 7% of the total output exhibiting a in significant importance of it in Qatar.

| Disciplines | No of papers in 2019 by Qatar | % of the output field wise | Field output World |
|--------------------------------------|-------------------------------|----------------------------|--------------------|
| Engineering | 1174 | 16.19% | 16.96% |
| Medicine | 1171 | 16.17% | 23.64% |
| Computer Science | 946 | 13.42% | 10.70% |
| Biochemistry & Molecular Biology | 560 | 7.94% | 11.97% |
| Materials Science | 502 | 7.16% | 4.19% |
| Energy | 400 | 5.67% | |
| Chemistry | 330 | 4.68% | 6.20% |
| Mathematics | 304 | 4.30% | 2.39% |
| Chemical Engineering | 286 | 4.05% | |
| Environmental Science | 283 | 4.01% | |
| Business, Management and Accounting | 205 | 2.90% | |
| Decision Sciences | 189 | 2.68% | |
| Agricultural and Biological Sciences | 150 | 2.12% | 2.16% |
| Health Professions | 149 | 2.11% | |
| Multidisciplinary | 132 | 1.87% | |

| | | | |
|-------------------------------------|-----|-------|-------|
| Immunology and Microbiology | 122 | 1.73% | |
| Economics, Econometrics and Finance | 111 | 1.57% | |
| Earth and Planetary Sciences | 105 | 1.48% | 3.07% |
| Arts and Humanities | 100 | 1.14% | |
| Dentistry | 18 | 0.25% | |
| Veterinary | 10 | 0.14% | |
| Unclassified | 2 | 0.03% | |

Table 3. Discipline wise output in 2019

To understand the field orientation by Qatar and other world countries, we have given in the last column the percentage of the world output in different disciplines. In Medicine and Biochemistry, Qatar shown relative low significance, whereas in Computer Science and Material Science it leads the world percentage. The study of discipline contribution will enable to understand the significance and importance attached in a country. In Biological sciences there is increasing scope for Qatar to contribute more in the future when they opt for collaboration in these disciplines.

Since the 2013 forum, a set of four Grand Challenges have been selected by the Foundation leadership and assigned to the relevant Qatar Research Institutes to serve as “champions” for coordinating across the stakeholder community. These four Grand Challenges are: 1. Develop, Refine, and Adopt Enhanced Desalination/Waste Water Re-use Capabilities (Water Security) 2. Develop/Deploy 2. Develop/Deploy Solar Energy on the Grid (Energy Security) 3. Develop security technology to protect the critical cyber infrastructure (Cyber security) 4. Develop plans to tackle Cancer, Diabetes & develop personalised medicine (Healthcare) (<https://www.qnrf.org/Portals/0/Download/QNRS%202014.pdf>)

The emphasis laid down during 2013 was for four fields, viz., Water Security, Energy, Cyber Security and Cancer. Whether these thrust areas are given priority in research by Qatar authors? We now based on 2019 data took stock of the research output. We have given the papers published by Qatar authors in different discipline journals in the table. We found that Computer Science, Multidisciplinary sciences and physics discipline journals are more frequently used for publication. Out of the four priority fields we can able to find more number of papers in Information Security and Energy including Water Security. However, the outputs in cancer journals are found to be low. Out of the four thrust areas identified three are given significance for publication.

The table has given the list of journals preferred, no of papers, SJR values in 2019, the rank of the journals in the respective disciplines, H index and Subject category of the journals.

| Source Journals where Qatar Papers published | No of Papers | SJR | Jl Rank in discipline | H Index | Subject Category |
|--|--------------|------|-----------------------|---------|------------------------------------|
| IEEE Access | 86 | 0.78 | 478/4115 | 86 | Computer Science |
| Scientific Reports | 55 | 1.34 | 9/145 | 179 | Multidisciplinary |
| Plos One | 44 | 1.02 | 10/145 | 300 | Multidisciplinary |
| Journal of High Energy Physics | 37 | 0.95 | 225/1514 | 209 | Physics and Astronomy |
| Lecture Notes in Computer Science | 37 | 0.43 | 984/4115 | 356 | Computer Science |
| Optik | 33 | 0.48 | 533/1514 | 57 | Physics and Astronomy |
| Journal Of Cellular Physiology | 31 | 1.27 | 535/2169 | 167 | Biochemistry and Molecular Biology |
| British Journal of Sports Medicine | 28 | 3.71 | 2/148 | 156 | Sports Science |
| Sustainability Switzerland | 21 | 0.58 | 88/498 | 68 | Energy |
| Frontiers In Physiology | 19 | 1.21 | 570/2169 | 86 | Biochemistry and Molecular Biology |

| | | | | | |
|---|----|------|-----------|-----|-------------------------------------|
| Sensors Switzerland | 19 | 0.65 | 1122/2169 | 153 | Biochemistry and Molecular Biology |
| BMJ Open | 16 | 1.25 | 1078/7462 | 84 | Medicine |
| Journal of Cleaner Production | 16 | 1.89 | 112/1659 | 173 | Business, Management and Accounting |
| Biomolecules | 15 | 1.61 | 370/2169 | 44 | Biochemistry and Molecular Biology |
| IEEE Transactions On Vehicular Technology | 15 | 1.63 | 158/4115 | | Computer Science |
| Qatar Medical Journal | 15 | 0.12 | 6311/7462 | 8 | Medicine |
| Frontiers In Endocrinology | 14 | 1.31 | 47/239 | 59 | Endocrinology |
| Nutrients | 14 | 1.33 | 189/2284 | 93 | Agricultural Sciences |
| Science of the Total Environment | 14 | 1.66 | 113/1659 | 224 | Environmental Science |
| Applied Surface Science | 13 | 1.23 | 116/961 | 174 | Chemistry |
| Desalination and Water Treatment | 13 | 0.33 | 1581/4841 | 51 | Engineering |
| Energies | 13 | 0.64 | 80/498 | 78 | Energy Engineering |
| International Journal of Hydrogen Energy | 13 | 1.14 | 42/498 | 202 | Energy Engineering |
| Materials | 13 | 0.65 | 383/1581 | 98 | Materials Science |
| Advances in Intelligent Systems And Computing | 12 | 0.18 | 226/393 | 34 | Computer Science, Miscellaneous |
| Applied Sciences Switzerland | 12 | 0.42 | 318/795 | 35 | Chemical Engineering |

| | | | | | |
|--|----|------|----------|-----|------------------------------------|
| International Journal of Molecular Sciences | 12 | 1.32 | 504/2169 | 140 | Biochemistry and Molecular Biology |
| Solar Energy | 12 | 1.54 | 32/197 | 167 | Energy |
| Data In Brief | 11 | 0.11 | 131/145 | 23 | Multidisciplinary |
| IEEE Transactions on Industrial Electronics | 11 | 2.91 | 26/911 | 262 | Computer Science |
| Results In Physics | 11 | 0.61 | 407/1514 | 41 | Physics and Astronomy |
| RSC Advances | 11 | 0.74 | 182/795 | 128 | Chemical Engineering |
| Energy Conversion and Management | 10 | 2.92 | 7/498 | 177 | Energy Engineering |
| IEEE Internet of Things Journal | 10 | 2.61 | 72/4115 | 67 | Computer Science |
| IEEE Transactions on Systems Man and Cybernetics | 10 | 2.93 | 56/4115 | 44 | Computer Science |
| Nature Communications | 10 | 5.57 | 59/2169 | 298 | Biochemistry and Molecular Biology |
| Neurocomputing | 10 | 1.18 | 268/4115 | 123 | Computer Science |

Table 4. Top journals producing Qatar papers

This table is able to yield many inferences. When we consider the SJR values and H Index, it seems to arrive at a positive correlation between these values. However, in a few cases such as Lecture Notes In Computer Science and Sensors Switzerland, the H index is higher and the SJR values are not significant. The total citations, SJR, H Index values of journals from difference fields cannot be compared as the citation practices and the volume of journals are not uniform. An accepted value in this situation is to use the rank of the published journals in the disciplines. When we take this indicator, we have identified a few journals that published more number of papers in the top 10% of the journals. The notable journals where Qatar researchers published are, Scientific Reports with 55 papers (Multidisciplinary), Plos One with 44 papers (Multidisciplinary), British Journal Of Sports Medicine with 28 papers (Sports Medicine), Journal Of Cleaner Production with 16 papers (Business), IEEE Transactions On Vehicular Technology with 15 papers (Computer Science), Energy Conversion And Management with 10 papers (Energy)

Out of the total highly preferred journals, computer science journals are predominant where 8 journals published 191 papers.

| Name of the Journal | No of Papers | SJR | Discipline Rank | H Index | Discipline |
|--|--------------|------|-----------------|---------|------------------|
| IEEE Access | 86 | 0.78 | 478/4115 | 86 | Computer Science |
| Lecture Notes In Computer Science | 37 | 0.43 | 984/4115 | 356 | Computer Science |
| IEEE Transactions On Vehicular Technology | 15 | 1.63 | 158/4115 | | Computer Science |
| Advances In Intelligent Systems And Computing | 12 | 0.18 | 226/393 | 34 | Computer Science |
| IEEE Transactions On Industrial Electronics | 11 | 2.91 | 26/911 | 262 | Computer Science |
| IEEE Internet Of Things Journal | 10 | 2.61 | 72/4115 | 67 | Computer Science |
| IEEE Transactions On Systems Man and Cybernetics | 10 | 2.93 | 56/4115 | 44 | Computer Science |
| Neurocomputing | 10 | 1.18 | 268/4115 | 123 | Computer Science |

Table 5. Journals in Computer Sciences producing Qatar papers

In Computing, most of the published papers appear in top percentile journals. Out of the total 4461 papers, more than 1150 papers were published in Computer Sciences. The SJR values of the published journals are significant. Also, the rank of these journals in their subjects are also notable. This finding is supported by H Index values of the published journals.

Besides, computer science, Energy is preferred by many researchers where the papers are significant. There are a few neglected fields such as Agriculture, Social Sciences, Business and Management and Humanities.

The top productive Qatar institutions are available in the table. The most contributing institutions are Qatar University, Hamad Bin Khalifa University and Texas A& M University at Qatar. These three universities account for more than three fourth of the total papers.

| Top Qatar Institutions | No of papers |
|---|--------------|
| Qatar University (1973) | 1964 |
| Hamad Bin Khalifa University (2010)* | 1099 |
| Texas A& M University at Qatar (2003) | 803 |
| Hamad Medical Corporation (1979) | 390 |
| Weill Cornell Medicine-Qatar (2001) | 376 |
| Qatar Foundation (1995) | 371 |
| Qatar Environment and Energy Research Institute (2013) | 201 |
| Aspetar Orthopaedic and Sports Medicine Hospital (2007) | 116 |
| Hamad General Hospital (1979) | 110 |
| Qatar Biomedical Research Institute (2012) | 94 |

Table 6. High Productive Qatar Institutions (2019)

**In Scopus the two schools of the Hamad Bin Khalifa University- the School of Science and Qatar Computing Research Institute are classified as separate institutions. However, they are the divisions of the Hamad Bin Khalifa University and hence we have unified the papers of the two divisions into one institution, Hamad Bin Khalifa University.*

The top productive Qatar institutions are listed in the table 5. Qatar University being a well-established and oldest university leads the table with nearly 2000 papers. The noted very significant contributions come from Hamad Bin Khalifa University Which has produced more than 1000 papers with the age of less than 10 years. It is an example of a classical institution. Most of the current Qatar institutions are started only in the last two decades. Out of the top 10 institutions four are medical science institutions and hospitals and one is on Biomedical Sciences. It is an important issue that while ranking the productivity of the institutions, we need to consider the age of them, number of researchers, the funding and a few more variables.

5. Collaboration

Qatar occupies a central position in the middle-east for collaborative partnerships and the resulting articles from these partnerships are associated with higher field-weighted citation impact. As Qatar researchers are clearly highly collaborative and mobile across international borders, it should come as no surprise that they are also highly cooperative and mobile between academic and corporate sectors within and beyond the UK.

The collaboration is instituted by many international universities and laboratories spread across countries. The predominating collaborators are listed in the below table 6.

| | |
|--|-----|
| UNIVERSITY OF CALIFORNIA | 327 |
| RWTH AACHEN UNIVERSITY | 181 |
| MASHHAD UNIVERSITY OF MEDICAL SCIENCES | 156 |
| UNIVERSITY OF BELGRADE | 154 |
| UNIVERSITY OF SPLIT | 128 |
| TEHRAN UNIVERSITY OF MEDICAL SCIENCES | 125 |
| CORNELL UNIVERSITY | 113 |
| MONASH UNIVERSITY | 97 |
| ISLAMIC AZAD UNIVERSITY | 96 |
| KING ABDULAZIZ UNIVERSITY | 95 |
| UNIVERSITY OF HELSINKI | 88 |
| UNIVERSITY OF MINNESOTA | 87 |
| UNIVERSITY OF BRISTOL | 86 |
| UNIVERSITY OF WASHINGTON | 85 |
| NORTHWESTERN UNIVERSITY | 83 |
| CARNEGIE MELLON UNIVERSITY | 82 |
| PURDUE UNIVERSITY | 82 |
| UNIVERSITY OF AUCKLAND | 82 |
| GHENT UNIVERSITY | 81 |
| TSINGHUA UNIVERSITY | 81 |
| JOHNS HOPKINS UNIVERSITY | 80 |

Table 7. Top Collaborating International Institutions

The University of California and Qatar have a strong research binding and regular and consistent research collaboration is witnessed when we look at the table. Many countries are involved in the international collaboration out of which the listed countries are important in terms of number of papers. It is visible that Qatar research productivity has, at least to some extent, been driven by the increase in the international research collaboration, which is also associated with greater citation impact. Most of the Qatar papers are the products of international collaboration.

The collaborating country with Qatar is produced in the table 8.

| Collaborating Countries | Papers |
|-------------------------|--------|
| US | 1129 |
| UK | 638 |
| China | 447 |
| Australia | 352 |

| | |
|--------------|-----|
| Saudi Arabia | 284 |
| India | 283 |
| Italy | 272 |
| Canada | 262 |
| Germany | 255 |

Table 8. Top Collaborating Countries (2019 data)

As most of the collaborating countries are scientifically advanced countries, the impact of the papers is high. The strategy of the Qatar's collaboration work well.

6. Top Cited Papers

We have listed below in the table 8 the most cited 50 Qatar papers. Out of them 49 are internationally collaborated papers and appeared in the top quality journals. Thus collaborating with international authors seems to be more beneficial for Qatar authors. Medical Sciences have gained more on international collaboration.

| Year | Source Journal | No of Citations |
|------|--|-----------------|
| 2015 | The Lancet | 3909 |
| 2015 | The Lancet | 3002 |
| 2015 | IEEE Communications Surveys and Tutorials | 2875 |
| 2016 | Autophagy | 2703 |
| 2016 | The Lancet | 2383 |
| 2016 | The Lancet | 2364 |
| 2017 | The Lancet | 1696 |
| 2016 | The Lancet | 1525 |
| 2015 | The Lancet | 1380 |
| 2015 | The Lancet | 1127 |
| 2015 | The Lancet | 956 |
| 2018 | The Lancet | 946 |
| 2017 | IEEE Communications Surveys and Tutorials | 937 |
| 2017 | The Lancet | 899 |
| 2016 | The Lancet | 894 |
| 2017 | The Lancet Gastroenterology and Hepatology | 761 |
| 2018 | The Lancet | 760 |
| 2017 | Neurology | 756 |
| 2018 | The Lancet | 754 |
| 2016 | Systematic Reviews | 752 |
| 2017 | The Lancet | 710 |
| 2016 | Cell | 698 |
| 2018 | The Lancet | 634 |
| 2015 | Desalination | 628 |
| 2016 | Nature Genetics | 626 |
| 2017 | The Lancet | 612 |
| 2016 | The Lancet | 572 |
| 2016 | IEEE Journal on Selected Areas in Communications | 542 |
| 2018 | Immunity | 536 |

| | | |
|------|--|-----|
| 2015 | Time-Frequency Signal Analysis and Processing: | 529 |
| 2016 | Journal of High Energy Physics | 527 |
| 2016 | Nature Energy | 513 |
| 2017 | JAMA - Journal of the American Medical Association | 485 |
| 2015 | Neuroepidemiology | 485 |
| 2016 | Separation and Purification Technology | 483 |
| 2018 | The Lancet | 464 |
| 2015 | Desalination | 453 |
| 2016 | Nature | 452 |
| 2016 | IEEE Transactions on Biomedical Engineering | 444 |
| 2015 | Nature | 434 |
| 2017 | Cell | 431 |
| 2015 | IEEE Communications Surveys and Tutorials | 424 |
| 2015 | Sensors and Actuators, B: Chemical | 415 |
| 2016 | The Lancet | 408 |
| 2016 | IEEE Transactions on Medical Imaging | 402 |
| 2018 | The Lancet | 401 |
| 2017 | Diabetes Care | 397 |
| 2018 | The Lancet | 382 |
| 2016 | Immunity | 382 |

Table 9. Highly Cited Journals

The scientific citation impact of Qatar is influenced largely by medical papers and medical research. The medical authors collaboration is mainly accounted by the journal, Lancet.

7. Funding

The characteristics of a funding system are of a particular importance because the magnitude of funds, their sources and procedure of distribution across different funding systems are crucial for the achievement of the goals set to the system of higher education such as efficiency, research productivity, high quality of teaching etc.

Moreover, countries differ substantially if we consider the source of funds. Bonaccorsi and Daraio (2007) distinguish between three main sources of funding sources common for the developed countries: government, private sector and student fees. In the group of seven countries analysed by Elsevier, the UK has the highest share of private sources (34%), while Finland has the lowest (less than 5%). In Poland, 29.6% of total expenditures originate from private sources, the rest comes from the public system (OECD, 2009). We have given below in the table 9, the funding details of the research done in Qatar.

| | |
|--|------|
| Qatar National Research Fund | 1043 |
| Qatar Foundation | 705 |
| National Natural Science Foundation of China | 233 |
| Qatar Foundation | 214 |
| National Science Foundation | 88 |

| | |
|---------------------------------------|----|
| National Institute of Health | 74 |
| National Research Foundation of Korea | 66 |
| European Commission | 65 |

Table 10. The major funding bodies for Qatar's research in 2019

More than 50% of the published research in Qatar has received research funding from both Qatar and other countries. Out of the total, the Qatar National Research Fund account for the one fourth of the total research output. The funding assistance by Qatar Government has a clear edge and impact over the productivity. More than 600 papers have received funding from other countries. It is clear that funding is very crucial for the success of Qatar's research programs.

In Qatar the major source of research funding comes from the Government. The private sector contribution is less when comparing with other countries. The Qatar Foundation is the major funding source to the Qatar researchers followed by the individual universities funds. Qatar solicits and facilitates individual researchers developing proposals for research grants. Qatar aims to submit more, and potentially more successful, grant proposals by professionalising grant-writing skills, better organisation of internal peer review, and systematic learning from (un)successful submissions.

8. R & D Inputs

Normally the manpower, research budgets, number of universities, research intensity and a few more variables need to be considered while assessing the output. However, for preparing this report, we do not have access to these data and hence we do not able to produce and input/output correlation measure. Gross Domestic Expenditure on R&D (GERD) represents the total expenditure on R&D within a country, the funding from business enterprises and industry to Qatar research is not available.

9. Normalizing or comparing the output

Identifying the rank of a country in global scale is not much meaningful as the input parameters differ considerably. In big countries such as US, UK or China, the size of the research efforts, the S & T manpower and number of laboratories are more. Measuring the relative growth rate of output such as papers, citations may offer a meaningful equation.

10. Journals published in Qatar

Out of the total journals used by Qatar researchers, just three are indexed in Scopus. If researchers publish in other journals, these papers are not indexed in databases and leaving the output of Qatar low. Qatar journals need to take initiatives to push them into good indexing. Increasing the level and quality of Qatar journals is thus become a need.

12. Limitations of this report

This report is not a comprehensive or all-inclusive report of the research carried out in Qatar. It is a preliminary exercise and we do not suggest any science policy decisions. We fail to introduce statistical correlations to arrive at decisions. We do not able to correlate the input variables such as funding, manpower, research size and so on. This is not a macro study and provide a very brief picture.

11. Conclusion

Qatar is making inroads in the world of scientific research which is evidenced in the volume of citations. The last decade is very crucial in the Qatar's scientific history. In the disciplines such as Medicine, Computing, Energy and Engineering, the contributions are significant and the volume is growing very rapidly. Improving the international reputation of research in various disciplines will promote the scientific culture and it may lead to structurally improving the international networks and increasing substantial institutional cooperation with international research partners. The opening of many higher educational institutions and foreign campuses will provide good scientific inputs in the near future.

The analysis presented here made clear to us that from a research management point of view, the creation of a regular overall review has been very effective in stocktaking the research and bring evaluation systems together. The sequence of, creating assessment models and carrying these exercises seems to have been a very good strategy for the country.

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