A bibliometric analysis of the Aga Khan University contribution to research on sustainable development goals

Anil Khamis and Peter Gatiti, Aga Khan University 8 May 2019

Abstract

Background:

The Sustainable Development Goals (SDGs) are expected to shape the global agenda on economic, social and environmental development for the next 15 years. Globally, SDGs are starting to become a reference point for a wide range of public and private institutions. However, the contribution of the developing world towards the sustainable development goals has not received adequate attention from the scientific community. The present study aims to provide a bibliometric overview of research addressing specific sustainable development goals, which have been carried out by researchers affiliated to Aga Khan University, an international institution of distinction that primarily serves the developing world.

Purpose:

This paper seeks to map AKU research on SDGs by analyzing publications from authors with Aga Khan University institutional affiliation that are indexed in Scopus, a citation database of peer-reviewed literature. The paper also demonstrates the impact of AKU's research on SDGs and use the citation report for organisational development.

Researchers rely on data from Web of Science, Scopus and Google Scholar to assess scholarly communication. However, this study choose Scopus as it covers more than 15,000 titles in comparison to Web of Science, which covers approximately 9,000 journals.

Methods:

We used Scopus to extract relevant papers published from January 2015 to March 2019 and referencing sustainable development goals with the Aga Khan University being the affiliation name of the author. The study presented the key bibliometric indicators such as trends of annual publications, citation analysis of articles, publication counts, h-index, journal rank, impact factor and societal impact through analysing articles published in open access journals.

We adopted SDG queries developed by a group of bibliometricians from Aurora, a network of institutions whose mission is to tackle global complex problems, in areas like the UN Sustainable Development Goals (SDGs). The Aurora network developed an SDG specific bibliometric tool for surveying and analyzing the research output and impact of universities in terms of academic quality, impact and societal impact. The analysis was performed using Scopus and Microsoft Excel.

Results:

The total number of publications on the 17 SDGs (discussed in detail below) which were published by researchers affiliated to AKU was 3854. The total number of SDG 3 papers was 1971. Out of these, 1630 were journal articles and 250 were review articles. The SDG 3 publications were cited 29,797 times from 2015 to 2019. The publications had an h-index of 62 meaning that the articles were cited at least 62 times over the four-year period.

280 publications were published in journals with impact factors ranging from 1.92 to 53.25. The most significant journal articles were published in Lancet (53.254), Lancet Global Health (18.705) and in the Cochrane Database of Systematic Reviews (6.754).

Majority of studies were published in Pakistan (696), followed by United Kingdom (70), Netherlands (40) and United States (39).

Conclusion:

There has been exponential growth of research on various SDGs by AKU affiliated researchers during the period between 2015 and 2019. AKU research is covers health and related fields including food security, inequality, economic growth, and gender equality. AKU researchers publish in a wide range of journals distributed across various countries.

The growth in high-impact publications can be attributed to the increase in research funding over the past four years exceeding USD 450 Million per annum including post-graduate training of faculty, student awards, and patient welfare.

Keywords:

Sustainable Development Goals, health, education, publication output, Citations, Impact Factor, Bibliometrics, Aga Khan University, research impact.

1.0 BACKGROUND

> *"The overall aim of the Aga Khan University will be to make clear and rational judgements as to which foreseeable future needs of the developing countries requires new educational programmes and, having identified those openings, to address them by the appropriate means, setting the highest standards possible whether in teaching, research or service.*
>
> *Inevitably, priorities will alter with the years as time and history unfold, and the University must be able to adapt itself to change. But one thing will remain constant: the mission of preparing graduates, men and women, to play constructive, worthwhile and responsible roles on society". (The Chancellor His Highness the Aga Khan 1983)*

The debate on the role and function of higher education in development, particularly in the majoritarian world, has been ongoing for many decades. Mamdani (2011) of Makerere University, Uganda considers the history of establishing universities at the time of African countries' independence. He critiques colonial powers for establishing schools and colleges to train cadres to be the 'subaltern': who serve but not speak or question. His critique also extends to the founding of such institutions, post-independence, as symbolic structures, such as the country's flag, as opposed to contributing agencies to national development, promoting knowledge generation, and undertaking fundamental research that is relevant to their contexts.

One of the main proponents of education for development is the World Bank. Using rates of return analyses, the Bank argued that it is far better to invest public funds in primary and lower secondary schools, to 'basic education', than to higher education (Psacharopoulos, 1994). In doing so, more equity would be the result with greater access to schooling for a larger percentage of the population. Birdsall (1996) challenged the Bank's analysis of economic rates of return with more nuanced social rates of returns. They argue that the public good of higher education in terms of research and post-graduate training, supporting a country's entry into the knowledge society, and creation of skills to support innovation with greater efficiencies far exceed the private returns spent on individual graduates. Bowen (2018) argued that the social and political return in terms of promoting peace and security, leadership of communities to be more self-sufficient, and supporting positive change come more from investment in higher education and that quantitative economic cost-benefit approaches cannot estimate such benefits with accuracy.

From the 2000s onwards the value of higher education vis-à-vis other schooling levels was reassessed. The World Bank Task Force, counter-parts in Pakistan and elsewhere began to rethink the role, functioning, and financing of higher education (Task Force on Higher Education, 2000). In 2018, the World Bank broke with its long-held approach to judging value focused on purely quantitative economic analysis: growth in gross domestic product (GDP). Higher investments in education and health lead to populations being more productive and yielding higher earnings for a country's workforce (World Bank, 2019). However, it also acknowledged the need to be outcomes-driven as opposed to focusing on inputs to encourage more experimentation and innovation. The report points out that during periods dominated by technological change and with the growth of artificial intelligence, investment in "human capital" must include not just skills-formation by higher order critical thinking and creativity, problem-solving capability,

and supporting people to pursue multiple – possibly as yet unthinkable – options (World Bank, 2019).

1.1 HIGHER EDUCATION AND DEVELOPMENT

The nature and function of higher education, the approaches to developing human capital, and the needs of society have fundamentally changed in an era of globalisation spurred by technological developments and the search for new markets. Universities, once funded by government for the greater social good, now find themselves in a market place competing with 'knowledge mobilisers. Klaus Schwab (2016), the founder of the World Economic Forum that meets annually at Davos Switzerland and the author of the landmark 'Fourth Industrial Revolution', notes

> *"The changes are so profound that, from the perspective of human history, there has never been a time of greater promise or potential peril. My concern, however, is that decision makers are too often caught in traditional, linear (and non-disruptive) thinking or too absorbed by immediate concerns to think strategically about the forces of disruption and innovation shaping our future.*"

Universities and global decision-makers have not fully considered the importance of knowledge-generation and its application to developing countries and their society's needs and development, confining the institutions to esoteric repositories of theoreticians. Further, the knowledge-production function has increasingly moved out of the university arena to the private sector in the absence of state funding sources.

To illustrate the divide noted by Schwab (2017), the United Nation's 17 Sustainable Development Goals Resolution only mention universities as training institutions to promote equal access to technical / vocational and higher education: *By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university* (United Nations, 2015).

Yet, Birdsall (1996) had argued that the public good of higher education in terms of research and post-graduate training, supporting a country's entry into the knowledge society, and creation of skills to support innovation with greater efficiencies far exceeds the private returns spent on individual graduates. Bowen (2018) show that the social and political returns in terms of promoting peace and security, leadership of communities to be more self-sufficient, and supporting positive change come more from investment in higher education and that traditional quantitative economic cost-benefit studies cannot estimate such outcomes with accuracy. The World Banks' Human Development Index (World Bank, 2018) breaks with its past focus on increases to GDP to argue that higher investments in education and health lead to populations being more productive and yielding higher earnings for a country's workforce. It also acknowledges that efforts have to be outcomes-driven as opposed to focusing on inputs to encourage more experimentation and innovation thereby delinking the earlier input-output linear judgements underpinning investment and financing of development programmes.

The role of universities was considered at the Pan-African Conference on Education (PACE 2018), which was convened to align global initiatives and programmes to the Continental Education Strategy for Education (CESA 16-25) that resulted in the Nairobi Declaration:

> *We recognize that the transformation of Africa requires strengthened efforts to move towards knowledge-based societies through the advancement of* ***higher education and research*** *in Africa with special focus on relevance and equitable access, strengthening of research, and teaching and learning of science, technology, engineering and mathematics (PACE, paragraph 7, 2018).*

The nature and character of what is knowledge, how it is developing, its applications, and what new knowledge will be required in the light of changes in technology including machine learning and artificial intelligence, globalisation and changing geo-political configurations and the new investment modalities raises another fundamental debate. This debate arises from the history of education in maintaining a centre-periphery world order that has reinforce hegemonies of what knowledge counts as important (Maringe, 2017).

In the light of the above overview of the position of universities today, there is new impetus to consider the institution's place. University can no longer remain isolated 'ivory towers'; universities are now firmly back in society McIlrath and MacLabhrainn (2007) and cannot just be a technical provider of skills in the service of economic gain at the behest of governments that are interested in short-termism (Watson, 2015).

Having discussed the changes that have taken place in the higher education sector, the next section provides an overview of the Aga Khan University, an international university operating on campuses in Central and South Asia, the African Great Lakes, Europe and the Middle East.

1.2 THE AGA KHAN UIVERSITY

The Aga Khan University (AKU) is the first internationally chartered university in Pakistan established by a special presidential order in 1983. The vision and mandate of the University is to be an 'institution of academic excellence that is also an agent for social development (Aga Khan University, 2019).

The School of Nursing was established in Karachi, Pakistan in 1980. Besides developing human resources for the very under-staffed health system, the objective of establishing the School was also to uplift the status of women. AKU has transformed nursing education across the country and its services have been requested, with further nursing programmes established in Afghanistan, Egypt, and Syria.

In 1983, AKU established its Medical College and Institute for Educational Development in 1993 in Pakistan. As an internationally chartered university, academic programmes in health and education were established subsequently in East Africa. Presently, AKU has 11 teaching sites in eight countries: Afghanistan, Egypt, Kenya, Pakistan, Syria, Tanzania, and Uganda and the United Kingdom. The AKU

Chancellor's Commission, an international task force led by then Harvard University President, reviewed the work of the University further to its founding vision and mandate. It surmised that AKU, having started with academic programmes and clinical and teaching sites with tertiary medical care facilities and co-operating schools, was sufficiently established to add further faculties to become a 'comprehensive' university. The University has since added the East African Institute, the Institute for Human Development, the Graduate School of Media and Communications in East Africa, and the Institute for the Study of Muslim Civilisations in England.

The next section describes the procedures and methods used in this bibliometric analysis of the Aga Khan University contribution towards Sustainable Development Goals.

2.0 BIBLIOMETRIC ANALYSIS

Bibliometric analyses may aid policy planners and researchers in identifying critical research areas for evidence-based decision making and policy formulation in lower middle income countries (Thomson Reuters, 2008).

Therefore, this study aims to map SDG research output of the Aga Khan University, assessing AKU's of research in various SDGs and making further analysis of AKU's contribution to SDG 3 through identifying the focus areas and key authors. This analysis will help inform faculty, researchers and the scientific community on the need and importance of research in sustainable development goals.

2.1 Methods

This study is a bibliometric analysis of research published in various SDGs and a further analysis SDG 3 by researchers affiliated to "The Aga Khan University"; "The Aga Khan University Hospital"; "Aga Khan Hospital Nairobi"; and "The Aga Khan University Medical College" as indexed in Scopus. Scopus is a leading citation database that provides citation counts for articles indexed within it (limited to article written in 1996 and after). It indexes over 15,000 journals from over 4,000 international publishers across the disciplines.

The time span of the study was limited to four years and three months (January 2015 to March 2019) because SDGs were set by the United Nations General Assembly in 2015. The results were further refined to articles, reviews, editorials, conference papers, book chapters and books. The analysis did not consider alternative metrics such as the number of downloads and conversations on social media. Consequently, 1971 research papers on health (SDG 3) were retrieved and considered for the study.

The papers were analyzed according to the year of publication, authorship pattern, country of publication and geographical distribution. The study also examined the research performance of AKU, using the numbers of articles appearing in journals, the number of citations received by those articles and the impact factor of the journals that published highly cited articles.

2.2 Results

The present bibliometric study has been undertaken with the view to understand the contribution of authors affiliated to Aga Khan to various SDG targets. The present bibliometric analysis considered publications indexed in Scopus between January 2015 and March 2019.

2.2.1 The characteristics of the publications

Table 1 below displays all document types indexed in SCOPUS, including peer-reviewed journal articles, reviews, editorials, conference papers, book chapters, books, rather than the narrower selection of journal articles.

The first column displays the SDGs targets while the second column displays the publication count per each SDG. Publication count is a measure of productivity and it provides the raw data for all citation analysis. The third column displays the citation counts. Citation counts are the number of citations that a particular journal or an article receives during a particular time. This technique is applied to determine how many citations are being received by a document, an author over a period of time or an institution. The fourth column displays h-index, which is one way of displaying and comparing the productivity and impact of published work of scholars. The h-index is based on the highest number of papers included that have had at least the same number of citations (Hirsch, 2005).

Table 1: Publication counts (all document types) by SDG targets, 2015–2019

SDG target	Publication count	No. of times cited	h-index
SDG 1: End poverty in all its forms everywhere	7	47	4
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	265	16773	41
SDG 3: Ensure healthy lives and promote well-being for all at all ages	2154	31123	62
SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	339	18690	39
SDG 5: Achieve gender equality and empower all women and girls	220	14697	34
SDG 6: Ensure availability and sustainable management of water and sanitation for all	13	236	7
SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all	12	38	3
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	231	24172	47
SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	122	14005	34
SDG 10: Reduce inequality within and among countries	253	20596	54
SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable	8	105	4
SDG 12: Ensure sustainable consumption and production patterns	1	7	1
SDG 13: Take urgent action to combat climate change and its impacts	11	38	3
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	102	15080	28
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	7	71	5
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	27	83	5
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development	82	6399	25

2.2.2 Publication counts by SDG targets

The Aga Khan University's contribution to SDGs is more prevalent on SDG 3 with 2154 publications (55.9 %) and SDG 4 with 339 publications (8.8%). Other significant contribution was on SDG 2 with 265 publications (6.9%); SDG 10 with 253 publications (6.6%); SDG 8 with 231 publications (6.0%); and SDG 5 with 220 publications (5.7%). The results of the analysis are shown in Table 2.

Table 2: Publication counts by SDG targets, 2015–2019

SDG target	Publication count	%
SDG 3: Ensure healthy lives and promote well-being for all at all ages	2154	55.9
SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	339	8.8
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	265	6.9
SDG 10: Reduce inequality within and among countries	253	6.6
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	231	6.0
SDG 5: Achieve gender equality and empower all women and girls	220	5.7
SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	122	3.2
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	102	2.6
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development	82	2.1
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	27	0.7
SDG 6: Ensure availability and sustainable management of water and sanitation for all	13	0.3
SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all	12	0.3
SDG 13: Take urgent action to combat climate change and its impacts	11	0.3
SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable	8	0.2
SDG 1: End poverty in all its forms everywhere	7	0.2
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	7	0.2
SDG 12: Ensure sustainable consumption and production patterns	1	0.0

2.2.3 Citation analysis by SDG targets

Citation analysis is the process whereby the impact or “quality” of an article is assessed by counting the number of times other authors mention it in their work (De Groote, 2015). This technique is used to establish the impact that a particular author or article had by showing which other authors cited the work within their own papers.

Research on eight SDG targets was cited at least over 10,000 times thus making it some of the most highly studies. The highest cited research was on SDG 3 as it was cited 31,123 times. Other highly cited research was on SDG 8 (24,172 times); SDG 10 (20,596 times); SDG 4 (18,690 times); SDG 2 (16,773 times); SDG 14 (15,080 times); SDG 5 (14,697 times); and SDG 9 (14005 times).

The results of the citation analysis are shown in Table 3.

Table 3: Citation analysis by SDG targets, 2015–2019

SDG target	No. of times cited
SDG 3: Ensure healthy lives and promote well-being for all at all ages	31123
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	24172
SDG 10: Reduce inequality within and among countries	20596
SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	18690
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	16773
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	15080
SDG 5: Achieve gender equality and empower all women and girls	14697
SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	14005
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development	6399
SDG 6: Ensure availability and sustainable management of water and sanitation for all	236
SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable	105
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	83
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	71

SDG 1: End poverty in all its forms everywhere	47
SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all	38
SDG 13: Take urgent action to combat climate change and its impacts	38
SDG 12: Ensure sustainable consumption and production patterns	7

2.2.4 H-Index analysis by SDG targets

H-index is another qualitative indicator widely used in bibliometric studies. H-index is a stable and consistent estimator of scientific achievements, which is used as a measure to quantify the scientific outputs of a single researcher, university research groups, and journal or any of (more extensive) publication sets (Hirsch, 2005).

According to this indicator, SDG 3 had the highest h-index (62). Other significant h-index was observed in SDG 10 (54); SDG 8 (47); SDG 2 (41); and SDG 4 (39). We observed that SDG 5 and SDG 9 were ranked at the same position with h-index 34.

The results of the h-index analysis are shown in Table 4.

Table 4: H-index analysis by SDG targets, 2015–2019

Target	***h*-index**
SDG 3: Ensure healthy lives and promote well-being for all at all ages	62
SDG 10: Reduce inequality within and among countries	54
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	47
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	41
SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	39
SDG 5: Achieve gender equality and empower all women and girls	34
SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	34
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	28
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development	25

SDG 6: Ensure availability and sustainable management of water and sanitation for all	7
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	5
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	5
SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable	4
SDG 1: End poverty in all its forms everywhere	4
SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all	3
SDG 13: Take urgent action to combat climate change and its impacts	3
SDG 12: Ensure sustainable consumption and production patterns	1

It is clear that the top two SDG target areas for AKU researchers are SDG 3 (2,154 publications) which have been cited 31,123 times and with an h-index of 62; and SDG 4 (339 publications) which have been cited 18,690 times, with an h-index of 39. This can be attributed to the financial investments that AKU has made in the fields of health and education. In addition, AKU runs state of the art programmes in health sciences (medicine & nursing) and educational development which may have contributed to the high research output.

Interestingly, it was observed that researchers affiliated to AKU had also made significant contribution to other SDGs with remarkable ones being SDG 2 (265 publications), SDG 10 (253 publications), SDG 8 (231 publications) and SDG 5 (220 documents). This implies that AKU research is spread across various fields such as food security, inequality, economic growth, and gender equality.

This section has analysed the research output of AKU on the 17 SDGs and has found that the top contribution is on SDG 3. Therefore, the next part of this paper makes further analysis of AKU's contribution to SDG 3.

3.0 Analysis of AKU contributions towards SDG 3

A total of 2154 publications on SDG 3 (ensure healthy lives and promote well-being for all at all ages) published by authors affiliated to AKU and indexed in Scopus from January 2015 to March 2019 were retrieved but only 1971 publications met the selection criteria. The publications that were considered included 1630 articles (82.7%), 250 reviews (12.6%), 45 editorials (2.3%), 28 conference papers (1.4%), 17 book chapters (0.9%) and 1 book (0.1%). The excluded documents were 60 letters, 55 notes, 16 articles in press, 8 short surveys and 8 erratum.

The type of publications that were considered for inclusion have been analyzed as shown on figure 1

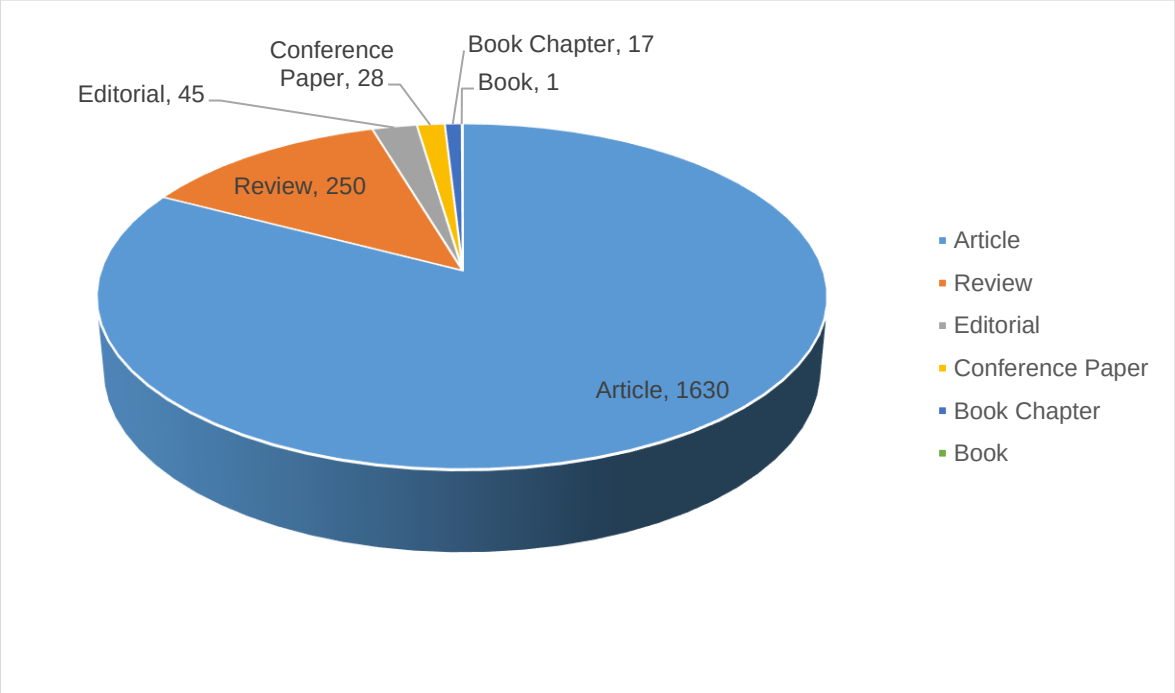

Figure 1: Type of publications

Out of the 1971 publications which were published during the 4 years period (2015- 2019), 480 documents were published in 2018; 442 in 2017; 478 in 2016; 445 in 2015. 126 papers were published in the first quarter (January to March) of 2019.

The publishing pattern of AKU researchers on SDG 3 is shown on figure 2.

Year ↓	Documents ↑
2019	126
2018	480
2017	442
2016	478
2015	445

Figure 2: Publishing pattern of AKU researchers on SDG 3

In the four-year period, the average number of publications on SDG 3 published by AKU researchers was 461 annually. Out of 1971 publications, 1783 were in Medicine and 78 publications were in Nursing. The other publications were in other related subjects such as Biochemistry, Immunology and Microbiology, Pharmacology, Toxicology and Pharmaceutics.

The distribution of publications in various subjects is as indicated on figure 3.

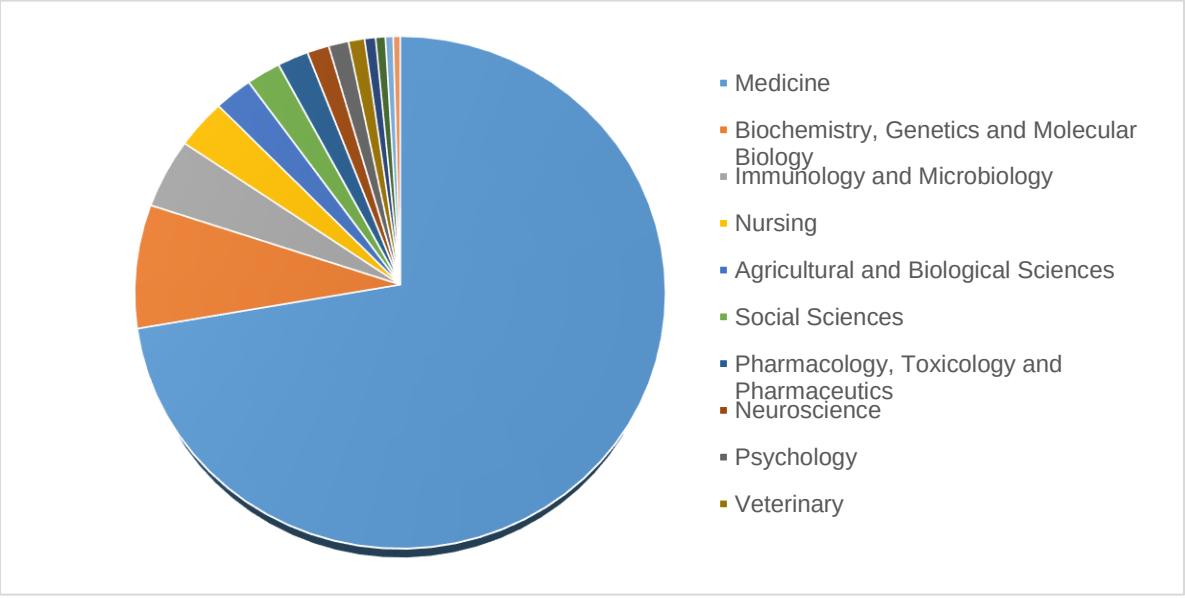

Figure 3: Distribution of publications by subject areas

3.1 Analysis of the journals

The table below lists the first 10 journals ranked by the number of SDG 3 articles authors from AKU have published.

Table 5: Journals where majority of articles were published

#	Journal	No. of articles published	Country of publication
1	Journal Of The Pakistan Medical Association	199	Pakistan
2	Journal Of The College Of Physicians And Surgeons Pakistan	86	Pakistan
3	Lancet	64	Netherlands
4	Reproductive Health	49	UK
5	BMJ Case Reports	37	UK
	Pakistan Journal Of Medical Sciences	37	Pakistan
	Plos One	37	US
6	Journal Of Ayub Medical College Abbottabad JAMC	26	Pakistan
7	Cochrane Database Of Systematic Reviews	25	UK
8	Lancet Global Health	23	Netherlands
9	Anaesthesia Pain And Intensive Care	22	Pakistan
	International Journal Of Mycobacteriology	22	India
10	Vaccine	20	Netherlands

AKU authors publish in a wide range of journals distributed across various countries, with Pakistan being the most significant country of publication (696 articles) followed by United Kingdom (70 articles), Netherlands (40 articles) and United States (39 articles).

As indicated on table 5, AKU scientists published 1,971 papers in 158 journals. The scatter across journals is striking as at least 30 journals published at least 10 or more articles representing (43.4%).

3.2 Distribution of AKU affiliated researchers

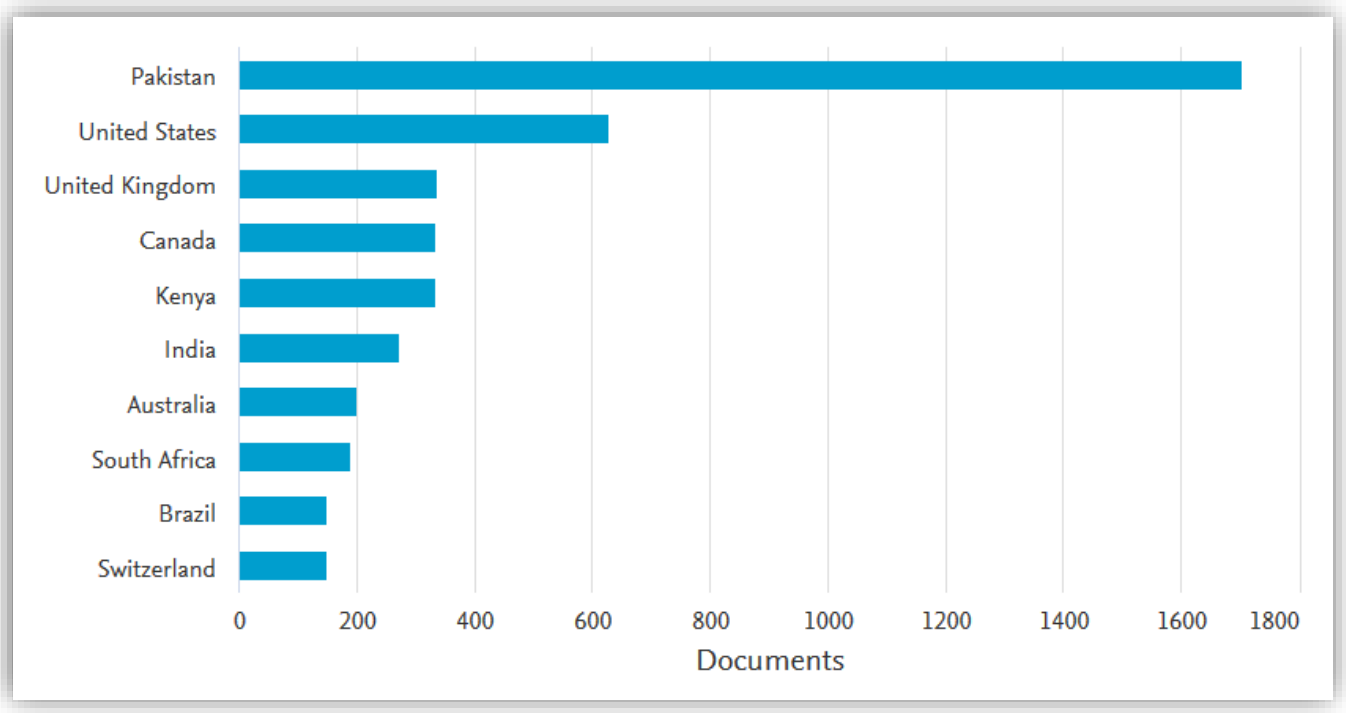

Figure 4: Distribution of AKU affiliated researchers

As demonstrated in figure 4, AKU affiliated researchers are spread in various countries. Majority of the publications were published by researchers based in Pakistan (1,702 articles), followed by United States of America (626 articles), United Kingdom (333 articles), Canada (331 articles), and Kenya (331 articles).

3.3 Citation analysis

The total number of SDG 3 papers published by AKU affiliated researchers was 1971. The 1971 publications were cited 29,797 times from 2015 to 2019 as shown on table 6.

Table 6: Citation analysis of SDG 3 publications 2015 - 2019

Year	No. of times cited	No. of citing documents
2015	701	652
2016	3,700	3,105
2017	7,954	6,581
2018	13,128	10,763
2019	4,314	3,573
Total	**29,797**	**24,674**

The h-index of the 1971 documents was 62 which means that out of the 1971 document, 61 documents have been cited at least 62 times (Hirsch, 2005).

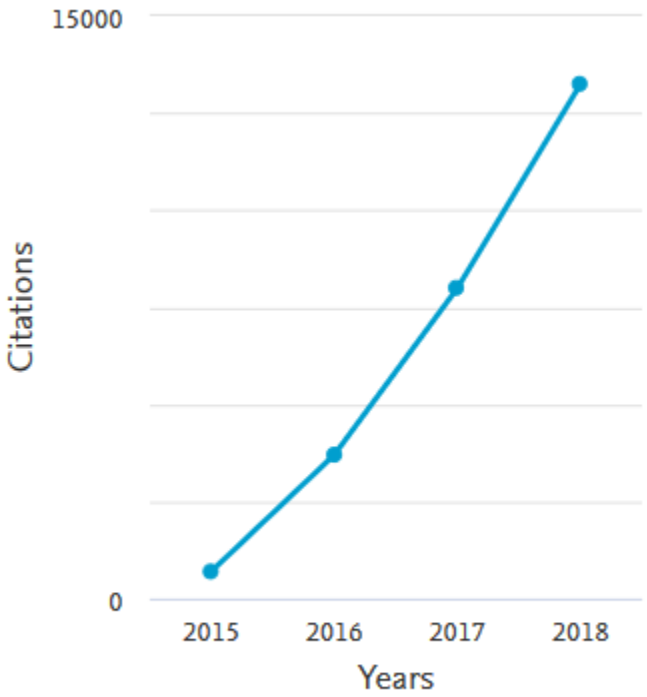

Figure 5: H-index of SDG 3 documents

There was a significant increase in citation from 2015 to 2018. For 2019, the citation index is incomplete as the study was carried out during the first quarter (March 2019).

Figure 5 shows the citation overview of the 1971 documents over a period of four years, 2015 to 2019.

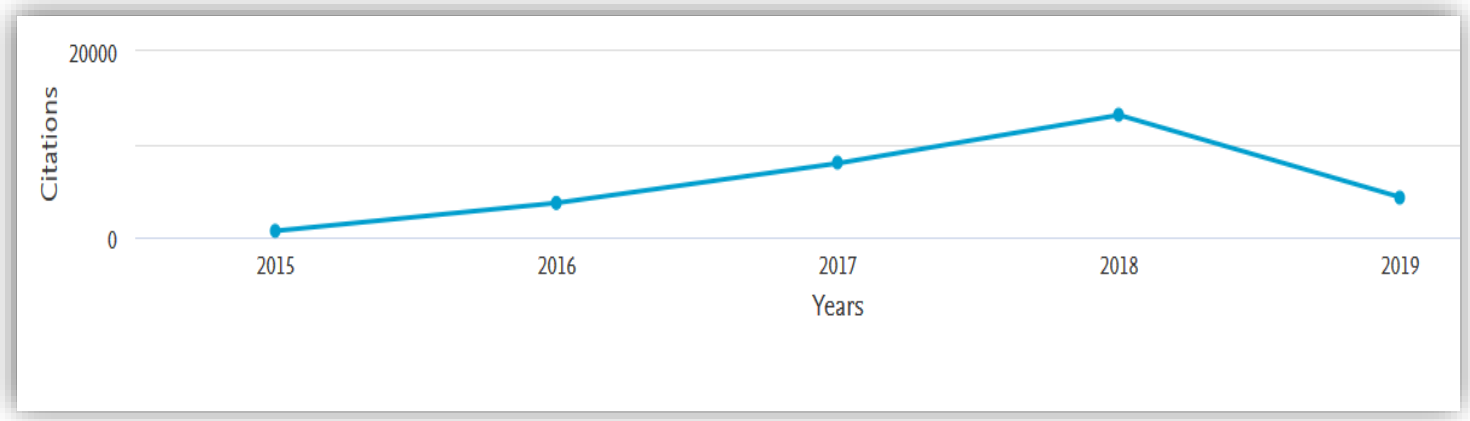

Figure 6: Citation overview 2015 – 2019

3.4 Impact factor of highly cited publications

Impact factor is a measure of the frequency with which the average article in a journal has been cited in a particular year or period (Glänzel & Moed, 2002). It is generally believed that journals with higher impact factor in a particular field publish on average more papers than journals with lower impact. The impact factor can therefore give an approximate indication of how prestigious a journal is in its field.

Table 7 shows the impact factor of the 20 highly published journals from ISI Web of Knowledge, Science Citation Index (Thomson Reuters, 2008).

Table 7: Impact factor of the top 20 highly published journals

#	Journal	No. of articles published	No. of citations	Impact Factor
1	Journal Of The Pakistan Medical Association	199	209	0.718
2	Journal Of The College Of Physicians And Surgeons Pakistan	86	57	0.439
3	Lancet	64	18227	53.254
4	Reproductive Health	49	338	2.014
5	Plos One	39	182	2.766
6	BMJ Case Reports	37	8	-
7	Pakistan Journal Of Medical Sciences	37	50	0.719
8	Journal Of Ayub Medical College Abbottabad JAMC	26	11	-
9	Cochrane Database Of Systematic Reviews	25	277	6.754
10	Lancet Global Health	23	748	18.705
11	International Journal Of Mycobacteriology	22	42	-
12	Anaesthesia Pain And Intensive Care	22	10	-
13	Vaccine	20	95	3.285
14	BMC Research Notes	19	21	-
15	African Journal Of Emergency Medicine	15	5	-
16	BMC Public Health	15	64	2.42
17	World Neurosurgery	15	15	1.924
18	Asian Pacific Journal Of Cancer Prevention	15	36	-
19	American Journal Of Tropical Medicine And Hygiene	15	66	2.564
20	International Journal Of Surgery	15	45	2.693

In terms of the significant journals' impact factor, 280 papers were published in journals with impact factors ranging from 1.92 to 53.25

Table 8: Impact factor of the top 10 journals

#	**Journal**	**Impact Factor**	**No. of articles published**
1	Lancet	53.254	64
2	Lancet Global Health	18.705	23
3	Cochrane Database Of Systematic Reviews	6.754	25
4	Vaccine	3.285	20
5	Plos One	2.766	39
6	International Journal Of Surgery	2.693	15
7	American Journal Of Tropical Medicine And Hygiene	2.564	15
8	BMC Public Health	2.42	15
9	Reproductive Health	2.014	49
10	World Neurosurgery	1.924	15

Lancet was the most significant journal with the highest Impact Factor (53.254). AKU affiliated authors published 64 SDG 3 papers in Lancet which were cited 18, 227 times between January 2015 and March 2019. Other significant journals were Lancet Global Health (18.705); Cochrane Database of Systematic Reviews (6.754); and Vaccine (3.285).

3.5 Societal impact of SDG 3 research: Open Access

Making an article openly available results in more citations of that article, than in pay-to-read articles (SPARC-Europe, 2016). There is a correlation between the impact of open access journals on society and how society uses research outcomes in general (ElSabry, 2017).

In order to determine the societal impact of AKU's contribution to SDG 3, an analysis of the articles published in open access journals was made. The open access articles included documents published in Gold Open Access, including full open access journals, hybrids, open archive and promotional open access.

Table 9 shows the top 20 open access journals where majority of the articles were published, number of articles published and number of times cited.

Table 9: Analysis of top 20 open access journals for SDG 3 publications

#	Title	No. of Articles	No. of times cited
1	Reproductive Health	48	359
2	Plos One	39	192
3	Pakistan Journal Of Medical Sciences	37	53
4	Lancet Global Health	34	9741
5	International Journal Of Mycobacteriology	22	46
6	BMC Research Notes	19	21
7	Vaccine	17	86
8	BMC Public Health	16	69
9	African Journal Of Emergency Medicine	15	5
10	American Journal Of Tropical Medicine And Hygiene	14	50
11	BMC Emergency Medicine	14	42
12	Cochrane Database Of Systematic Reviews	13	177
13	Asian Pacific Journal Of Cancer Prevention	12	35
14	BMC Pregnancy And Childbirth	12	52
15	BMJ Open	12	30
16	Saudi Journal Of Anaesthesia	12	19
17	BMC Health Services Research	11	28
18	Journal Of Medical Case Reports	10	10
19	Journal Of Adolescent Health	9	214
20	Journal of Global Health	9	114

As shown on table 9, 960 publications were published in open access journals and they were cited 18,444 times over the four years period. The open access publications had an H-index of 48. This implies that SDG 3 research by AKU affiliated authors made significant impact to the society beyond the scientific community.

4.0 DISCUSSION

This paper has presented a bibliometric review of the Aga Khan University, and thereby the contribution of AKU scholarship and research output to the sustainable development goals. The paper has made further analysis of the university's contribution to SDG 3 – Health. The analysis shows a steady increase in SDG 3 related publications from 445 in 2015 to 480 in 2018. The implication of this is clear: the SDGs are embedded increasingly in the work of the University and SDG 3 relates to the mission of the University, which began as a Medical College with a Nursing School within its Faculty of Health Sciences.

It is possible that the AKU scientific community in collaboration with funding agencies and international partners focus more on the SDGs and the specific indicators contained therein – Figure 7 shows that the top ten funding agencies that funded a total of 315 SDG 3 related publications. The Bill and Melinda Gates Foundation (146 publications), National Institutes of Health (100 publications), and Aga Khan University Research Council (42 publications) are the principal funding agencies for AKU work in the health sciences. Other funders include the Wellcome Trust (41 publications), the World Health Organization (39 publications), Fogarty International Center (27 publications), University of Oxford (27 publications), the Medical Research Council (26 publications), University of Sydney (25 publications) and Harvard University (22 publications).

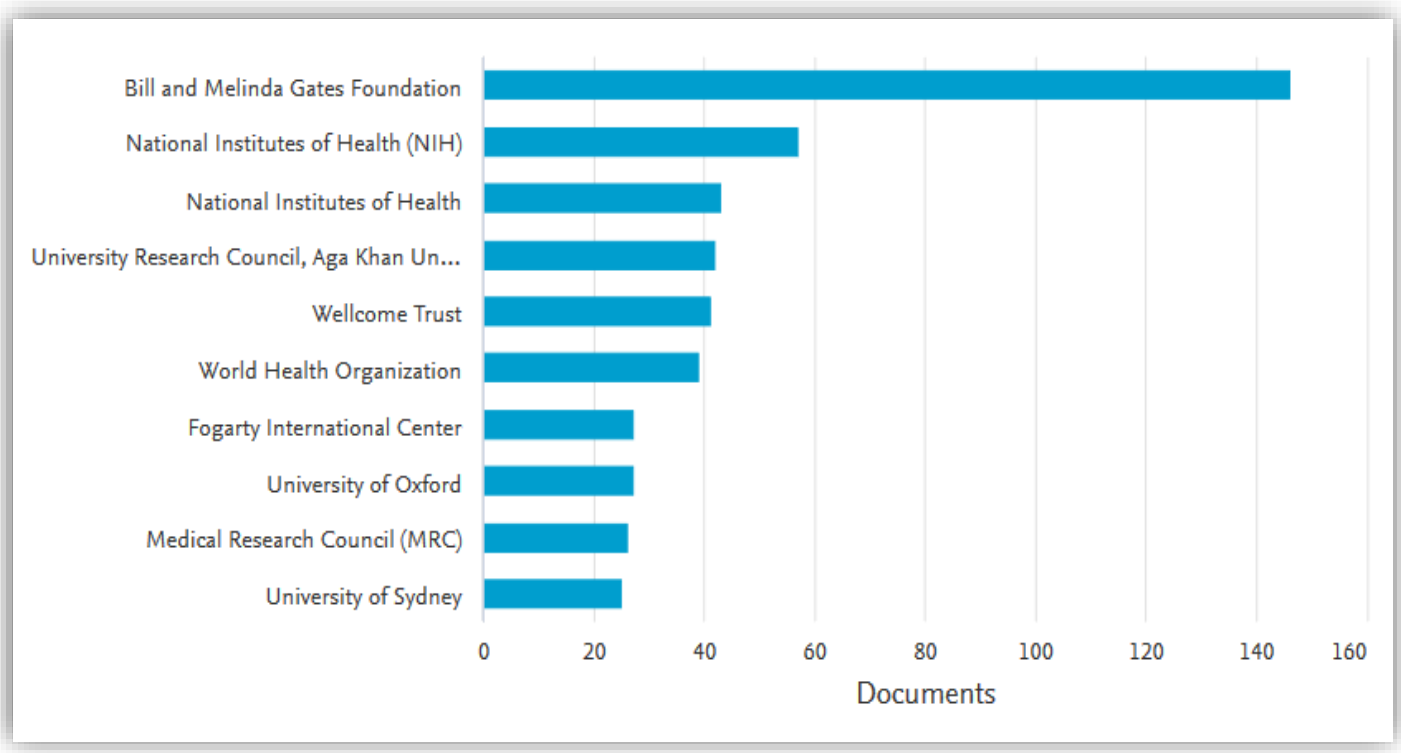

Figure 7: Analysis of externally funded publications

To determine the actual and explicit effect of the SDGs on research funding, a comparative analysis of all AKU publications would be required that is beyond the scope of this paper.

5.0 CONCLUSION – REDRESSING THE VALUES-PROPOSITION IN INTERNATIONAL DEVELOPMENT AND ACADEMIA

In addition to attracting significant external funding, AKU's own resources are matched by investments that are highly significant and strategically targeted to address the imbalances of neglected needs of developing country contexts. Forty years ago AKU was founded, designed, and committed to being a university 'in and for the developing world'. In the present era, its position – working across numerous developing countries with international academic and development agency partners – AKU is now a global institution as evidenced by the findings of this paper with reach well beyond its borders.

Universities and global decision-makers are exercised to remain at the forefront of knowledge-generation and application to their society's needs. This study shows that AKU has not isolated itself in the ivory tower, and the work of its faculty and staff is rigorous academically and accepted at world-class standards that reflect societal needs and aspirations and which also complement the intent of the SDGs.

REFERENCES

Aga Khan University. (2019). About the University. Retrieved from https://www.aku.edu/about/Pages/home.aspx

Birdsall, N. (1996). Public spending on higher education in developing countries: too much or too little? *Economics of Education Review, 15*(4), 407-419.

Bowen, H. (2018). *Investment in learning: The individual and social value of American higher education*: Routledge.

De Groote, S. (2015). Measuring your impact: Impact factor, citation analysis, and other metrics: Citation analysis.

ElSabry, E. (2017). Who needs access to research? Exploring the societal impact of open access. *Revue française des sciences de l'information et de la communication*(11).

Europe, S. (2016). The Open Access Citation Advantage Service: Summary of results of studies until 2015.

Glänzel, W., & Moed, H. (2002). Journal impact measures in bibliometric research. *Scientometrics, 53*(2), 171-193.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National academy of Sciences, 102*(46), 16569-16572.

Mamdani, M. (2011). Okugenda Mu Maaso: The Link Between Tradition, Reform and Development. Retrieved from https://misr.mak.ac.ug/file-download/download/public/259

Maringe, F. (2017). Transforming knowledge production systems in the new African university. In *Knowledge and Change in African Universities* (pp. 1-18): Brill Sense.

McIlrath, L., & MacLabhrainn, I. (2007). *Higher education and civic engagement: International perspectives*: Ashgate Publishing, Ltd.

PACE. (2018). Nairobi Declaration and Call for Action on Education Continental and global education frameworks for the Africa We Want. Retrieved from http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Nairobi/nairobideclarationenwebsite.pdf

Psacharopoulos, G. (1994). Returns to investment in education: A global update. *World Development, 22*(9), 1325-1343.

Reuters, T. (2008). A guide to evaluating research performance with citation data.

Schwab, K. (2016). The fourth industrial revolution. *Moscow: Eksmo (in Russian)*.

Schwab, K. (2017). The Fourth Industrial Revolution, Crown Business. *New York*.

Task Force on Higher Education. (2000). *Higher education in developing countries: peril and promise*: World Bank.

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. *Resolution adopted by the General Assembly*.

Watson, D. (2015). The coming of post-institutional higher education. *Oxford Review of Education, 41*(5), 549-562.

World Bank. (2019). World Development Report: The Changing Nature of Work. Retrieved from http://www.worldbank.org/en/publication/wdr2019