REPORT ON THE EVALUATION OF THE 2021 UNIVERSITIES' RESEARCH OUTPUTS

MARCH 2023

Evaluated in terms of the Research Outputs Policy, 2015

higher education & training

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FOREWORD BY THE DIRECTOR-GENERAL

It gives me great pleasure to publish the 2022 Research Outputs Report. The report presents the results of the 2022 research evaluation process under the sterwardship of the Department of Higher Education and Training (the Department). The 2022 research outputs evaluation was the third evaluation cycle to be carried out under the challenging conditions imposed by the COVID-19 pandemic. As in the preceding two cycles, the evaluation had to happen online with minimum contact between evaluation team members. However, the experience gained with the online evaluation process during the 2020 and 2021 evaluation years proved invaluable in ensuring that the 2022 evaluations proceeded seamlessly.

The Department is grateful to our researchers and academics across all our universties who persevered and continued with the important work of research and knowledge production during the challenging times of COVID-19. The extent of their commitment and diligence manifests in the volume and quality of research outputs that they were able to produce in 2021.

The South African higher education sector has over the years experienced a consistent increase in the number of research publications produced by universities across all academic publication types. The total number of publications has increased from **7 230** units in 2005 to **23 416.32** units in 2021. This translates into a compound average annual growth rate (CAGR) of 7.62%. This growth is indeed admirable, and the sector, in particular, the authors of academic publications, need to be commended for the work well done.

Whilst quantity is important, quality too constitutes an important variable in the research evaluation process. The *Research Outputs Policy* (2015) succinctly states that the main purpose of the evaluation process is to "encourage research productivity by rewarding quality research outputs (produced in) public higher education institutions". Our monitoring and analysis of the publications submitted for subsidy show that some institutions pay insufficient attention to the issue of quality. We implore all contributors to strive for greater standards, and report practices which undermine efforts to advance the reputation of our sector.

The Department will continue to explore interventions and initiatives which safeguard the integrity of the sector, and ensure that only quality research is recognised and rewarded through our evaluation system. We are grateful to all those institutions and research outputs evaluation panel members who continue to share ideas with us on how we can improve our processes. This augurs well for both the growth of the sector as well as the international reputation of our higher education system.

In conclusion, the Department extends its gratitude to the National Research Foundation (NRF) for its support in the administration of the Research Outputs Submission System (ROSS), an online system through which publications are submitted and evaluated. Without this support, the evualuation process would have been cumbersome under the COVID-19 lockdown conditions. We are also grateful to the Centre for Research on Evaluation, Science and Technology (CREST) for its invaluable support.

Dr Nkosinathi Sishi
Director-General: Department of Higher Education and Training
March 2023

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ACRONYMS

CAGR	Compound Average Growth Rate
CESM	Classification of Educational Subject Matter
CPUT	Cape Peninsula University of Technology
CUT	Central University of Technology
DHET/the Department	Department of Higher Education and Training
DOAJ	Directory of Open Access Journal
DUT	Durban University of Technology
HEMIS	Higher Education Management Information System
IBSS	International Bibliography of Social Science
ISBN	International Standard Book Number
ISI	Institute of Science Information
MUT	Mangosuthu University of Technology
NMU	Nelson Mandela University
NRF	National Research Foundation
NWU	North West University
ROSS	Research Outputs Submission System
RU	Rhodes University
SciELO SA	Scientific Electronic Library Online South Africa
SMU	Sefako Makgatho Health Sciences University
SPU	Sol Plaatje University
SU	Stellenbosch University
TUT	Tshwane University of Technology
UCT	University of Cape Town
UFH	University of Fort Hare

UFS	University of the Free State
UJ	University of Johannesburg
UKZN	University of KwaZulu-Natal
UL	University of Limpopo
UNISA	University of South Africa
UNIVEN	University of Venda
UNIZULU	University of Zululand
UP	University of Pretoria
UWC	University of the Western Cape
VUT	Vaal University of Technology
WITS	University of the Witwatersrand
WoS	Web of Science
WSU	Walter Sisulu University

List of CESM Categories

CESM
01: Agriculture, Agricultural Operations and Related Sciences
02: Architecture and the Built Environment
03: Visual and Performing Arts
04: Business, Economics and Management Studies
05: Communication, Journalism and Related Studies
06: Computer and Information Sciences
07: Education
08: Engineering
09: Health Professions and Related Clinical Sciences
10: Family Ecology and Consumer Sciences
11: Languages, Linguistics and Literature
12: Law
13: Life Sciences
14: Physical Sciences
15: Mathematics and Statistics
16: Military Sciences
17: Philosophy, Religion and Theology
18: Psychology
19: Public Management and Services
20: Social Sciences

1. INTRODUCTION: PROCESS AND PROCEDURE

1.1. The process

The Department of Higher Education and Training (the Department) implements the *Research Output Policy, 2015 (*hereafter the Policy), which provides a framework for the evaluation and subsidy allocation for research outputs produced by South African public higher education institutions (universities). The subsidisation of research outputs forms a basis for sustaining research and promoting increased research productivity and other forms of knowledge generation required to meet national development needs. The Policy journal articles, books, chapters in books and published conference proceedings. The policy relies on the principle of peer-review, among others, for quality academic publications.

The Policy accords all South African universities the responsibility to co-own its implementation and ensure the improvement of quality research outputs from the sector. In order to reduce errors, institutions are required to ensure that all research office personnel are well acquainted with the Policy; that an institutional internal evaluation committee assesses all publications before submitting to the Department as per paragraph 8.2 (d) of the Research Outputs Policy and that all are familiar with the general requirements, principles, objectives and ethics upon which the policy is set. Only claims that meet the policy requirements must be submitted to the Department.

All 26 universities submitted their 2021 research publication outputs before or on 15 May 2022 for the purpose of subsidy allocation. The Directorate: University Research Support and Policy Development together with the National Research Foundation (NRF) administered the process and evaluated technical compliance of all submissions. Having been spurred by the experience of the national lockdown of the previous year, the submission process for the 2021 research outputs was planned for online processing from the outset. The Research Outputs Submission System (ROSS) that has been developed and managed by the NRF facilitates the online research outputs submissions and their processing through to the outcomes of the evaluations by the relevant field-specific expert peer review sub-panels. The sub-panels use pre-determined evaluation criteria in line with the Policy. The sub-panellists, who are drawn mainly from the university sector, are expert-practitioners in their respective fields. The sub-panels conducted evaluations of book publications and published conference proceedings under the guidance of the Research Output Evaluation Panel (the Panel), whose members chair the respective sub-panels.

The online research outputs submissions and evaluation process has proven to be convenient and efficient because the evaluations were completed on time since the development and introduction of ROSS in 2020. The system also allowed for a longer and more thorough process of evaluations.

The Policy requires institutions to submit audited subsidy claims for research outputs appearing in approved journal indexes and lists. The Department recognises the following indexes and lists: Scopus; Scientific Electronic Library Online South Africa (SciELO SA); the Norwegian Register for Scientific Journals (Level 2); Clarivate (formerly Thomson Reuters) Web of Science; the ProQuest International Bibliography of the Social Sciences (IBSS); the Directory of Open Access Journals (DOAJ) and the Department of Higher Education and Training (DHET) list of SA journals.

The process followed for evaluating the 2021 research outputs submissions was as follows:

a) The Department received all electronic copies (and a few hard copies) of publications in the form of books, chapters in books, published conferences proceedings and audited claims for article in accredited journals, and the required supporting documents on or before 15 May 2022.
b) The Department, supported by the NRF, screened all the submissions for eligibility and according to the technical criteria as per the Policy.
c) Field-specific expert peer review sub-panels were convened from 11 to 31 July 2022 and evaluated books, chapters in books, and pubished conferences proceedings according to predetermined criteria and scholarship of the publications.
d) The Department, supported by the NRF, analysed the outcomes of the sub-panels and calculated the number of units allocated to each institution for publications in books, chapters in books and published conference proceedings.
e) Audited claims for publications in accredited journals submitted by universities were checked and verified against the approved journal indexes and lists and final unit allocations for each institution were calculated.
f) Individual institutional reports were developed by the Department and sent to the respective institutions in April 2023.
g) This report on the evaluation of 2021 Universities' research outputs was drafted by the Department, with the assistance of the Centre for Research, Evaluation, Science and Technology (CREST) on statistical analysis and quality.

Late publications for the year 2020 (n-2) were considered where valid and legitimate reasons for late submission were provided and accepted, but publications dating before 2019 (n-3 and beyond) were not considered, as stipulated in the policy. For purposes of pattern analysis and improving its systems, the

Department will in future request a separate submission of n-3 publications and articles appearing in non-approved publications, however, these will still not be considered for subsidy.

1.2. Methodological notes

A number of methodological clarifications are in order with regard to-

- The distinction between publication output units and publication outputs
- The classification of scientific fields/disciplines
- The definition and meaning of normalized indicators used in the report
- The analysis of demographic trends in publication outputs.

1.2.1 Publication output units and publication outputs

This report makes a distinction between publication output **units** and publication **outputs.** The former refers to the subsidy units awarded for each approved publication (according to the criteria set out in the Policy) based on the submissions made in a particular year. This means that a university is awarded a total subsidy based on the calculation of all submissions made in, say, 2022 for the preceding year (2021). However, because the Policy allows for late submissions accompanied by valid reasons (i.e. 2020 – 1 year or year *n* minus 1), the result is that the total subsidy units awarded in 2022 for 2021 publications will invariably include a small proportion of publications that had been published in 2020. In this report, the total number of subsidy units (or output units) that have been awarded to universities based on the submissions made in 2022 are reported at the beginning of each section. When the results are reported by scientific field, journal index or demographics, the analyses are based on the actual publication year of each output instead of the submission year of publication output.

1.2.2 Classification of outputs by scientific field or discipline

The analysis may refer to the Classification of Education Subject Matter (CESM) categories which has been extensively used in the previous reports. The use of CESM categories for analysis in this report has been minimised since it is best used for subsidy allocations and less suitable for the classification of research publication outputs.

1.2.3 The definition and meaning of normalized indicators used in the report

Four indicators are included in the report:

- Per capita research **publication output** (where the total number of publications by a university is divided by the headcount of the permanent instructional and research staff in the same year). The result is the number of publications per permanently employed academics per annum.

- Weighted per capita **research output** (where all research output - including research masters and doctoral graduates - is calculated against set norms and divided by the headcount of academic staff in the same year). Each research masters graduate has a weight of 1 unit while a doctoral graduate has a weight of 3 units.
- Proportion of academic staff by their highest degrees or qualifications against the research outputs.
- Proportion of doctoral graduates per doctorate academic staff.

1.2.4 The analysis of demographic trends in publication output

This report includes a number of analyses related to demographic shifts in the publication outputs of universities. Four demographic variables used in these analyses are:

- Gender of the author
- Country of birth of the author (SA-nationals and foreign nationals)
- Race of the author (only for SA nationals)
- Age of the author

The analyses of the above categories are based on data sourced from the most recent submissions. It is important to point out that coverage of these variables in the current version of the database varies (for example, 'gender of author' is much better covered than the 'nationality of the author'). However in all cases information about these variables is available for more than 80% of the individual records on which the final analyses was conducted.

The purpose of analysing the demographic patterns assists the Department to monitor the trends in transformation of knowledge production in the university sector, particularly the development of young academics in higher education institutions. Such knowledge assists the Department to design the necessary interventions as, for example, in the University Capacity Development Plan. The understanding of shifts in the above-stated demographics over time is imperative if the Department and the individual institutions are to make a contribution to redress and transformation of our country.

1.3. Quality and Integrity of Research Outputs

The Department remains committed to ensure that an appropriate framework is in place to assure quality and integrity of academic publications. There are currently initiatives underway in this regard in order to strengthen existing frameworks and procedures. The Department will continue to communicate with the sector on these initiatives and any changes that may be required in the future to ensure that the subsidy system is guarded against abuse and only publications of high quality and ethical integrity are subsidised. As indicated before, the Department reserves the right to withhold payment of research

output subsidy in respect of any publication unit that does not meet the criteria as outlined in the research output policy and violate international rules about research integrity and ethics, as well as not upholding the acceptable academic practices of good scholarship.

The purpose of the Research Outputs Policy, is to "encourage research productivity by rewarding quality research outputs at public higher education institutions". The emphasis must be put on 'quality' research and publications. Each year the Department scrutinises the quality of submissions made by institutions. Such scrutiny has assisted in improving the policy; processes and procedures for submission and determination of subsidy allocations.

Institutional reports for the 2021 publications carry some information with regard to the publication units that were withheld from the 2020 submissions (2019 publications), pending an investigation. Based on subsequent analyses and further investigations, some submissions were declined in 2021 and excluded in the analysis in this report.

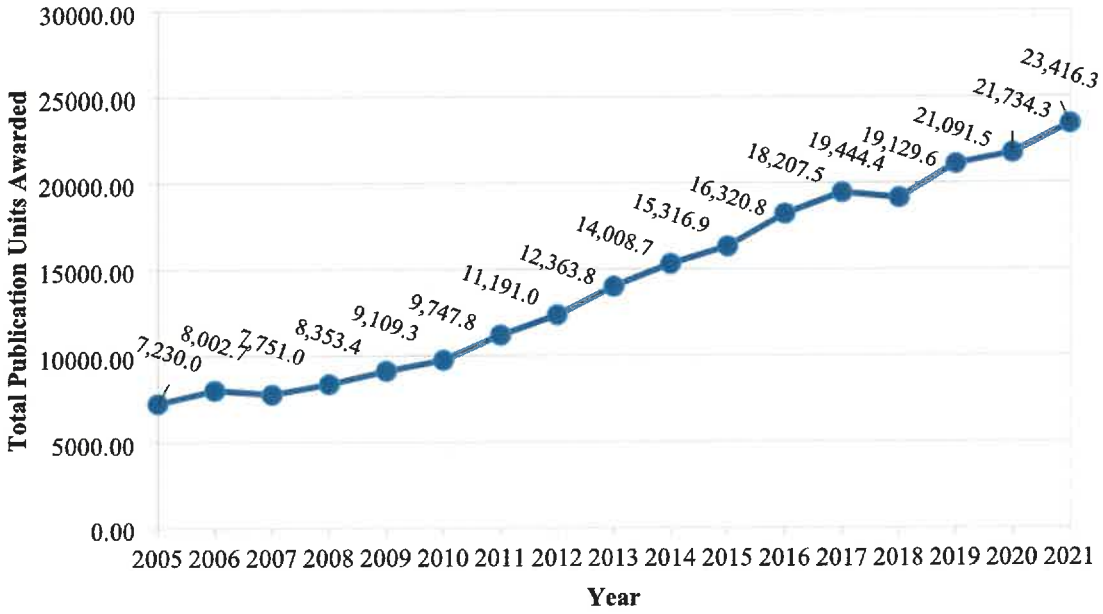
2. OVERALL RESEARCH PUBLICATIONS OUTPUT

2.1. Overview and trends

A total of 23 416.32 publication subsidy units in all publication categories (journal articles, books and book chapters and published conference proceedings) were awarded to universities for the 2022 submission cycle (2021 publication year). This constitutes a 7.74% increase from the 2020 publication units, from 21 734.3 to the 23416.32 units (or an increase of 1 682.02 units). **Figure 1** presents the timeline of the approved publications units generated by the university sector for the past 17 years.

A better interpretation of the research publications output growth (as shown in **figure 1**) can be achieved by factoring the analysis of the Annual Growth Rate (AGR) and the Compound Average Growth Rate (CAGR) as shown in **figure 2**. The Annual Growth Rate is the year-to-year calculation of percentage growth, while the CAGR (equivalent to exponential gowth rate) factors the previous percentages of growth and is reported here in three-year periods

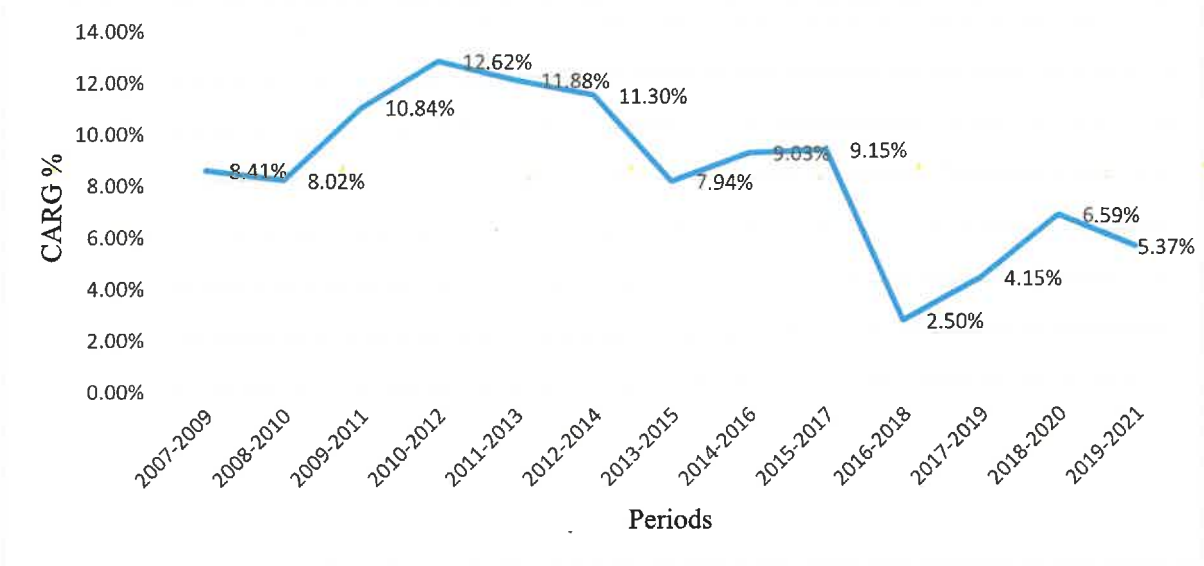
Figure 1: Total Publication Units awarded, 2005 – 2021



The overall percentage growth rate of research publications outputs from 2005 to 2021 was 7.62%.(CAGR). The sharpest increase in publication output (of 9.08%) occurred from 2019 to the present (see **figure 2**).

The year-to-year growth in publication outputs over the past 17 years peaked at 14.81% in 2011. Further disaggregation of the CAGR into three-year time frames (**figure 2**) helps to understand the differences in trends in publication output over the past 17 years. The CAGR bar for 2008, for instance, represents compounded growth between 2005 to 2008, and so on. The compounded growth rate of publications output peaked at 10.7% between 2009 and 2012, not surprisingly because there had been high growth during that period. Since then the rate of increase has gradually declined and has been at its lowest in 2020.

Figure 2: Percentage Growth Rate and 3-year Cycles of CAGR, 2005 - 2021



2.2. Publications units by publication type

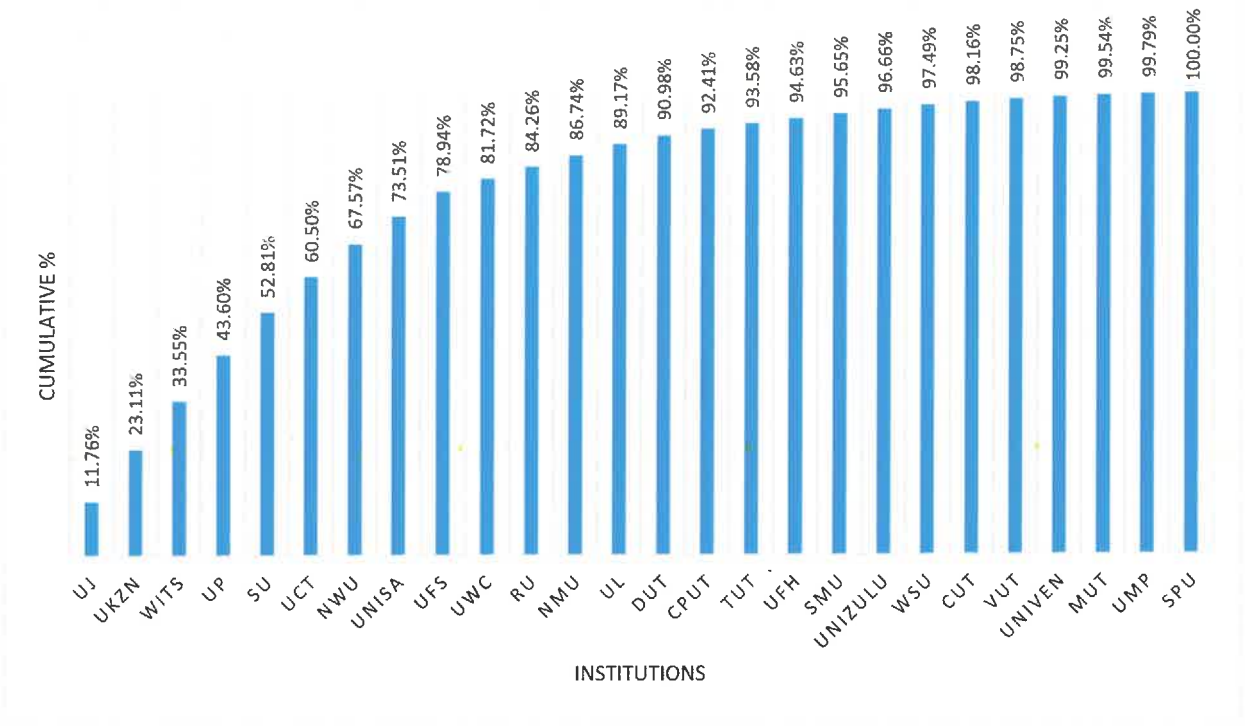
The Research Outputs policy recognises book publications (i.e. books and book chapters); published conference proceedings and journal articles. The output units awarded in 2021 by each type and by university are listed in **Table 1** (in descending order of overall sector units of 2021). The institutional shifts that have occurred over time are noteworthy.

Table 1: Publication output units by publication type by universities, 2021

Institution	Books		Conferences		Journals		Overall Institutional units 2020	Overall Institutional units 2021	% Share of Overall Sector units 2021
	Units	% of institutional units	Units	% of institutional units	Units	% of institutional units			
UJ	510.5	17.62%	236.5	26.72%	2006.5	10.22%	2305.6	**2753.4**	**11.76%**
UKZN	201.0	6.93%	20.5	2.32%	2436.7	12.41%	2402.4	**2658.2**	**11.35%**
WITS	338.5	11.68%	58.7	6.64%	2046.3	10.42%	1924.2	**2443.6**	**10.44%**
UP	244.7	8.45%	72.4	8.18%	2036.0	10.37%	2099.8	**2353.1**	**10.05%**
SU	304.6	10.51%	78.7	8.89%	1774.5	9.04%	2188.5	**2157.9**	**9.22%**
UCT	212.2	7.32%	54.5	6.15%	1534.4	7.82%	1886.8	**1801.1**	**7.69%**
NWU	222.9	7.69%	66.9	7.56%	1366.3	6.96%	1536.6	**1656.0**	**7.07%**
UNISA	141.5	4.88%	46.0	5.20%	1202.8	6.13%	1323.2	**1390.3**	**5.94%**
UFS	211.1	7.29%	44.1	4.98%	1015.7	5.17%	1321.4	**1270.9**	**5.43%**
UWC	90.1	3.11%	7.5	0.85%	553.5	2.82%	603.9	**651.1**	**2.78%**
RU	105.8	3.65%	17.1	1.93%	471.6	2.40%	535.1	**594.5**	**2.54%**
NMU	55.7	1.92%	39.0	4.40%	485.9	2.47%	564.4	**580.6**	**2.48%**
UL	44.2	1.53%	11.0	1.24%	515.2	2.62%	371.2	**570.4**	**2.44%**
DUT	43.8	1.51%	21.8	2.46%	358.2	1.82%	449.0	**423.7**	**1.81%**
CPUT	28.1	0.97%	15.5	1.75%	290.4	1.48%	231.5	**334.0**	**1.43%**
TUT	6.7	0.23%	20.5	2.31%	246.8	1.26%	328.9	**274.0**	**1.17%**
UFH	40.0	1.38%	11.0	1.24%	194.2	0.99%	275.4	**245.2**	**1.05%**
SMU	0.0	0.00%	1.1	0.12%	237.7	1.21%	174.3	**238.8**	**1.02%**
UNIZULU	36.4	1.26%	3.1	0.35%	198.9	1.01%	267.5	**238.4**	**1.02%**
WSU	5.8	0.20%	12.8	1.44%	173.7	0.88%	154.9	**192.2**	**0.82%**
CUT	1.6	0.05%	27.2	3.07%	128.9	0.66%	172.1	**157.7**	**0.67%**
VUT	18.4	0.64%	13.7	1.55%	106.3	0.54%	195.4	**138.4**	**0.59%**
UNIVEN	5.9	0.20%	1.2	0.13%	109.1	0.56%	223.7	**116.2**	**0.50%**
MUT	12.3	0.42%	1.4	0.16%	55.2	0.28%	105.5	**68.9**	**0.29%**
UMP	3.5	0.12%	1.4	0.16%	52.7	0.27%	64.0	**57.6**	**0.25%**
SPU	12.4	0.43%	1.8	0.21%	35.9	0.18%	29.3	**50.1**	**0.21%**
Total	**2897.9**	100.00%	**885.1**	100.00%	**19633.4**	100.00%	**21734.3**	**23416.3**	**100.00%**

A graphic presentation of the cumulative relative share to sector output by individual universities is presented in **Figure 3.** The graph shows that 61% of the research publications output units were produced by six universities in the sector. Another three institutions contributed 22% to the overall sector output. These figures, which have not changed fundamentally over the recent past, show the large differentiation in knowledge-productive capacity of the sector. Although there have been major changes to the entire sector, such as the overall growth in the publications outputs since the policy came into effect (past 17 years), the proportional contribution of institutions has remained mostly unchanged.

Figure 3: Relative cumulative share to sector output by individual universities



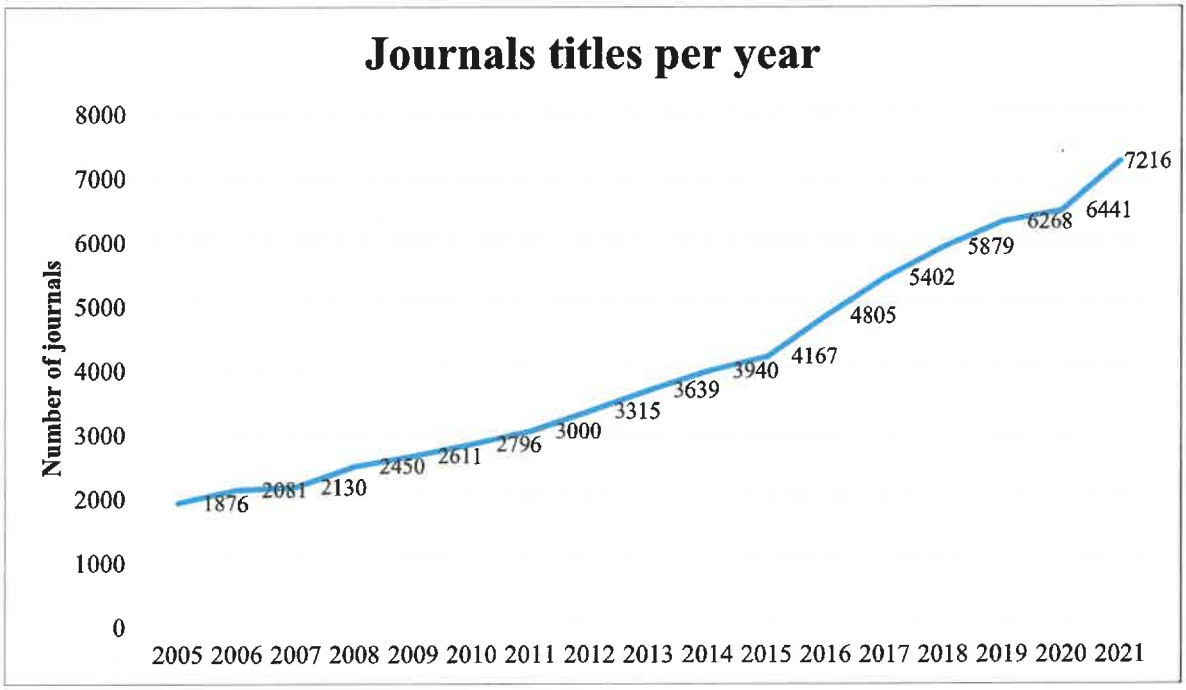
The specific areas of performance of the system are captured in the following sub-sections of the report.

3. JOURNAL PUBLICATION OUTPUTS

3.1. Overview of journal publications

Coupled with the growth of publications outputs from the sector, the addition of more journal indexes in the 2016 revision of the policy provided academics with a broader range of publication outlets for journal articles. **Figure 4** shows the increase in the number of journals in which SA academics have published in the past 17 years. The inclination of the graph (2016 to 2021) is testimony to the inclusion of new indexes and the number of journals used by South African academics. The total number of journals used in 2021 for publication by South African academics represents about 14% of the overall number of journals in, hitherto, recognised six indexes (WoS, IBSS, Scopus, Norwegian List, SCIELo SA, DOAJ and DHET List).

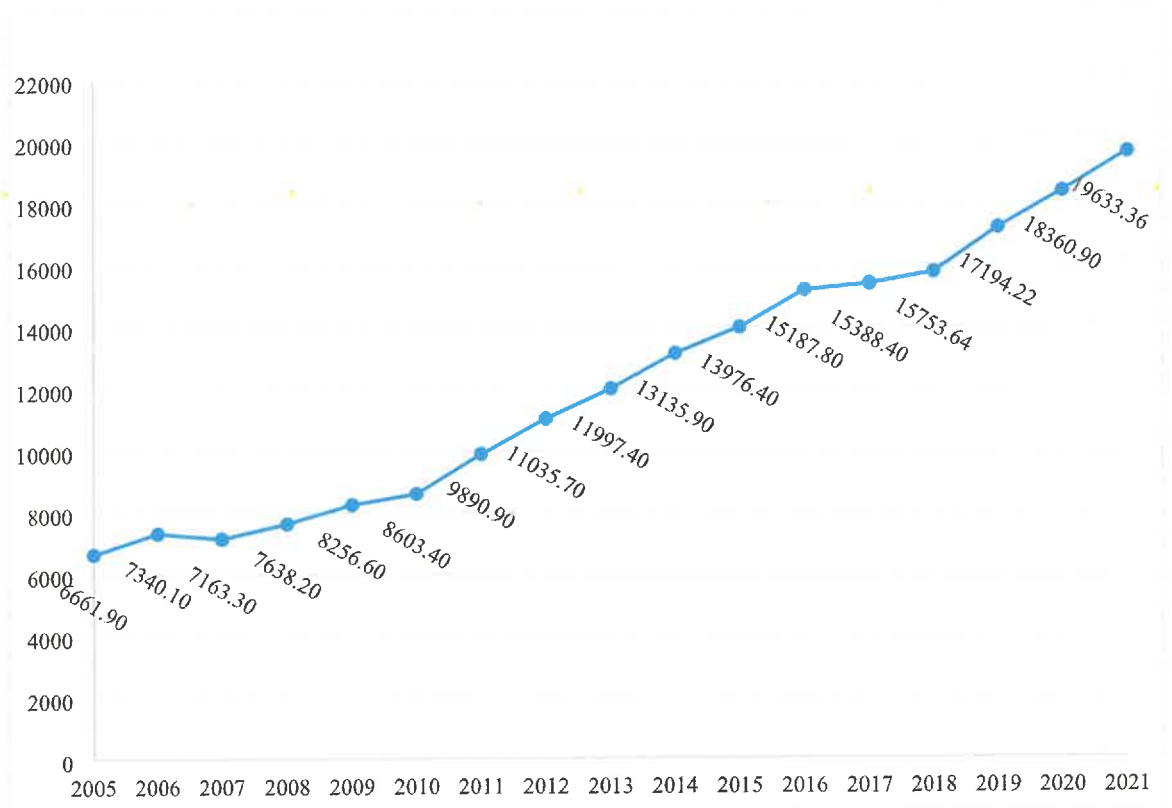
Figure 4: Increase in the number of journals in which SA academics published (2005 - 2021)



Journal articles are the predominant mode of knowledge dissemination across the majority of scientific fields and disciplines. **Figure 5** shows the trend of units awarded for journal outputs since 2005. A comparison between the increase in the number of journals in which academics published (**figure 4**) and the number of units accrued for journal articles (**figure 5**) shows that the number of journals increased dramatically between 2015 and 2018, by 1 888 (69%) journals. Whilst, during the same period, the number of output units increased by 1 779.7 (12.7%) units. A marked increase in the number of research output units was recorded from 2019 (journal publications of 2018) to 2020 (publications

of 2019), that is, two years after the addition of new indexes. Analysis of new indexes commenced in the 2017 report (publications of 2016). This shows that the expansion of the indexes, and additional journals, introduced in 2016 did not have an immediate impact or reaction on the number of units (which could have been observed in 2017 report of 2016 publications). In other words, many academics began to publish in the new journal indexes after they were approved, which may as well have been a re-migration influenced by the recognition of the indexes.

Figure 5: Trend in the number of journal article output units, 2005 – 2021



The Compound Average Growth Rate (CAGR)-values over this period are presented in **Table 2**. The three-year periodical CAGR presented in Table 2 helps to understand publications output performance trends, the 'ebb and flow', of publications outputs in past 17 years. **Table 2** shows that the increase in output peaked between 2010 and 2013 whereafter it declined (between 2015 and 2018) and then started to increase in the most recent period.

Table 2: CAGR by rolling three-year windows for journal articles, 2007–20121

Publication Year	Journal Article Units	Annual Growth	3Yr CAGR
2005	6661.90		
2006	7340.10	10.18%	
2007	7163.30	-2.41%	
2008	7638.20	6.63%	4.66%
2009	8256.60	8.10%	4.00%
2010	8603.40	4.20%	6.30%
2011	9890.90	14.97%	9.00%
2012	11035.70	11.57%	10.15%
2013	11997.40	8.71%	11.72%
2014	13135.90	9.49%	9.92%
2015	13976.40	6.40%	8.19%
2016	15187.80	8.67%	8.18%
2017	15388.40	1.32%	5.42%
2018	15753.64	2.37%	4.07%
2019	17194.22	9.14%	4.22%
2020	18360.90	6.79%	6.06%
2021	19633.36	6.93%	7.61%

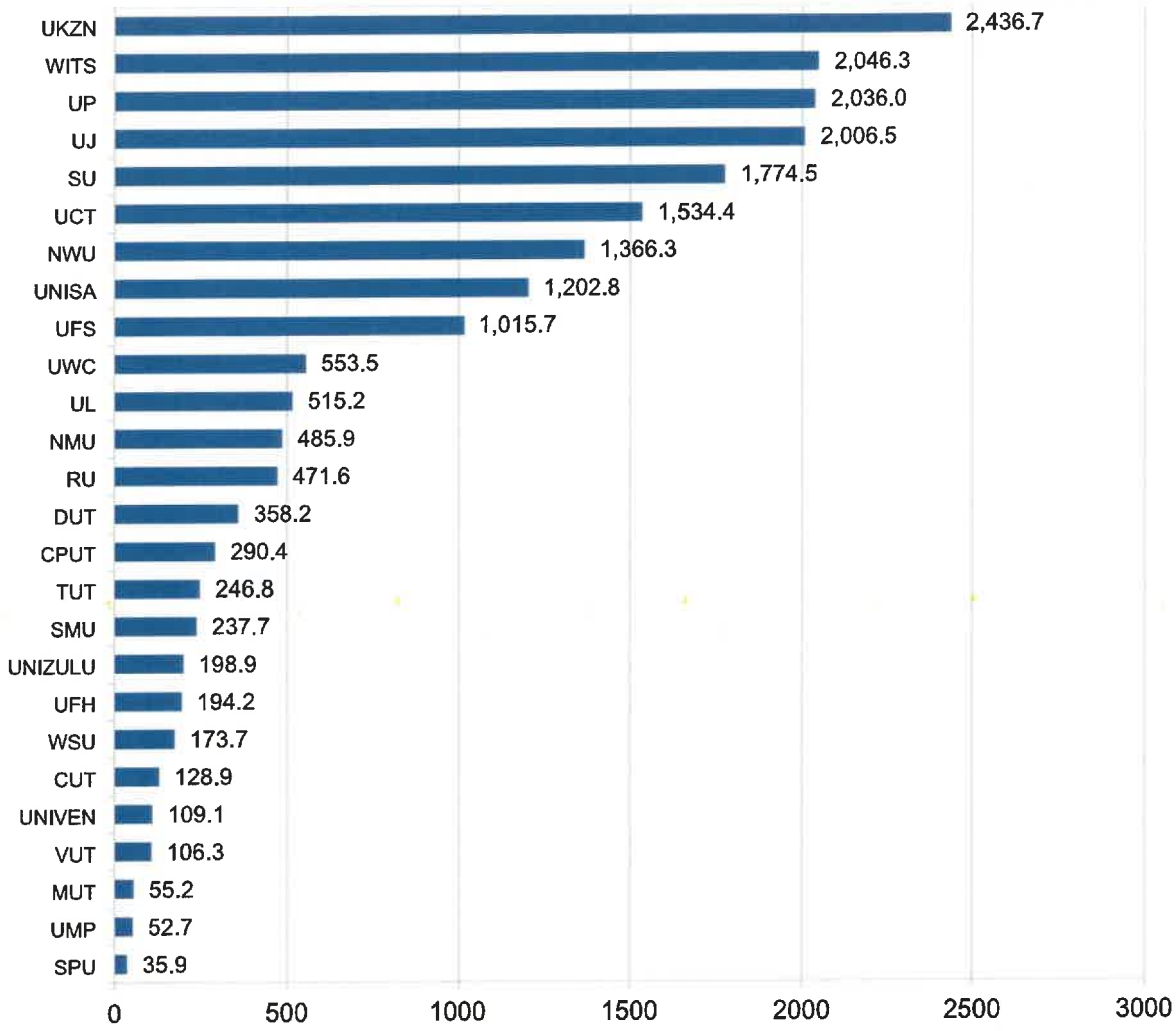


Figure 6: Units awarded (rounded off) for journal article outputs by universities 2021

3.2. Publications disaggregated by the approved indexes

The inclusion of new indexes after the 2016 review of the policy started having a clear effect in the publication output from 2019 onwards. The newly added indexes from 2016 are **Scopus** (a journal indexing solution by Elsevier); Scientific Electronic Library Online South Africa (**SciELO SA**) and the Norwegian Register for Scientific Journals, Series and Publishers and since 2021, the Directory of Open Acces Journals (DOAJ). **Table 3** presents the breakdown of journal output by journal index or list.

Table 3: Journal Publication Outputs by Index, 2021 (n=29 950)

DHET	WoS	Scopus	DOAJ	IBSS	Scielo	Norwegian List*	Number of articles	Percentage
Yes	Yes	Yes	Yes		Yes		17	0.06%
Yes	Yes	Yes					122	0.41%
Yes	Yes						7	0.02%
Yes		Yes	Yes		Yes		11	0.04%
Yes		Yes	Yes				215	0.72%
Yes		Yes		Yes			17	0.06%
Yes		Yes					334	1.12%
Yes			Yes		Yes		100	0.33%
Yes			Yes				301	1.01%
Yes				Yes			57	0.19%
Yes							1159	3.87%
	Yes	Yes	Yes	Yes	Yes		53	0.18%
	Yes	Yes	Yes	Yes		Yes	1	0.00%
	Yes	Yes	Yes	Yes			6	0.02%
	Yes	Yes	Yes		Yes		691	2.31%
	Yes	Yes	Yes			Yes	133	0.44%
	Yes	Yes	Yes				967	3.23%
	Yes	Yes		Yes		Yes	177	0.59%
	Yes	Yes		Yes			718	2.40%
	Yes	Yes			Yes		143	0.48%
	Yes	Yes				Yes	2166	7.23%
	Yes	Yes					9460	31.59%
	Yes		Yes				43	0.14%
	Yes			Yes		Yes	2	0.01%
	Yes			Yes			14	0.05%
	Yes					Yes	30	0.10%
	Yes						1639	5.47%
		Yes	Yes	Yes	Yes		68	0.23%
		Yes	Yes	Yes			16	0.05%
		Yes	Yes		Yes		355	1.19%
		Yes	Yes				1242	4.15%
		Yes		Yes		Yes	8	0.03%
		Yes		Yes			438	1.46%
		Yes			Yes		53	0.18%
		Yes				Yes	74	0.25%
		Yes					5623	18.77%
			Yes	Yes	Yes		19	0.06%
			Yes	Yes			72	0.24%
			Yes		Yes		289	0.96%
			Yes				2015	6.73%

				Yes	Yes		8	0.03%
				Yes			745	2.49%
					Yes		237	0.79%
						Yes	16	0.05%
							89	0.30%

* Norwegian Register for Scientific Journals, Series and Publishers

All articles are linked to a specific journal that is indexed or listed in one or more of the DHET approved journal indexes or lists. The results show the dominance of two indexes: Scopus and the [CA]Web of Science. Nearly half (49%) of all journal articles in 2021 were published in either the [CA]Web of Science (WoS) or Scopus indexes. Articles published in the Scopus index-listed journals alone made up 18.77% of all articles published in journals, and making it the largest component by a single index. The next single largest component is the DOAJ listed journals (6.73%). The Norwegian list again included the fewest index unique articles published at 0.05% of the total journal articles. Publications exclusive to the DHET listed journals declined from 5.16% in 202 to 3.87% in 2021. It is significant to note that 77.2% of all publications overlap with Scopus and 54.7% overlap with WoS.

A notable emergeing pattern is clear, relatively newer indexes **Scopus**; SciELO SA and the Norwegian list currently cover 21.23% of articles appearing in journals. This explains the surge in publications outputs that occurred from 2019 (see also **figures 1, 4** and **5**). The inclusion of DOAJ in 2021 had a significant impact, showing 6.73% exlusive publications and 22.1% publications overlapping with other indexes.

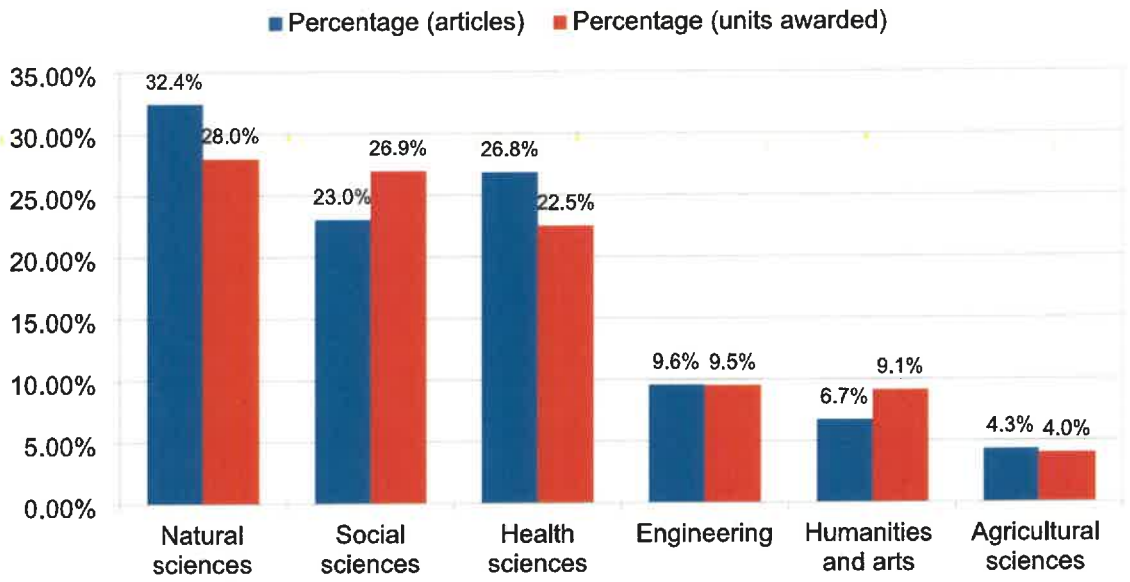
3.3. Journal publication outputs by scientific field

As noted in the previous report, there are no, or very small shifts over the past three years with regard to the proportional shares by scientific field. **Table 3** shows the number of articles by scientific fields.

Table 4: Number of Articles by Scientific Fields, 2015 to 2021

Domains	Number of articles	Units Awarded
Natural sciences	9689	5491.418
Health sciences	8014	5291.0057
Social sciences	6872	4411.7682
Engineering	2857	1868.4559
Humanities and arts	2000	1787.5046
Agricultural sciences	1282	783.2113

Figure 7: Comparing article units awarded with article output by subject field



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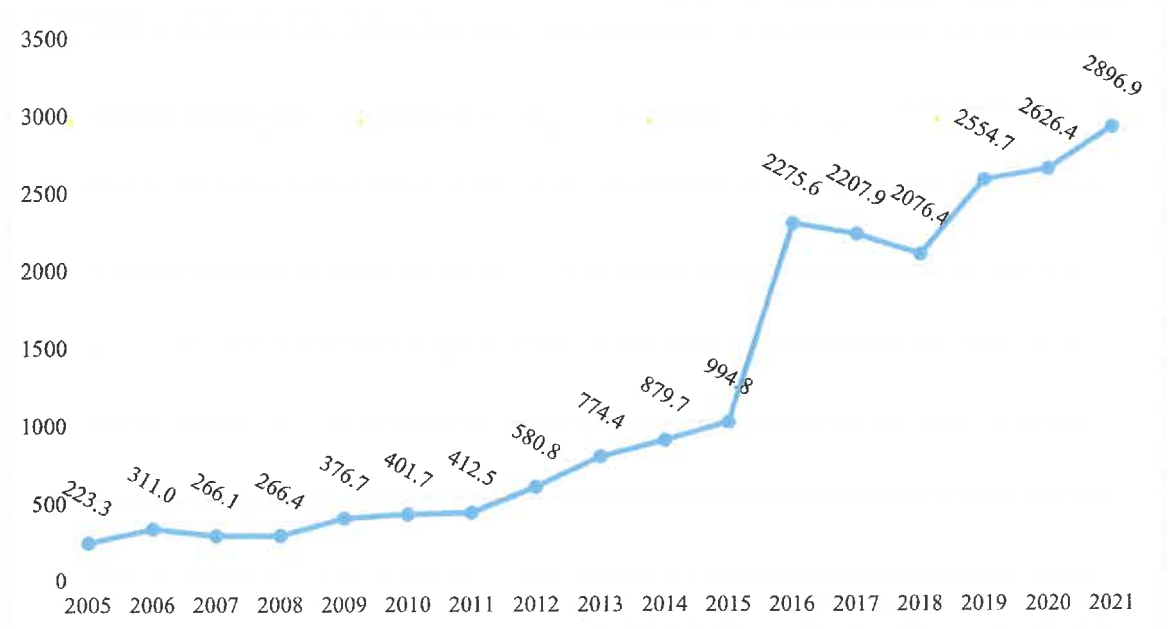
4. BOOK AND BOOK CHAPTER OUTPUTS

4.1. Overview and trends

Research publication units in scholarly books for 2021 amounted to 2897.9 units, an increase of 271.5 units from 2626.4 units in 2020 (a 10.34% increase). The longer term trend of book publications outputs is presented in **Figure 8**.

Figure 8: Trend in book and book chapter output: 2005 - 2021



To better understand the trend of growth in book publications over the years, **Table 5** presents the CAGR-values for three-year window periods from 2005. The highest compounded growth occurred in the 2014 – 2016 (by 43.23%) and 2015-2017 (35.90%) periods. The two periods mark the introduction of the improved unit allocations for book publications which were introduced by the 2016 policy revision. Thereafter, the book publications units growth has been stabilising at the single digit percentages.

Table 5: CAGR by rolling three-year windows for books and chapters, 2007-2021

Year	Books & Chapter Units	Annual Growth	3Yr CAGR
2005	223.3		
2006	311.0	39.27%	
2007	266.1	-14.44%	
2008	266.4	0.11%	6.06%
2009	376.7	41.40%	6.60%
2010	401.7	6.64%	14.71%
2011	412.5	2.69%	15.69%
2012	580.8	40.80%	15.53%
2013	774.4	33.33%	24.46%
2014	879.7	13.60%	28.72%
2015	994.8	13.08%	19.65%
2016	2275.6	128.75%	43.23%
2017	2207.9	-2.98%	35.90%
2018	2076.4	-5.96%	27.80%
2019	2554.7	23.04%	3.93%
2020	2626.4	2.81%	5.96%
2021	2896.9	10.30%	11.74%
CAGR (2005-2021)	**17.37%**		

In 2021 book publications constituted 12% of overall publications units, compared with journal articles which accounted for 84% of all outputs and conference proceedings made up the rest (4%).

4.2. Book and book chapter outputs by university

The distribution of book publications units by university for the past two years is presented in **Table 6**. The results are organized in descending order of the relative share by university of the 2021 book publications output units. The table can also be used to compare or track growth from the previous year within individual institutions.

Table 6: Percentage of book publications output units by university, 2020 and 2021

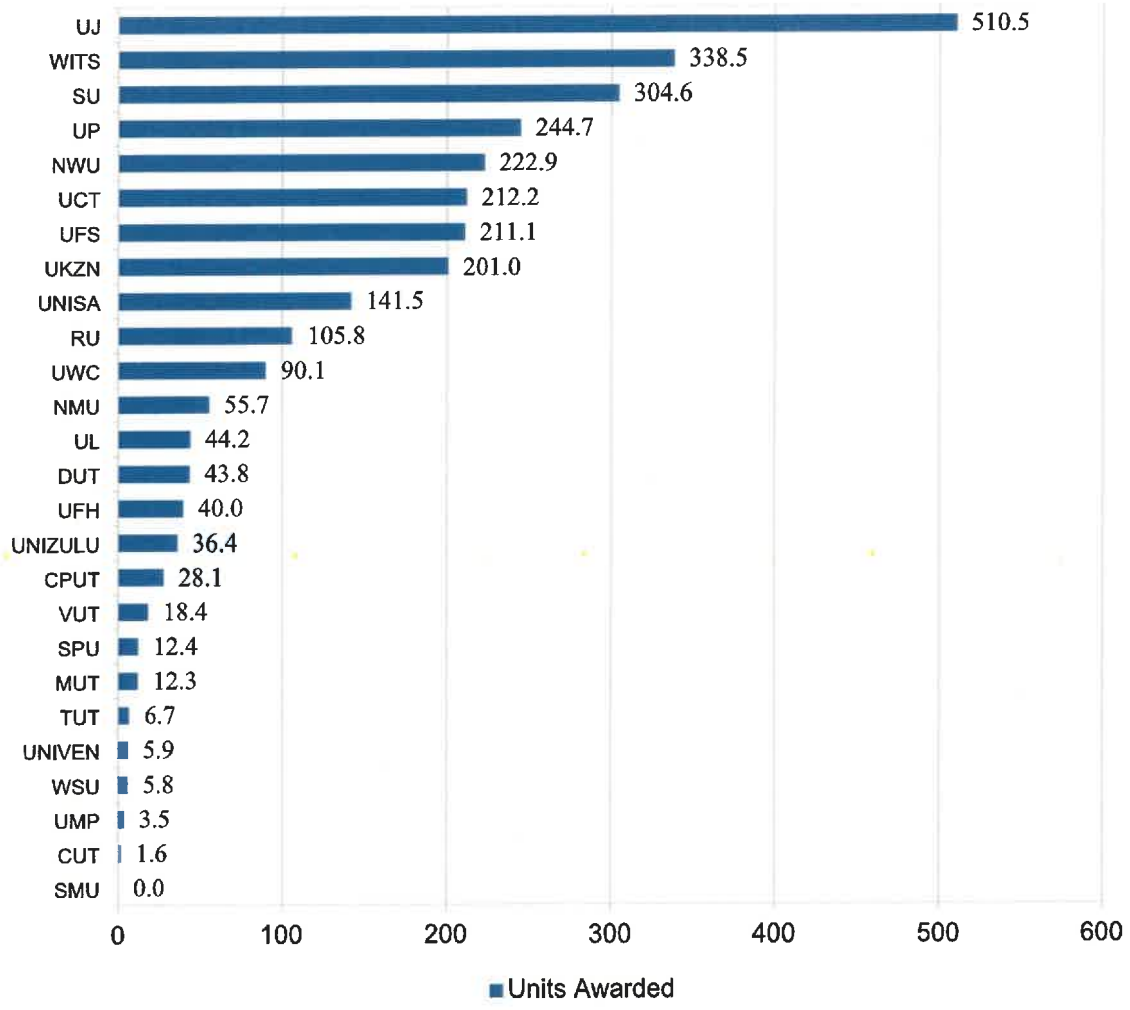
	2020		2021			
Institution	**No. of Units**	**% of Total**	**No. of Units**	**% of Total**	**Difference (year to year)**	**% Growth**
CPUT	12.3	0.47%	28.078	0.97%	15.778	128.28%
CUT	4.6	0.18%	1.5926	0.05%	-3.0074	-65.38%
DUT	48.4	1.84%	43.7833	1.51%	-4.6167	-9.54%
MUT	0.4	0.02%	12.2772	0.42%	11.8772	2969.30%
NMU	67.1	2.55%	55.7478	1.92%	-11.3522	-16.92%
NWU	233.4	8.89%	222.8994	7.69%	-10.5006	-4.50%
RU	54.5	2.08%	105.8196	3.65%	51.3196	94.16%
SMU	1	0.04%	0	0	-1	-100.00%
SPU	2.3	0.09%	12.384	0.43%	10.084	438.43%
SU	444.5	16.92%	304.6425	10.51%	-139.8575	-31.46%
TUT	0.4	0.01%	6.7317	0.23%	6.3317	1582.93%
UCT	165.6	6.31%	212.1787	7.32%	46.5787	28.13%
UFH	11	0.42%	39.9971	1.38%	28.9971	263.61%
UFS	320.7	12.21%	211.1251	7.29%	-109.5749	-34.17%
UJ	344.6	13.12%	510.504	17.62%	165.904	48.14%
UKZN	131.2	5.00%	200.9635	6.93%	69.7635	53.17%
UL	13.2	0.50%	44.2287	1.53%	31.0287	235.07%
UMP	2.9	0.11%	3.5369	0.12%	0.6369	21.96%
UNISA	149.9	5.71%	141.4986	4.88%	-8.4014	-5.60%
UNIVEN	12.6	0.48%	5.9064	0.20%	-6.6936	-53.12%
UNIZULU	16.2	0.62%	36.3729	1.26%	20.1729	124.52%
UP	301.1	11.46%	244.735	8.45%	-56.365	-18.72%
UWC	32.2	1.23%	90.084	3.11%	57.884	179.76%
VUT	8.1	0.31%	18.4428	0.64%	10.3428	127.69%
WITS	235.2	8.96%	338.542	11.68%	103.342	43.94%
WSU	12.8	0.49%	5.8286	0.20%	-6.9714	-54.46%
TOTAL	**2626.4**	**100.00%**	**2897.9**	**100.00%**	**271.5004**	**10.34%**

The longer term trend in the production of books and book chapters by university is presented in **Table 7**. The table is organized in descending order of the CAGR-percentages. Institutions moving from a relatively low base and experiencing significant growth have higher percentages of CAGR. However, there are also institutions from a significantly higher book publications output levels with significantly higher growth rates. It will also be noted that the new universities do not cover the periods presented in the table. The most salient results for the past year are the increases of 165.9 units (17.62%) for UJ, 103.34 units (11.68%) for WITS and a decline in the number of book units (139.86 units) for SU and 109.57 units for UFS.

Table 7: CAGR of book publications units by university, 2015 - 2021

Institution	2015	2016	2017	2018	2019	2020	2021	CAGR
UJ	92.37	228.2	326.54	220.42	359	344.64	510.504	32.97%
WITS	159.4	241.68	286.36	196.46	272.4	235.21	338.542	13.38%
SU	78	284.93	266.02	280.51	327.7	444.45	304.643	25.49%
UP	101.1	195.24	237.67	266.81	296	301.06	244.735	15.88%
NWU	48.84	118.99	110.03	131.85	189.2	233.43	222.899	28.79%
UCT	161.47	223.56	185.98	169.63	220	165.61	212.179	4.66%
UFS	79.08	178.22	239.2	182.55	305.9	320.68	211.125	17.78%
UKZN	66.47	275.47	128.09	176.05	156.8	131.22	200.964	20.25%
UNISA	71.79	238.71	117.61	146.56	125.6	149.92	141.499	11.97%
RU	48.1	47.22	99.22	94.87	65.8	54.53	105.82	14.04%
UWC	29.34	94.33	53.18	45.43	68	32.24	90.084	20.56%
NMU	10.05	30.84	22.52	35.48	21	67.06	55.7478	33.05%
UL	3.66	1.59	21.41	2.71	13.1	13.22	44.2287	51.49%
DUT	16.59	23.77	28.58	49.66	33.7	48.4	43.7833	17.56%
UFH	2.99	18.6	13.81	12.05	7.6	11	39.9971	54.07%
UNIZULU	4.52	5.17	24.9	17.38	19.1	16.18	36.3729	41.56%
CPUT	5.99	11.87	25.84	13.9	32	12.3	28.078	29.37%
VUT	0	4		2.74	4.7	8.15	18.4428	35.75%
SPU	0	0	0	0	4.6	2.29	12.384	64.08%
MUT	0	1.33	0.78	0	0.5	0.42	12.2772	55.97%
TUT	3.02	10.52	6.47	3.86	8.2	0.39	6.7317	14.29%
UNIVEN	10.8	23.29	8.38	10.76	6.7	12.63	5.9064	-9.57%
WSU	0.08	1	1.14	0.73	4.5	12.78	5.8286	104.37%
UMP	0	0	0	3.33	1.7	2.95	3.5369	2.03%
CUT	1.11	9.89	3.21	6.19	9.5	4.64	1.5926	6.20%
SMU	0	0.65	1	0	1.2	1	0	-100.00%
TOTAL	**994.77**	**2269.07**	**2207.94**	**2069.93**	**2554.5**	**2626.4**	**2897.9**	**19.51%**

Figure9: Units awarded (rounded off) for book and chapter units by universities 2021



5. PUBLISHED CONFERENCE PROCEEDINGS

5.1. Overview and trends

The trend line of published conference proceedings shows that after the steep decline in units to 747.0 in 2020 was followed by a moderate 'recovery' to 885.08 units in 2021. A few submissions for conference proceedings have declined and some were not approved by the respective sub-panels of experts.

Figure 10: Trend in the output of published conference proceedings:, 2005 - 2021

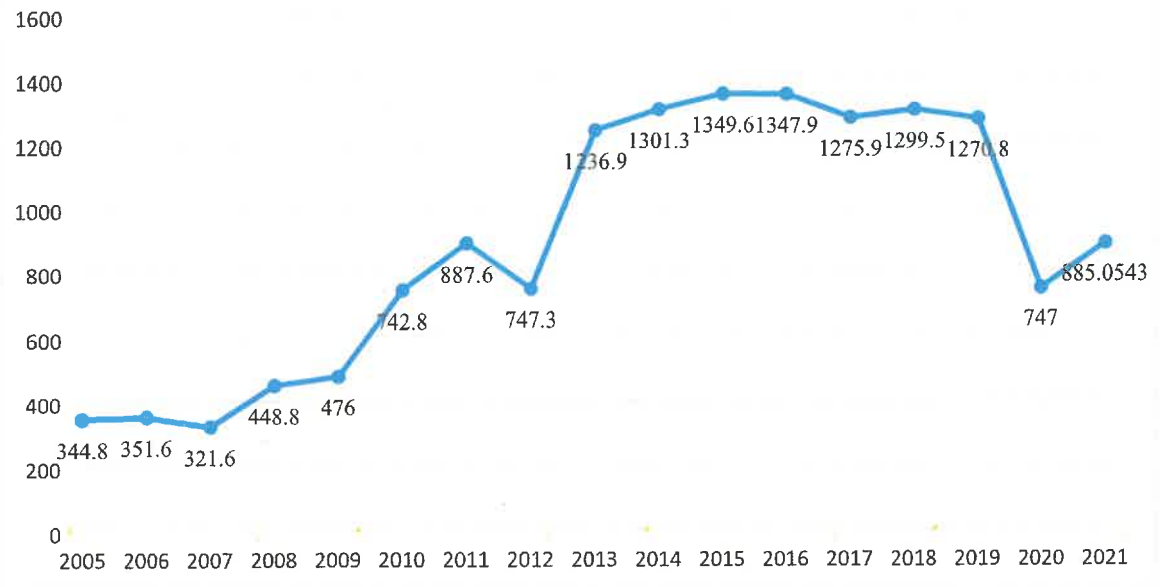


Table 8 presents the CAGR-values for the corresponding time frames.

Table 8: CAGR values for growth rates in annual published conference proceedings (2007 to 2021)

Year	Conference Proceeding Units	Growth	3Yr CAGR
2005	344.8		
2006	351.6	1.97%	
2007	321.6	-8.53%	
2008	448.8	39.55%	9.18%
2009	476	6.06%	10.62%
2010	742.8	56.05%	32.19%
2011	887.6	19.49%	25.52%
2012	747.3	-15.81%	16.22%
2013	1236.9	65.52%	18.53%
2014	1301.3	5.21%	13.60%
2015	1349.6	3.71%	21.78%
2016	1347.9	-0.13%	2.91%
2017	1275.9	-5.34%	-0.65%
2018	1299.5	1.85%	-1.25%
2019	1270.8	-2.21%	-1.94%
2020	747	-41.22%	-16.34%
2021	885.0543	18.48%	-12.02%
CAGR	**6.07%**		

The coumpunded growth rate of published and approved conference proceedings units per institution – for the past 7 years - is shown in **Table 9**. The table shows that at the majority of institutions, conference publications have been on a decline over this period. This has resulted in an overall negative rate for conference proceedings for the sector. Moreover, conference publications have consistently constituted the smallest percentage of publications outputs, measuring 3.8% in 2021.

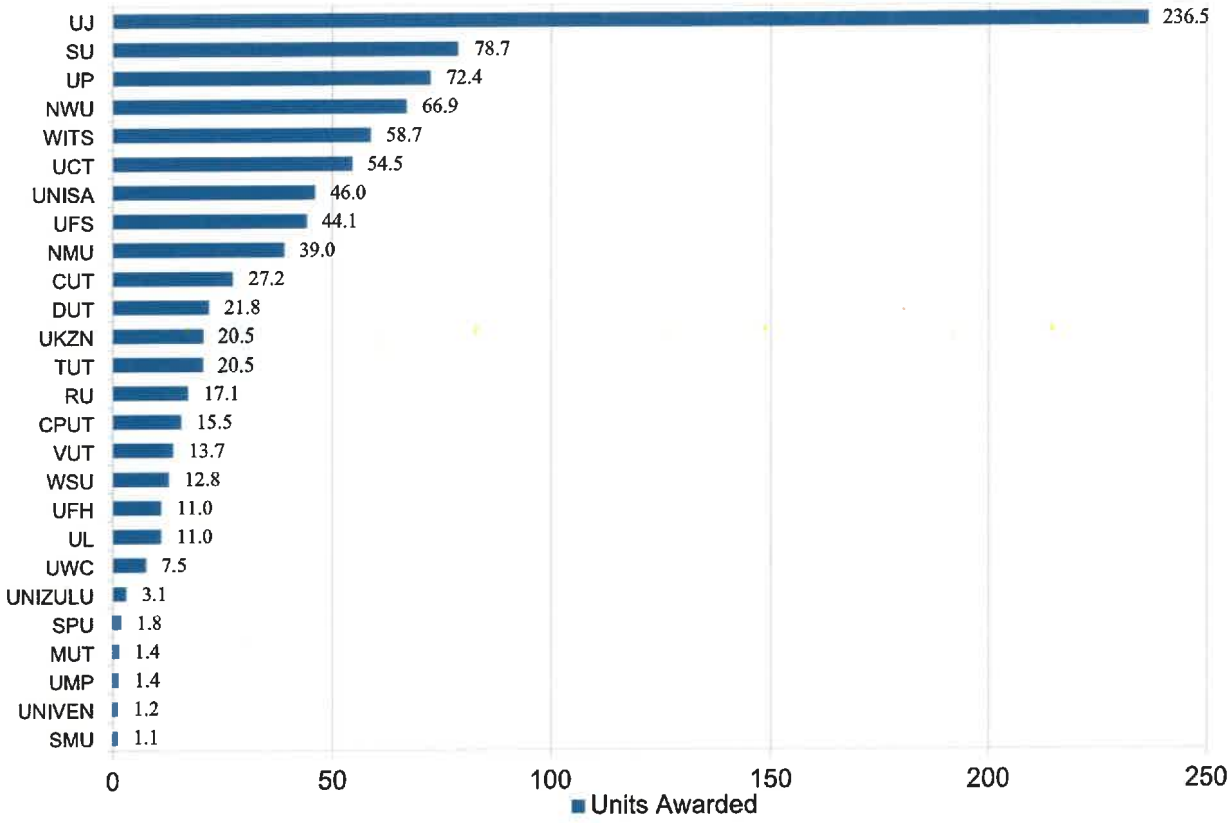
Table 9: Published Conference Proceedings Units per university, 2015 – 2021

Institution	Units per year							
	2015	2016	2017	2018	2019	2020	2021	CAGR
UJ	288.4	301.7	303.7	301.1	294.8	173.7	236.4532	-3.26%
SU	82.6	115.2	105.2	97.6	110.2	74.6	78.6754	-0.81%
UP	151	138.6	111.9	85.2	82.2	49.1	72.3772	-11.54%
NWU	126.8	89.1	82.4	133.4	118.8	38.8	66.8823	-10.11%
WITS	86.4	79	102.9	83.4	68.5	50.8	58.7249	-6.23%
UCT	102.6	103.9	104.5	101.2	79.9	63	54.467	-10.02%
UNISA	87.7	84.7	57.9	75.1	73.1	37.7	46.0001	-10.20%
UFS	46.3	27.3	39.7	27	52.3	31.3	44.0999	-0.81%
NMU	63.6	83.1	54.2	41.9	49.6	24.9	38.9583	-7.84%
CUT	30.9	40.4	44.2	58.9	49.1	38.8	27.2082	-2.10%
DUT	31.8	8.5	21.3	18.5	19.5	30.1	21.775	-6.12%
UKZN	51.2	61	67.1	46.6	61.9	29.2	20.5415	-14.12%
TUT	44.4	47.9	49.5	41.3	58.4	22.1	20.4702	-12.11%
RU	34.6	29	23.8	12.8	21.7	6.1	17.0834	-11.10%
CPUT	33.4	32.6	23.4	41.9	32.6	18.3	15.4583	-12.05%
VUT	13.3	18.2	22.9	40.6	29.9	14.7	13.7083	0.51%
WSU	2.5	2.3	4	3.9	4	9.5	12.75	31.20%
UFH	8.9	16	17.9	2.8	1.5	2	11	3.59%
UL	33	15.4	16	31.4	25.9	7.4	10.9667	-16.77%
UWC	6.8	10.4	7.3	11.3	12.3	10.9	7.5167	1.68%
UNIZULU	11.3	6.3	5.6	8.2	17.2	6.9	3.0625	-19.55%
SPU					2.4	3	1.8334	-12.60%
MUT	1.3	2.9	0.3	1.9	0.4	1.3	1.4168	1.44%
UMP	0	0	1.5	0.8	3.1	0.4	1.375	-2.15%
UNIVEN	9.1	12.9	8.9	5.4	1.4	1.2	1.1667	-28.99%
SMU	1.5	0	0	0.6	0	1.2	1.0833	-5.28%
TOTAL	1349.6	1326.2	1275.9	1272.8	1270.7	747	885.0543	-6.79%

The percentage share of total conference publications for 2021 for the sector is presented in **figure 11**. The profile of the graph has remained similar to that of the previous year, however, the pecking order

of institutions has changed, with UJ at the top and having increased its sector share to 26.7% from 23.25% in 2020.

Figure 11: Units awarded for published conference proceedings by universities 2021



NORMALIZED RESEARCH OUTPUT INDICATORS

The findings shown in the report thus far represent absolute numbers of subsidy-units awarded irrespective of the size of the respective universities. In this section we report on four indicators where the data is normalized to enable a fairer comparison of the 'research performance' of South African universities.

- *Per capita research publication output* - the total number of publications (all document types) by a university is divided by the headcount of the permanently employed instructional and research staff.
- *Weighted per capita research output* - the sum of the total number of publications (all document types) plus the number of research masters graduates and doctoral graduates (weighted by a factor of 3) produced, and divided by the headcount of the permanently employed instructional and research staff.

The first two indicators can be interpreted as proxy indicators of the research publication intensity and research intensity of SA universities respectively[1].

The third indicator – the percentage of academic staff with doctoral degrees – can be interpreted as a proxy for doctoral quality at a university.

The fourth indicator included here is defined as 'the ratio of doctoral graduates to doctorate academic staff' which can be interpreted as a research productivity measure.

5.2. *Per capita* research publication output

The average per capita research publication output for all universities in 2021 was 1.15 units which constitutes a small increase from the previous year of 1.1 publication units per staff member **(Table 10)**. This means that the average permanently employed academic in the sector produced one research publication unit in 2021, or an equivalent of a peer-reviewed article in a journal or a research masters graduate. Academics at eight universities (UKZN, SU, UJ, UP, UCT, WITS, RU and UFS) on average produced research publications higher than the sector average.

[1] It is important to note that the first indicator is referred to as the per capita **publication** output and the second as the weighted per capita **research** output, as the latter combines publications with the production of post-graduate students.

Table 10: Per capita research publications outputs, 2021

Institution	Headcount of permanently employed academics (A)	Research Publications Units -1	Per Capita Research Publication Output (1/A)
UKZN	1222	2 658.22	2.18
UJ	1309	2 753.45	2.10
WITS	1215	2 443.60	2.01
UP	1260	2 353.12	1.87
SU	1302	2 157.86	1.66
RU	359	594.50	1.66
UCT	1182	1 801.06	1.52
UFS	864	1 270.89	1.47
Sector Average		**1.15**	
NWU	1648	1 656.04	1.00
UWC	671	651.10	0.97
UL	613	570.44	0.93
NMU	702	580.59	0.83
UNISA	1781	1 390.31	0.78
UFH	326	245.21	0.75
UNIZULU	345	238.37	0.69
DUT	710	423.72	0.60
CUT	316	157.73	0.50
CPUT	779	333.96	0.43
VUT	365	138.42	0.38
SPU	141	50.09	0.36
SMU	696	238.78	0.34
UMP	168	57.56	0.34
TUT	879	274.01	0.31
MUT	228	68.87	0.30
UNIVEN	425	116.20	0.27
WSU	908	192.23	0.21

5.3. Weighted *per capita* research output

The weighted per capita research output indicator sums the publications in all categories (journal articles, books,book chapters and published conference proceedings) and divides the total research publication output units by the headcount of permanently employed academic (instructional and research) staff at a university. The results as presented in Table 11 shows that the average weighted per capita research output value across all universities in 2021 was 2.10 units. This constitutes a slight improvement from the previous year (average of 2.07 units). However, despite this improvement of the

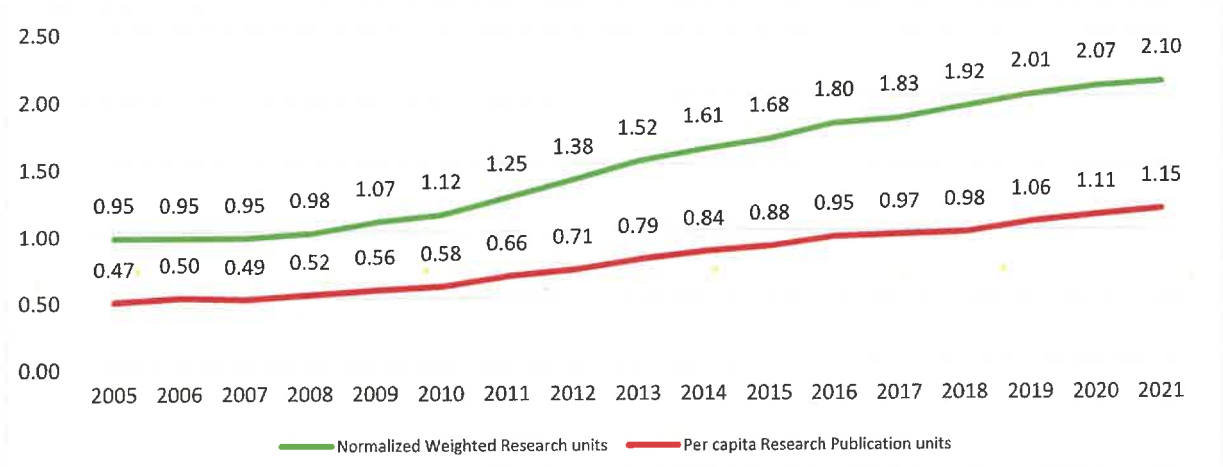
average score, the results re-affirm the very uneven performance across the sector with only eight universities (UKZN, UP, WITS, UJ, SU, RU, UCT and UFS) recording a score above the sector average.

Table 11: Weighted per capita research output (2021)

Institution	Headcount of permanently employed academics (A)	Research Publications Units -1	Research Masters Graduates Units -2	Doctoral Graduates Units -3	Total Weighted research Output Units (1+2+3)	Weighted per capita research output (1+2+3)/A
UKZN	1222	2 658.22	738.00	1335.00	4731.2	3.87
UP	1260	2 353.12	1169.00	1101.00	4623.1	3.67
WITS	1215	2 443.60	924.00	948.00	4315.6	3.55
UJ	1309	2 753.45	791.00	798.00	4342.4	3.32
SU	1302	2 157.86	953.00	921.00	4031.9	3.10
RU	359	594.50	195.00	255.00	1044.5	2.91
UCT	1182	1 801.06	668.00	822.00	3291.1	2.78
UFS	864	1 270.89	412.00	483.00	2165.9	2.51
Sector Average						**2.10**
UWC	671	651.10	234.00	369.00	1254.1	1.87
UNISA	1781	1 390.31	587.00	1263.00	3240.3	1.82
NWU	1648	1 656.04	510.00	792.00	2958.0	1.79
UFH	326	245.21	139.00	171.00	555.2	1.70
NMU	702	580.59	224.00	288.00	1092.6	1.56
UL	613	570.44	270.00	108.00	948.4	1.55
UNIZULU	345	238.37	100.00	135.00	473.4	1.37
DUT	710	423.72	188.00	234.00	845.7	1.19
CUT	316	157.73	47.00	69.00	273.7	0.87
UNIVEN	425	116.20	117.00	114.00	347.2	0.82
TUT	879	274.01	214.00	207.00	695.0	0.79
CPUT	779	333.96	176.00	84.00	594.0	0.76
VUT	365	138.42	55.00	39.00	232.4	0.64
SMU	696	238.78	69.00	51.00	358.8	0.52
SPU	141	50.09	0.00	0.00	50.1	0.36
UMP	168	57.56	0.00	0.00	57.6	0.34
MUT	228	68.87	4.00	0.00	72.9	0.32
WSU	908	192.23	16.00	12.00	220.2	0.24

Figure 12 presents the trend in the values of the two normalized indicators (**per capita research publication output** and the **weighted per capita research output** of the past 17 years. The results show very clearly that the higher education sector has continued to improve its research performance consistentl over this period. In fact, SA universities have more than doubled both their average publication and research output from 2005 to 2021.

Figure 12: Per Capita Publications Outputs, Weighted Research and Normalized Weighted Research Output 2005 – 2021



5.4. Proportion of academic staff with doctorates

The proportion of academic staff with doctorates is generally used as a proxy for the 'quality' of academic staff. It is also an indicator which correlates strongly with the research publication output of a university. Over the years it has been shown that universities with higher proportion of academics with doctoral degrees are typically more research active than other institutions with a smaller percentage of doctorate staff.

Table 12 presents the data of permanently employed academics by their highest qualifications in the reporting year of 2022 (The percentage of staff with doctorate as the highest qualification per university is arranged in the descending order from highest to lowest). The average number of academics with doctorate as highest qualification in the sector in 2021 was 47.7%, a slight decline from 49.6% in 2020.

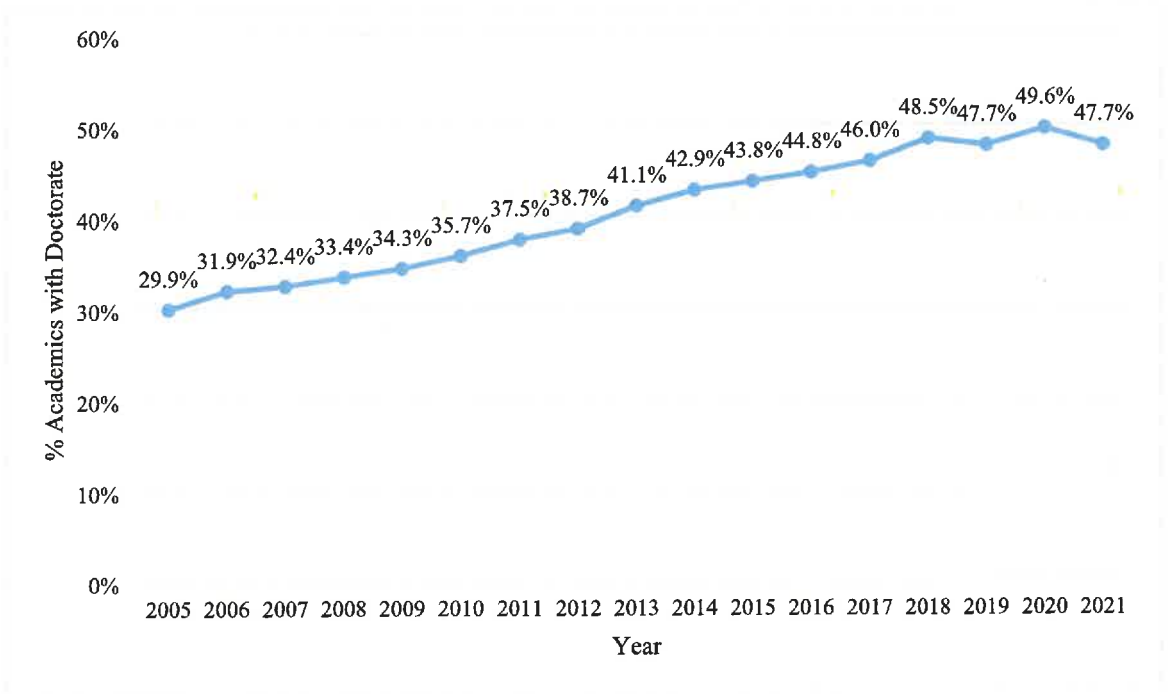
Table 12: Number of permanently employed academics by highest qualification, 2021

Institution	Total Instructional/ Research Staff	Academics with Doctorate as Highest Qualifications		Weighted Research Output Units
		Headcount	% of Institutional Total Academics	
UP	1260	905	**71.83%**	4623.12
WITS	1215	823	**67.74%**	4315.60
SU	1302	841	**64.59%**	4031.86
RU	359	227	**63.23%**	1044.50
UWC	671	418	**62.30%**	1254.10
UCT	1182	727	**61.51%**	3291.06
UKZN	1222	750	**61.37%**	4731.22
UJ	1309	731	**55.84%**	4342.45
NWU	1648	919	**55.76%**	2958.04
SPU	141	78	**55.32%**	50.09
UFS	864	476	**55.09%**	2165.89
UNIVEN	425	209	**49.18%**	347.20
Sector Average			**47.71%**	1646.74
UMP	168	80	**47.62%**	57.56
UNIZULU	345	164	**47.54%**	473.37
UFH	326	153	**46.93%**	555.21
NMU	702	328	**46.72%**	1092.59
CUT	316	131	**41.46%**	273.73
TUT	879	324	**36.86%**	695.01
UL	613	215	**35.07%**	948.44
DUT	710	245	**34.51%**	845.72
CPUT	779	245	**31.45%**	593.96
UNISA	1781	467	**26.22%**	3240.31
SMU	696	168	**24.14%**	358.78
WSU	908	217	**23.90%**	220.23
MUT	228	48	**21.05%**	72.87
VUT	365	76	**20.82%**	232.42
Total or Average	**20414**	**9739**	**47.71%**	**42813.32**

As shown in **Table 12**, twelve universities (UP, WITS, UCT, UKZN, UWC, RU, SU, NWU, UJ, UFS, SPU and UNIVEN) recorded an above sector average number of academics with doctorate as the highest qualification.

Figure 13 presents the time series data of academics with doctorate as highest qualification in the sector for the period 2005 to 2021. The overall trend between 2005 and 2018 has been of a consistent, linear increase in the percentage of staff with doctoral degrees. However, over the past four years, it seems as if the sector is stagnating on this indicator with no apparent increase in the percentages of doctorate staff. This should be cause of some concern as well as motivation to expand support to South African academics through, for examples, programmes such as the University Capacity Development Programme.

Figure 13: Trend in percentage of academic staff with doctorates: 2005 - 2021



5.5. Ratio of doctoral graduates to academics with doctorate

The final indicator on which we report is an indicator of research productivity and specifically the production of highly-skilled and doctoral graduates. The ratio of doctoral graduates to academics with doctoral degree as highest qualification is caculated as the number of registered doctoral candidates to academics with doctoral degree as highest qualification at a university. **Table 13** shows that the sector average of academics with doctorate and doctoral candidates in 2020 was 0.36.

Table 13 presents analysis of the ratio of doctoral graduates per permanent doctorate academic by university. Eight universities recorded values above the national average.

Table 13: Ratio of doctoral graduates to doctorate staff member by university (2021)

Institution	Number of academics with Doctorate	Number of Doctoral graduates	Ratio
UNISA	467	421	0.90
UKZN	750	445	0.59
UP	905	367	0.41
WITS	823	316	0.38
UCT	727	274	0.38
RU	227	85	0.37
UFH	153	57	0.37
SU	841	307	0.37
UJ	731	266	0.36
Sector Average			**0.36**
UFS	476	161	0.34
DUT	245	78	0.32
UWC	418	123	0.29
NMU	328	96	0.29
NWU	919	264	0.29
UNIZULU	164	45	0.27
TUT	324	69	0.21
UNIVEN	209	38	0.18
CUT	131	23	0.18
VUT	76	13	0.17
UL	215	36	0.17
CPUT	245	28	0.11
SMU	168	17	0.10
WSU	217	4	0.02
MUT	48	0	0.00
SPU	78	0	0.00
UMP	80	0	0.00

The ratio of doctoral graduates to academics with doctorates as the highest qualification can be used as proxy for 'supervisory carrying load'. That is, the number of doctoral candidates per supervisor per academic year. However, the ratio as used above does not assist in analysing **supervisory carrying load** because it excludes research masters graduates. The simple ratio as applied above only factors headcount graduates and not the units. The use of units is much more accurate particularly in the case of doctoral graduates which are weighed by factor of 3, based on an assumption that the supervision of doctoral candidates utilises relatively more resources. Therefore, a relatively accurate formula would include research masters and make use of units rather than actual number of graduates (which do not distinguish between masters and doctoral graduates). **Table 14** combines all the above elements and presents the supervisory carrying capacity per institution in 2021.

For instance, **Table 14** shows that 26.2% of academics with doctorate at UNISA in 2021 had a supervisory carring load of four. In other words, each academic with a doctorate at that university in 2021 was supervising an average of 4 research students. The disparity, however, can be seen when comparing institutions with relatively higher percentages of academics with doctorate (UP, WITS and SU) with relatively lower supervisory carrying capacity of 2.6, 2.4 and 2.2 respectively. Thus a more thorough analysis is required to understand the developing trends in this regard.

Table 14: Supervisory Carrying Load per doctorate academic staff by university (2021)

Institution	Research Graduates Output Units			Academics with Doctorate as Highest Qualifications		Supevisory Carrying Load = Ratio (C/D)
	Masters units (A)	Weighted Doctoral units (B)	Total M+D units (C)	Headcount (D)	% of Institutional Total Academics	
UNISA	587	1263	1850	467	**26.2%**	4.0
UKZN	738	1335	2073	750	**61.4%**	2.8
UP	1169	1101	2270	905	**71.8%**	2.5
WITS	924	948	1872	823	**67.7%**	2.3
SU	953	921	1874	841	**64.6%**	2.2
UJ	791	798	1589	731	**55.8%**	2.2
UCT	668	822	1490	727	**61.5%**	2.0
UFH	139	171	310	153	**46.9%**	2.0
RU	195	255	450	227	**63.2%**	2.0
UFS	412	483	895	476	**55.1%**	1.9
Sector Average	**338.4615**	**407.6538**	**746.1154**	**383.2692**	**47.7%**	**1.9**
UL	270	108	378	215	**35.1%**	1.8
DUT	188	234	422	245	**34.5%**	1.7
NMU	224	288	512	328	**46.7%**	1.6
UWC	234	369	603	418	**62.3%**	1.4
UNIZULU	100	135	235	164	**47.5%**	1.4
NWU	510	792	1302	919	**55.8%**	1.4
TUT	214	207	421	324	**36.9%**	1.3
VUT	55	39	94	76	**20.8%**	1.2
UNIVEN	117	114	231	209	**49.2%**	1.1
CPUT	176	84	260	245	**31.5%**	1.1
CUT	47	69	116	131	**41.5%**	0.9
SMU	69	51	120	168	**24.1%**	0.7
WSU	16	12	28	217	**23.9%**	0.1
MUT	4	0	4	48	**21.1%**	0.1
SPU	0	0	0	78	**55.3%**	0.0

UMP	0	0	0	80	**47.6%**	0.0
Total	**8800**	**10599**	**19399**	**9965**		

6. DEMOGRAPHIC TRENDS

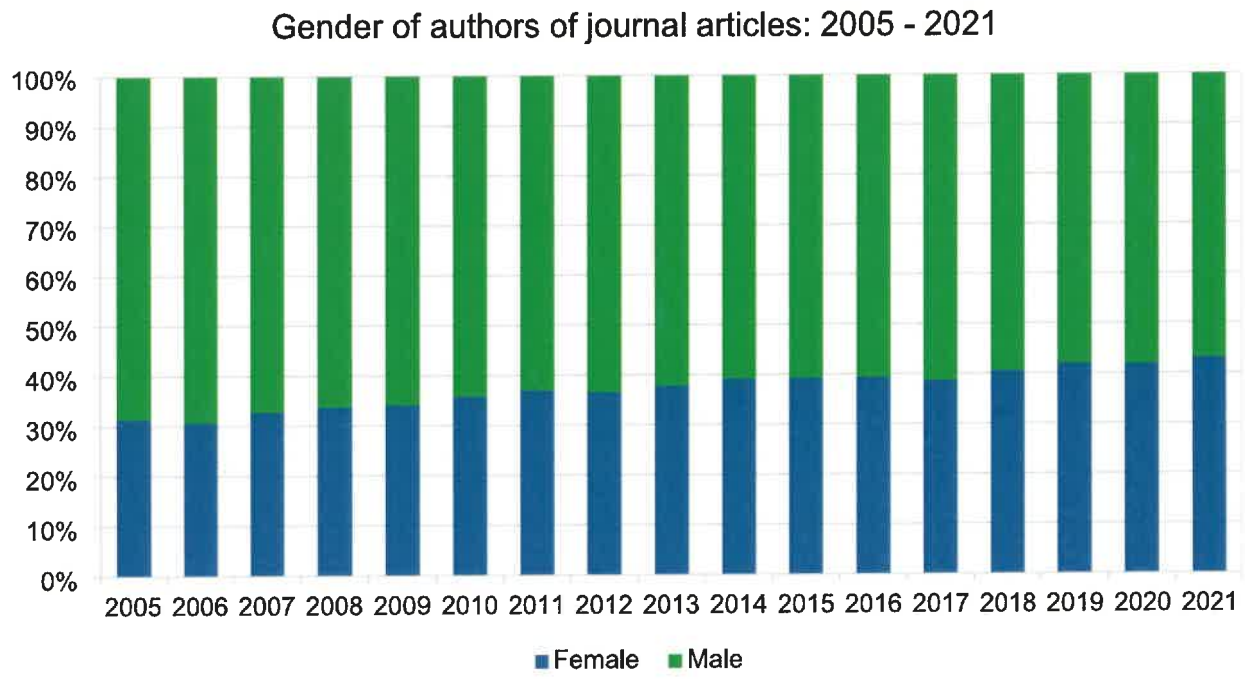
6.1. Publication outputs by gender of author

The Department gathers demographic information of all authors for the purposes of monitoring national trends in the interest of the transformation of higher education in South Africa. Such information is required to asisst the Department as well as the individual universities to do better planning and policy development.

There is relative improvement in the quality and reliability of the data since the Department started gathering biographical data six years ago.

Figure 14 presents the trend by gender in the contribution to the overall publication outputs of the sector since 2005. The figure shows that the contribution of women grew to about 43.1% in 2021. As had been noted before, the growth of publications published by women must be read against the background that there has been more female enrolments in the sector for the past two decades.

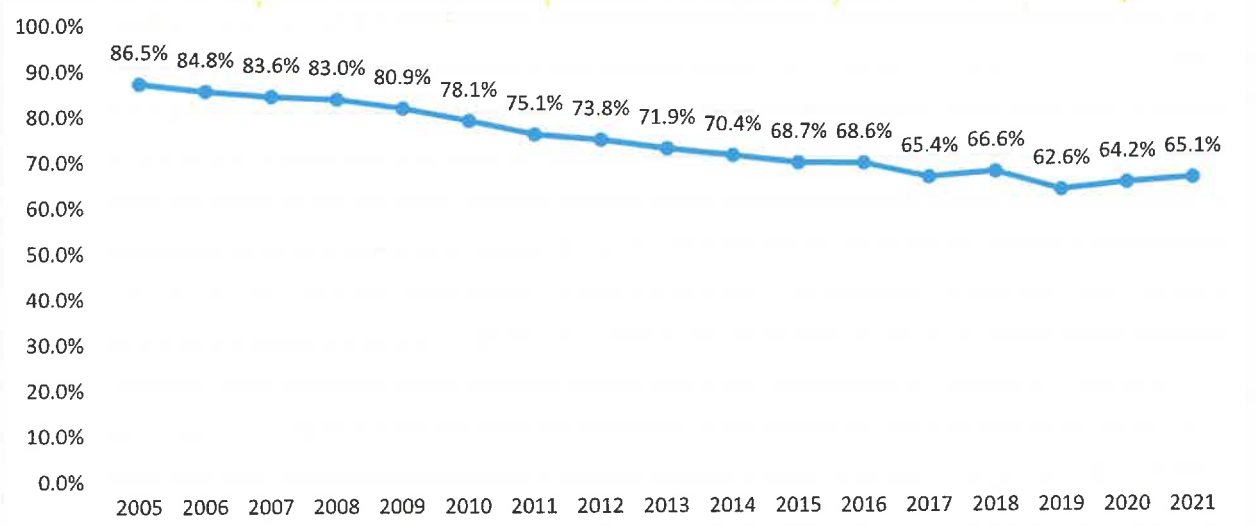
Figure 14: Gender of authors of journal articles: 2005 - 2021



6.2. Publication outputs by country of birth of the author

The focus of this demographic indicator is on establishing trends in the contributions of South African academics (SA, naturalised citizens and permanent residents) in comparison to the contribution of non-South Africans employed at SA universities. The trend exhibited in **Figure 15** shows a decreasing contribution by SA nationals to overall sector output, from 87% in 2005 to 65% in 2021.The decline has flattened of at 64% in the last two years, 2019 and 2020 and reasons for the trend should be investigated. The slight increase in the last two years, 2020 and 2021 from 62% to 65% must also be explained. The decline in publications produced by SA nationals is an indication of an increase in the number of publications produced by foreign nationals. The data is yet to be analysed according to distribution by the scientific fields and against other empirical data.

Figure 15: Proportion of publication units produced by SA nationals, 2005 to 2021



6.3. Publication outputs by race of author

Another key variable that is included in the analysis is the 'race' of the contributing authors and is confined to South African citizens or permanent residents. Under the Statistics Act of 1996 only SA citizens are classified by population group or race and into four categories: Black African, Coloured, Indian/Asian and White (and reaffirmed by the Employment Equity Act of 1998). The classification by race for purposes of measuring transformation does not apply to non-South African nationals .

Figure 16 presents a trend in the relative contribution by each of the 'race groups' to overall publication output between 2005 and 2021. The trend shows the gradual increase of the publications contribution by Black (African, Coloured and Indian/Asian) academics to the sector's knowledge production. The

contribution by black academics surpassed 40% of the overall contributions for the first time in 2018, having grown from about 15% in 2005 to 47.4% in 2021.

Figure 16: Race of authors (SA nationals only) of all publications: 2005 - 2021

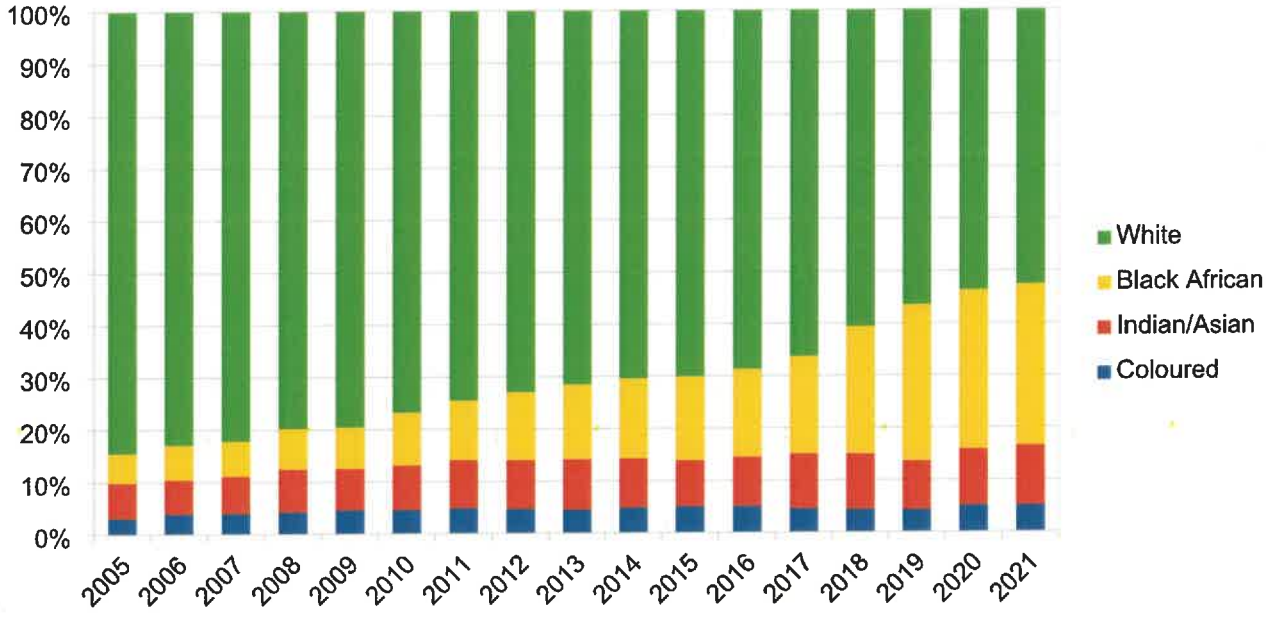


Table 15: Trend in race of authors 2005 to 2021

Race of author	2005	2010	2015	2020	2021
Black African	5,5%	10,0%	15,0%	25,4%	30.38%
Coloured	2,9%	4,5%	5,6%	5,6%	5.10%
Indian/Asian	7,2%	8,8%	8,8%	11,2%	11.48%
White	84,4%	76,6%	70,6%	57,8%	52.57%

All universities are required to provide data to enable the Department to interpret transformation patterns and trends in knowledge production at universities. The reliability and quality of the data on the demographics of the claiming authors, however, must still be improved.

6.4. Publication outputs by age of author

Figure 17 shows the shifts in time of the age of authors (age at date of publication recoded into age intervals) for all the publications from 2005 to 2021. The aim of this graph is to show whether there are major shifts in the average ages of actively publishing academics. This information is important when considering the imperative to build the next generation of academics in South Africa. This means that it is important to follow the relative contributions of younger academics over time (under the age of 30

as well as between 30 and 39). At the same time, the contributions made by older generations should not be ignored or discarded. In fact, the older generations may be contributing more than this report can measure, especially in terms of mentoring of the younger generations.

The general trend shows an increase in the performance of younger academics: for those under the age of 30, the percentage increased from 5,1% in 2005 to 7,8% in 2019, but decreased to 6.7% in the last two years (2020 – 2021), and for the ages between 30 and 39 performance increased from 21,9% in 2005 to 28% in 2021. It is interesting to note that the relative contribution of academics over the age of 60 also increased from 11,1% in 2005 to 14,6% in 2021. The relative contribution of academics in the age interval between 40 and 49% recorded a decline from 33,9% in 2005 to 28,2% in 2021. This decline is concerning and needs to be interrogated.

Figure 17: Grouping of academic authors by age for all publications: 2005 – 2021

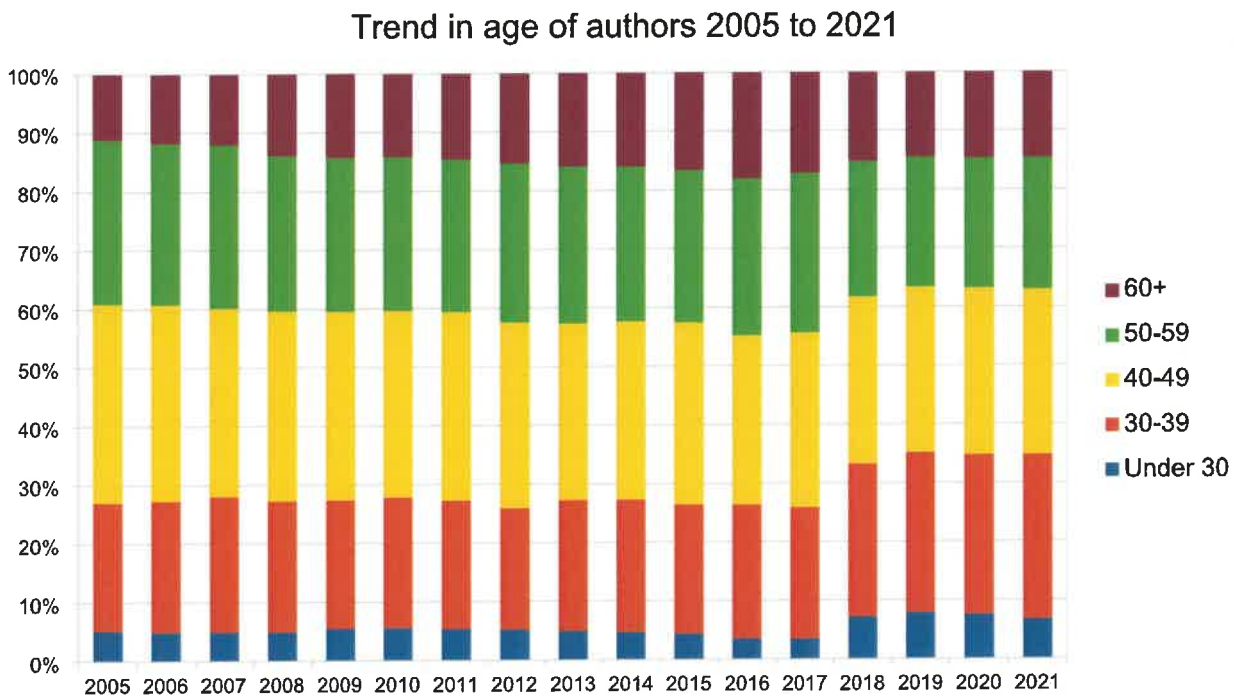


Table 16: Trend in age of authors 2005 to 2021

Year	under 30	30 to 39	40 to 49	50 to 59	60+
2005	351	1504	2322	1917	763
2006	395	1819	2714	2224	951
2007	435	2046	2845	2464	1061
2008	521	2418	3486	2853	1487
2009	653	2628	3836	3135	1701
2010	747	3000	4293	3527	1907

2011	868	3558	5201	4213	2364
2012	959	3831	5834	5004	2823
2013	1008	4613	6186	5506	3275
2014	1100	5293	7100	6163	3725
2015	1062	5326	7511	6251	4022
2016	917	5980	7545	6977	4715
2017	1020	6606	8761	8006	5049
2018	3256	11732	12858	10379	6826
2019	3552	12379	12784	10036	6532
2020	4629	16634	17354	13565	8953
2021	4450	18458	18558	14788	9602

7. GENERAL OBSERVATIONS AND CONCLUSIONS

The Department believes that the sustaining increase of the research publications outputs for the past 17 years is partly as a result of the positive impact of the *Research Outputs Policy*. A corelation between the policy and the performance of the sector has been drawn by some analysts. The Department continues to strive for better quality and efficient system of processing research publications outputs. The continuous efforts to improve the policy and the processing of the research outputs are intended to facilitate positive impact on research productivity of the higher education sector and, most importantly, improve quality in the entire pipeline. Moreover, the Department hopes that its regular improvements to the policy and the system of processing research outputs are replicated at the institutional level so that there is synergy and common purpose in the higher education sector.

The Department has identified some elements of unethical practices in the publication of research outputs. As recommended in the policy, institutional research integrity committees together with the research offices are urged to double their effort to draw out unethical practices in research publications or subsidy claims. Such practices are better dealt with at institutional level. The Department has developed a proposal for establishing a framework to improve the quality of research publications. However, this does prevent institutions from confronting unethical practices in research publications.

The claims that were categorised as unethical are described in greater detail in the institutional reports. The Department would appreciate further enegagement with the affected individual institutions before it exercises its obligation to withhold payment of research output subsidy in respect of claims that do not comply with the research output policy requirements, and where evidence of unethical conduct relating to the claims has been found.

The Research Subsidy provides an important revenue stream for the higher education sector. It is imperative that the sector guards this resource and ensure that it is not affected by malpractice. The end goal must be that it remains sustainable and provides sustained impetus to research productivity in the higher education sector. The Department hopes that the report fairly projects research performance of the sector, and that all stakeholders will embrace the observation as means to attain greater standards in the sector.