

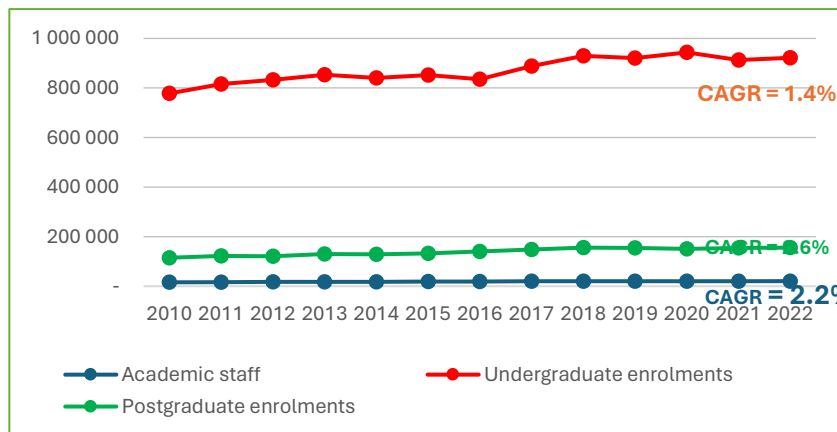
## Megatrends in the South African higher education and science system

Unlike our previous SciBytes which focused on a specific theme or issue, we have decided in this case to put together a SciByte that summarizes highlights recent 'mega'-trends related to the South African higher education and science system. The statistics presented here are the most recent available. After presenting information on the key trends, we conclude with some high-level reflections.

### What has changed in human resources capacity for STI over the last decade?

#### Stagnating growth in academic staff capacity

Public universities in South Africa remain constrained by the slow growth in their academic staff capacity especially when compared to the faster



growth of postgraduate students. Over the last decade, the number of permanent academic staff (headcount) has grown at a compound average growth rate of 2.2% with small annual increases since 2017. At the same time the number of postgraduate enrolments grew at 2.6% and the number of undergraduate enrolments grew at an equally slow rate of 1.4%. This higher rate of growth in the number of postgraduate enrolments contributes to the already heavy supervisory burden experienced by South African academics.

#### Improved qualifications of academic staff

There has been a steady increase in the percentage of permanent academic staff with doctoral degrees. In 2022, 53% of all staff were in possession of a PhD: an improvement from 45% in 2015. This sector average should be understood

SciBytes @ SciSTIP is an information series produced by SciSTIP. Its aim is to disseminate on a regular basis, brief reports about some aspect of the science and innovation system in South Africa. The aim is to inform and share knowledge produced by SciSTIP. The "bytes" are written in a non-technical style. Every issue of Sci Bytes is structured in the form of a main question (with some elaboration). This series also forms part of SciSTIP's science engagement strategy. We want to invite anyone to send us any suggestions for topics/questions that you would want us to address in future issues. You can send the emails to Johann Mouton at [jm6@sun.ac.za](mailto:jm6@sun.ac.za)

against the huge differentiation in the university sector. The top research universities record percentages in the mid- to high sixties; whilst the university of technologies record substantially lower percentages of staff with a doctoral degree.

### Improved diversification of academic staff

The trend between 2010 and 2022 shows that academic staff at public universities has gradually become more inclusive of women academics. The percentage South African female permanent instructional research staff increased from 46% in 2010 to 52% in 2022 and reached parity with male staff in 2016. At the same time there has been a substantial increase in the percentage of black South African academic staff over the reported period where South African black staff (including black African, Coloured, and Indian) constituted 62% of all South African academic staff in 2022.

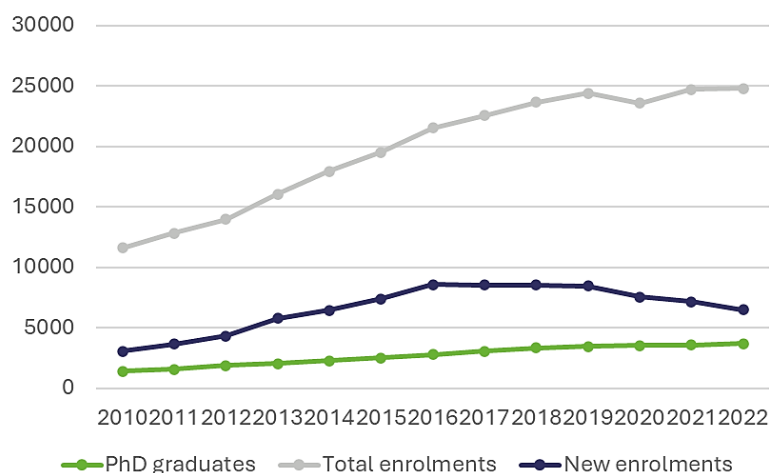
### Little growth in the number SET students

The trend over the last 12 years shows that the share of student graduates in science, engineering, and technology (SET) fields at public universities as a percentage of all university graduates, has remained consistent over the reporting period. The percentage SET graduates increased slightly from 27% in 2010 to 29% in 2022. In 2022, the share of SET student students is well below the intended target of 35% by 2030 as set out in the National Development Plan. The fact that there has been little change in the trend over the last decade shows that it is unlikely that this target will be achieved.

The share of doctoral graduates in science, engineering, and technology (SET) fields as a percentage of doctoral graduates in the sector, has decreased slightly from 51% in 2010 to 48% in 2022. Despite the steady growth in the number of doctoral graduates in SET programmes, the steady decline in the proportional share is a concerning trend which should be monitored closely.

### The production of doctoral students

Although we have witnessed consistent increases in the number of total doctoral **enrolments** between 2010 and 2019, we have also seen that the growth has slowed down with no real increase in absolute numbers since 2020. Disaggregation of the data shows that the latter trend is specifically associated with a decline in new enrolments from other African countries. It is also worth keeping in mind, that these are the years that COVID had its highest impact on societies worldwide. A similar picture is emerging for doctoral graduates. Up to 2019, we saw a steady increase in the number of doctoral **graduates** in the sector. However, the past three years have effectively seen a stagnation in annual numbers. As a result, it is now quite clear that the target of producing 5 000 PhD graduates by 2030 as stated in the National Development Plan is probably not going to be met.



### Substantial gains in the transformation of doctoral education

Doctoral education has become more inclusive. The share of South African female doctoral graduates increased from 41.9% in 2010 to 46.3% in 2022. Although there is no specific target set in any South African policy document against which this trend can be assessed, this is a positive trend in terms of the general transformation imperative. However, it is important to note that there are substantial differences in female representation across disciplinary fields. We have also seen a substantial increase in the percentage of black doctoral graduates in the sector. The share of black graduates (including black African, Indian, and Coloured) increased from 36% in 2010 to 68% in 2022.

### Decreasing levels of inbound student mobility

South Africa remains an attractive destination for postgraduate students, especially at a doctoral level. The data show that the largest share of foreign enrolments at public universities is at the doctoral level where in 2022, 34% of doctoral students were international students. This compares to 13% Masters students and 6% of Honours students. At the undergraduate level, the data show that in 2022, 2.4% of all enrolments were international students. However, since 2017 we have seen a steady decline in the proportional share of international students across all levels .

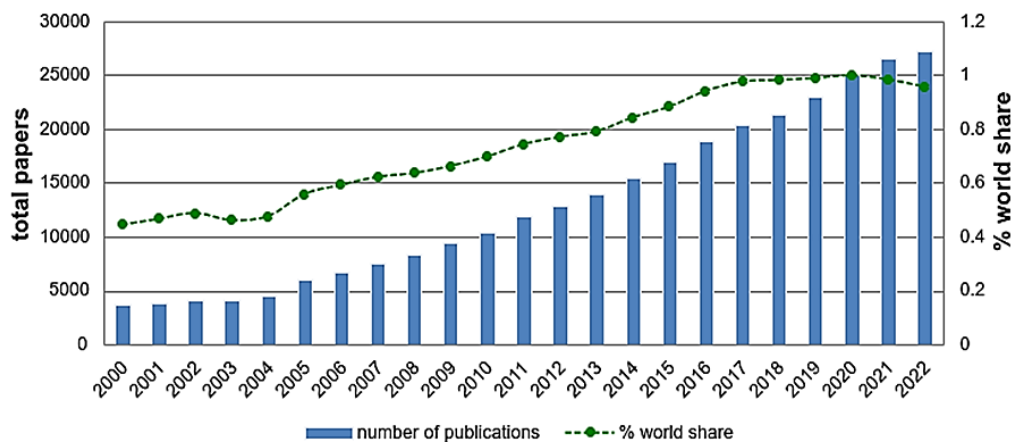
### How has the profile of South African research publications changed?

#### Sustained increases in publication output

South Africa has maintained its strong annual growth in publication output (calculated as full paper counts) as indexed in the <sup>CA</sup>Web of Science: an increase from 3 693 publications in 2000 to 27 208 in 2022. However, despite this sustained growth in publications, the country’s world share seems to have peaked at around 1% by 2018 and since then has slowly begun to decline. This is evidently because of the fact that many other countries in the world (most notably, countries such as China and India) have increased their output at an even higher rate.

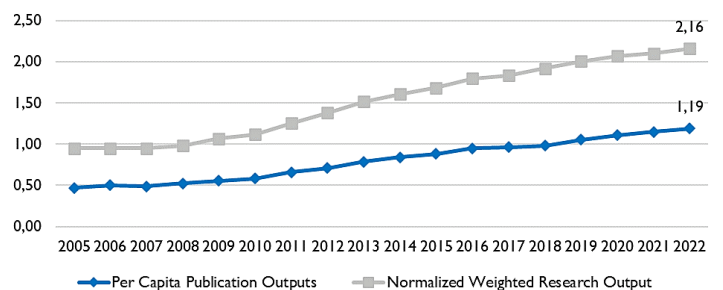
Based on the annual publication output. South Africa’s ranking in terms of the number of scientific publications produced annually reached its best rank (24<sup>th</sup> in the world) in 2016. In 2022, the country was ranked 29<sup>th</sup> in the world.

Given the large differences between countries it is useful to report on the number of scientific articles per million of the population. The South African science system is productive when the number of publications is divided by millions of the population except for 2022 which recorded a slight decrease. The increase over the past 22 years is a positive trend suggesting that despite the financial and other constraints, the South African science system continue to be increasingly productive. However, the decline in 2022 is cause for concern.



#### Increased research productivity of university staff and students

Over the past 17 years the per capita production of scientific articles by South African university authors has more than doubled from 0.47 articles (on average) per permanent staff member in 2005 to 1.19 in 2022. This is a laudable achievement as it attests to the increased productivity of university staff and students. However, it is worth keeping in mind that the articles that are counted in the nominator, are in fact not only produced by permanent staff, but also by post-graduate students, post-doctoral fellows, visiting scholars and other categories of individuals. The increase in productivity over this period, therefore, requires further investigation in order to establish whether it does in fact reflect a real increase in individual output or simply an expansion of the knowledge productive base in the higher education system.



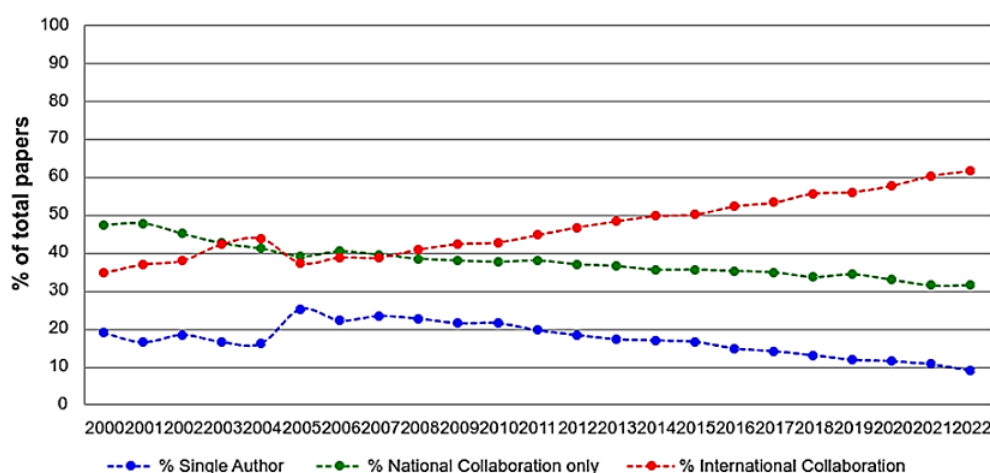
Measuring the ‘knowledge productive’ performance of university academics at South African universities through the normalised weighted research output, the trend shows a steady (and increasingly steep since 2012) increase in the knowledge productivity of the average South African academic. For the latest years, the data show that South African academics produce on average at least two ‘knowledge outputs’ per year.

### Relative strength in research output in the agricultural sciences, social sciences, and humanities

Based on the specialisation or activity index which assesses the strength of a country, region, or institution in a specific field as measured by the relative field score (RFS), the results for the South African science system shows above-average activity and relative strength in agricultural science, social sciences, and humanities. In comparison to the world publications in engineering and health sciences, the RFS values indicate that these fields are under-represented in South Africa. South Africa’s performance in natural sciences is aligned with the world average.

### Increased international research collaboration

Over the last two decades, international collaboration increased from constituting one-third of all scientific publications in 2000 to more than 60% in 2022. This increase has occurred with commensurate declines in both single-authored and nationally collaborative publications. The



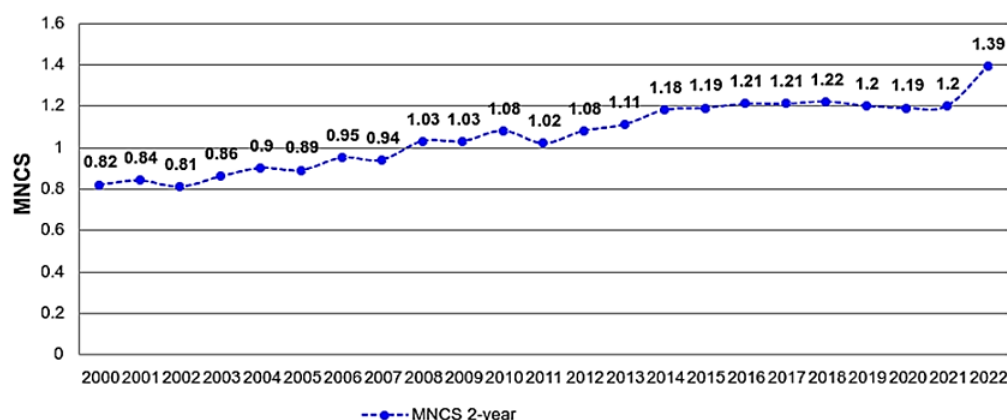
collaboration with African countries has been increasing but at a slow rate. It is worth noting that these trends summarise collaborative authorship in all scientific fields. In some fields, such as health sciences, astronomy and high-energy physics, foreign collaboration comprises a much higher percentage.

Inspection of the data show that South African scientists have increased their collaborations with the USA, Germany, the UK, and Australia, and BRICS countries, Canada, and several European countries. Except for the increased collaboration with Egypt, Nigeria, Morocco and some east and southern African countries, collaboration with African countries remains low.

### Scientific impact

#### Above average visibility of South African publication output

The number of times a publication is cited is often used as a measurable proxy for quality or impact. While the strength of this proxy is debatable, the number of citations is an indicator of visibility and recognition. The trend in the citation impact of South Africa’s scientific publications as measured by the Mean



Normalised Citation Score (MNCS) over the last two decades shows an overall positive trend, with the citation impact of the South Africa's publications consistently exceeding the world average over the last decade.

The PP top 1%, top 5%, and top 10% are indicators which measure the percentage of a country's scientific publications that falls within the top 1%, top 5% and top 10% of the most frequently cited publications in the same year and field. Our analysis shows that South African-authored publications are well represented in the three percentile groups while the trend over time is consistent. The highest percentage of publications in the top 1% of most-cited papers are in natural, health and engineering sciences.

## Reflections

As is often the case when looking at high-level trends in a science system, the picture is a mixed one. This is also the case in this brief assessment of the SA higher education and science system. There are positive trends – increase in staff with doctoral degrees, increased productivity of academic publishing authors, sustained increase in the visibility of South African science as measured by the citation impact of its publications and finally, positive trends regarding the transformation of SA science. But there are also negative trends – little growth in the academic capacity in the system, decreasing growth in doctoral enrolments and more recently also stagnation in the numbers of doctoral graduates and a decline of our world share in publications and hence also our world rank. These trends re-affirm the absolute necessity of increased investment and expenditure both by the public and private sector in the human resources capability and scientific enterprise in the country to ensure that we maintain acceptable levels of growth across the system.

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