National Research Foundation

NRF DATA INSIGHTS

Unveiling the trends to shape tomorrow

ANALYSIS OF RESEARCH OUTPUT

Supported or Performed by the NRF

science, technology & innovation

Department:
Science, Technology and Innovation
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VOLUME 2: 2026

Introduction

In this edition of *NRF Data Insights*, we continue to explore and analyse research produced and supported by the National Research Foundation (NRF). Building on the insights from the previous editions of *NRF Data Insights* Volume 2[1], this edition provides updated insights into the research trends and achievements that are shaping the South African research landscape. The analyses presented in this edition focus on the period 2021 to 2025.

First, we highlight the significant contributions of NRF-funded researchers to the national and global body of knowledge, with a particular focus on the advancements made in the past five years.[2] We examine their productivity as well as the strategic alignment of the research with national and international development priorities as a proxy for the societal impact of these research endeavours. Using Web of Science (WoS) data, this publication analyses the research performance of NRF-funded researchers relative to national and international benchmarks,[3] while also considering the extent to which research addresses key societal challenges aligned with the United Nations (UN) Sustainable Development Goals (SDGs), including health, climate change, and poverty alleviation.

Second, we consider the research produced by the NRF's National Research Facilities, showcasing their role as critical enablers of high-impact research, supporting innovation, collaboration, and capacity development across a range of scientific disciplines. Five National Facilities (NFs) form part of the NRF, namely the South African Radio Astronomy Observatory (NRF-SARAO), South African Astronomical Observatory (NRF-SAAO), iThemba Laboratory for Accelerator-Based Sciences (NRF-iThemba LABS), South African Institute for Aquatic Biodiversity (NRF-SAIAB) and South African Environmental Observation Network (NRF-SAEON). The NFs produced 664 WoS research publications in 2025.

Key findings noted in this edition of *NRF Data Insights* are:

- NRF-funded researchers contributed 9 693 Web of Science (WoS) publications in 2025, accounting for 33% of South Africa's total research output, despite support for a smaller proportion of the entire research cohort.
- Research output from NRF-funded researchers increased by 6% between 2021 and 2025, demonstrating sustained productivity.
- 75% of NRF-funded publications in 2025 were linked to one or more SDGs, reflecting strong alignment between NRF-funded research and national and global development priorities.
- 664 WoS publications were produced by the five NRF National Facilities in 2025.
- Investment in NRF research infrastructure increased by 157% from R1.2 billion in 2020/21 to R3.1 billion in 2025/26, strengthening national research capacity and supporting world-class scientific facilities.

Research Output Supported or Performed by the NRF

Research productivity (with quality assessment) is one measure of researcher performance and research system efficiency. The Department of Higher Education and Training (DHET) uses seven journal indices to assess research performance and determine research subsidies.[4] The NRF uses Clarivate's WoS index for its analysis due to its extensive coverage and comprehensive indexing of journals in the Natural Sciences, Social Sciences, Arts and Humanities. More than half (52,7%) of all DHET-subsidised journal articles published in 2024 appeared in Scopus- and WoS-indexed journals.[5]

1. National Research Foundation. *NRF Data Insights* Volume 2 Available from:
   NRF Data Insights Volume 2 (2024): https://www.nrf.ac.za/wp-content/uploads/2025/02/NRF-Insight-Volume-2.pdf
   NRF Data Insights Volume 2 (2025): https://www.nrf.ac.za/wp-content/uploads/2025/10/NRF-Data-Insights_Volume-2.pdf
2. The data in this edition of *NRF Data Insights* cover calendar years, not financial years.
3. The data are drawn from Clarivate Web of Science (WoS) and reflects numbers on that specific day. Slight variations are evident depending on the date on which the data are extracted. The number refers to WoS documents and not only research articles.
4. Scopus, the Scientific Electronic Library Online South Africa (SciELO SA), the Norwegian Register for Scientific Journals, Clarivate's (previously Thomson Reuters) Web of Science (WoS), the ProQuest International Bibliography of the Social Sciences (IBSS), the Directory of Open Access Journals (DOAJ), and the SA DHET index.
5. Department of Higher Education and Training (DHET). 2026. The Sector Report on the Evaluation of 2024 Universities' Research Output available from https://www.dhet.gov.za/Policy%20and%20Development%20Support/2024%20Research%20Outputs%20Sector%20Report.pdf accessed 13 Aug 2026.

To assess the productivity of NRF-funded researchers, Figure 1 shows a comparative analysis of WoS publications produced by NRF-funded authors, all South African authors, and authors worldwide. Over the five-year period 2021 to 2025, NRF-funded publications increased by 6%, while global publication output grew by 13% over the same period. Data indicate a worldwide recovery after a decline from 2021 to 2023. Despite challenges such as resource constraints, NRF-funded researchers continued to contribute positively to South Africa's overall research output.

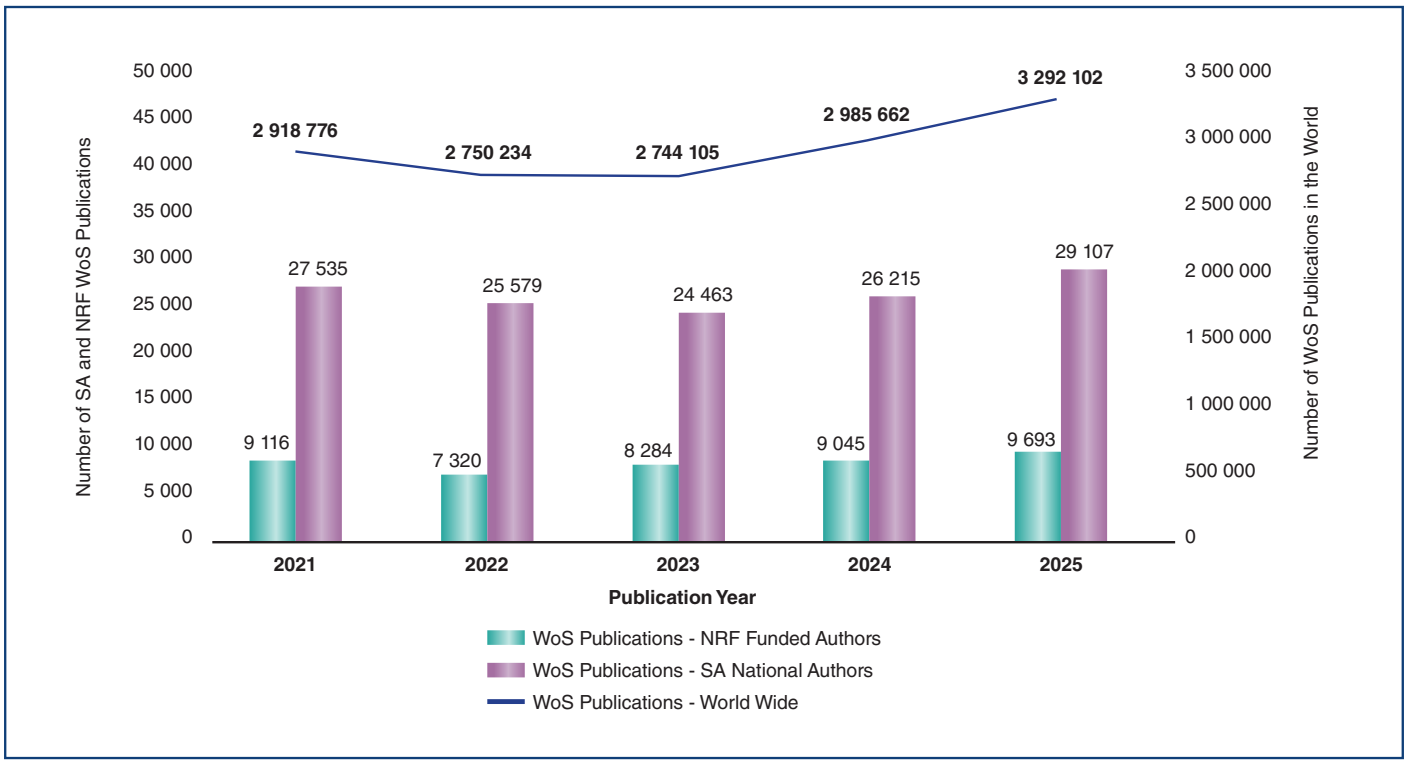


Figure 1: Number of Web of Science Publications, 2021 to 2025

NRF-funded researchers contributed 33% (9 693) of the total South African publications (29 107) in 2025, demonstrating their vital role in the national research system. Higher research productivity is evident when considering the proportion of public university permanent research and instruction staff funded by the NRF. Using 2024 data, the latest DHET data available, the NRF funded 15% (3 212 researchers) of the entire permanent research and instruction staff cohort (20 887) and 28% of those with a doctorate (11 695), but these researchers produced 33% of South African research publications.[6]

Publication fields and priorities

In addition to examining the number of publications produced by South African and NRF-funded researchers, it is also important to consider the research areas in which these studies are published, and their potential societal impact. A key assessment tool globally is the mapping of publications to specific UN SDGs. This provides an indication of how research contributes to addressing important societal challenges, such as health, climate change, poverty, education, gender equality, and other development priorities. While some SDGs align more closely with South Africa's development needs than others, all of them highlight the importance of international collaboration in addressing shared global challenges. The NRF first mapped NRF-funded WoS-published research to SDGs in 2021, and the South African analysis for 2025 is shown in Figures 2 and 3.

6. The analysis is conducted for 2024 as HEMIS data are not available for 2025. The researcher cohort refers to the headcount of all Permanent Instruction and Research Staff at public universities, while the second cohort is only those with a doctoral degree.

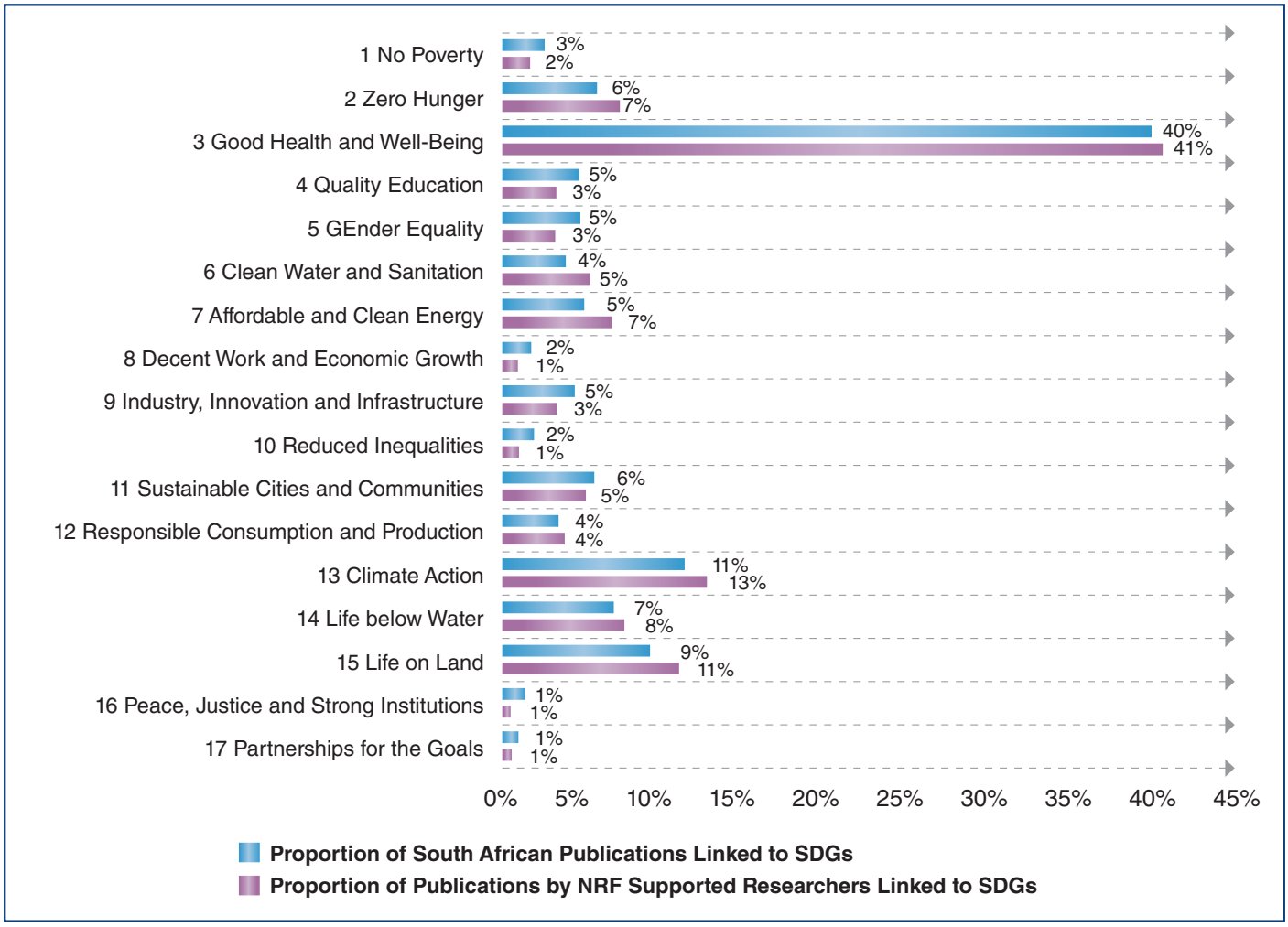


Figure 2: WoS Analysis of South African and NRF-funded Research Output Linked to SDGs, 2025

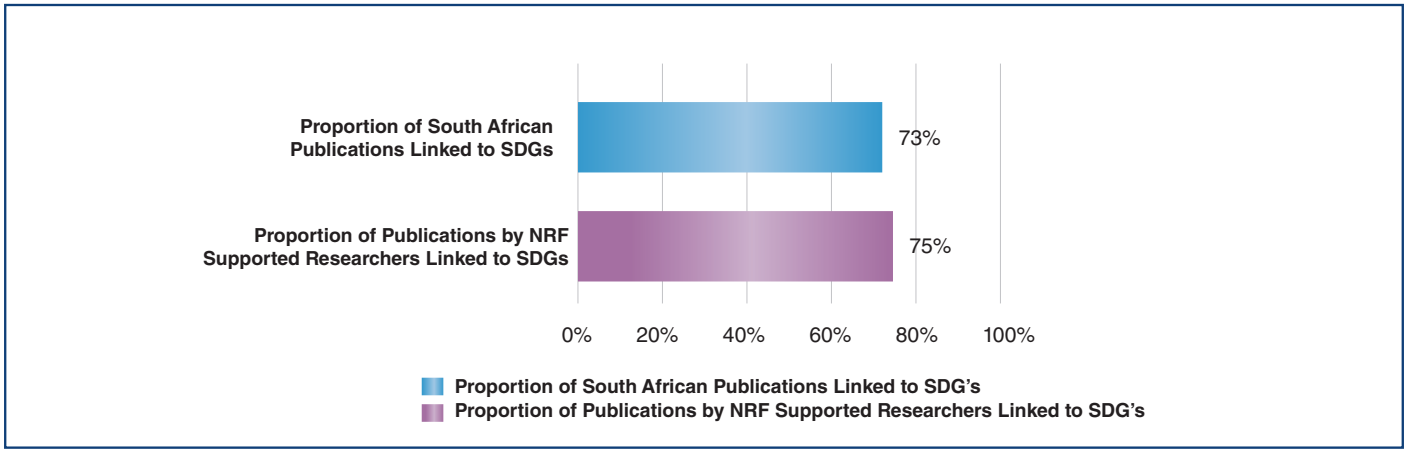


Figure 3: WoS Analysis of South African and NRF-funded Research Output Linked to One or More to SDGs, 2025

In 2025, 75% of NRF-funded research publications were linked to one or more SDGs, compared to 74% in 2024. This aligns closely with all South African research, where the proportion was 73% in 2025 and 72% in 2024. Analysis over a longer period is required to establish trends, and the variations are not sufficiently significant to indicate a shift in research focus.

In both 2024 and 2025, the highest proportion of publications for both NRF and South African researchers was linked to SDG 3: Good Health and Well-Being. This reflects the importance of health research within South Africa's research landscape. Key public health challenges facing the country include Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome (HIV/AIDS), tuberculosis, maternal and child health, non-communicable diseases such as diabetes and hypertension, mental health, and environmental health impacts. The societal benefits of research are already evident, and some examples are discussed below, but further efforts are needed to ensure that health studies lead to innovations that improve health outcomes, inform policy, and tackle the country's pressing public health challenges.

Research on HIV and tuberculosis (TB) co-infection addresses one of South Africa's most pressing public health challenges. Through the South African Medical Research Council (SAMRC) HIV-TB Pathogenesis and Treatment Research Unit, based at the Centre for the AIDS Programme of Research in South Africa (CAPRISA), researchers are working to improve the prevention, treatment, and management of HIV-TB co-infections, which remain a leading cause of illness and death in the country. The research aims to reduce mortality, improve treatment outcomes, strengthen healthcare interventions, and inform national health policies. By addressing the dual burden of HIV and TB, this work contributes to improving population health, enhancing the quality of life of affected individuals, and supporting South Africa's efforts to combat infectious diseases.

Other NRF-supported initiatives are also contributing to efforts to address the tuberculosis burden in South Africa. One example is the DSI-NRF SARChI Chair in Paediatric Tuberculosis, hosted at Stellenbosch University's Desmond Tutu TB Centre and led by Professor Anneke Hesseling, which addresses one of South Africa's most pressing health challenges (childhood tuberculosis). The Chair focuses on improving the early detection, prevention, and treatment of TB in children, including drug-resistant forms. Research efforts, such as the Tuberculosis Child Multidrug-Resistant Preventive Therapy (TB-CHAMP) study on preventing multidrug-resistant TB in exposed children, have provided valuable evidence on transmission and preventive therapy. The Chair's findings have influenced national TB guidelines and contributed to World Health Organisation (WHO) recommendations. Beyond advancing scientific knowledge, the programme has significant societal impact by improving child health outcomes, supporting evidence-based health policies, strengthening South Africa's response to TB and HIV co-infection, and developing the next generation of health researchers through postgraduate training and capacity building.

The DSI-NRF SARChI Chair in Precision Oncology and Cancer Prevention utilises advanced research infrastructure and cutting-edge technologies, including genomics and molecular biology laboratories, next-generation sequencing technologies, bioinformatics platforms, biobanks, and clinical research facilities to tackle Africa's rising cancer burden. The Chair's research supports the development of personalised treatment strategies, informs evidence-based health policies, and builds specialist research capacity, ultimately contributing to improved health outcomes for African populations. This infrastructure allows for the investigation of cancer's genetic and molecular drivers, enhancing innovations in prevention, diagnosis, and treatment, and strengthening South Africa's capacity for impactful cancer research across the continent.

Given South Africa's developmental challenges, there are SDG areas where more research is needed to address persistent developmental challenges. For instance, the National Development Plan (NDP) Assessment Report by Stellenbosch University[7] and the National Planning Commission[8] noted that, while South Africa has made strides in aligning national priorities with the SDGs, implementation and evidence-based policy development remain weak in areas such as *SDG 1: No Poverty, SDG 5: Gender Equality, SDG 8: Decent Work and Economic Growth, SDG 10: Reduced Inequalities, and SDG 16: Peace, Justice and Strong Institutions*. All of these are areas where research could play a significant role in improving the lives of ordinary South Africans.

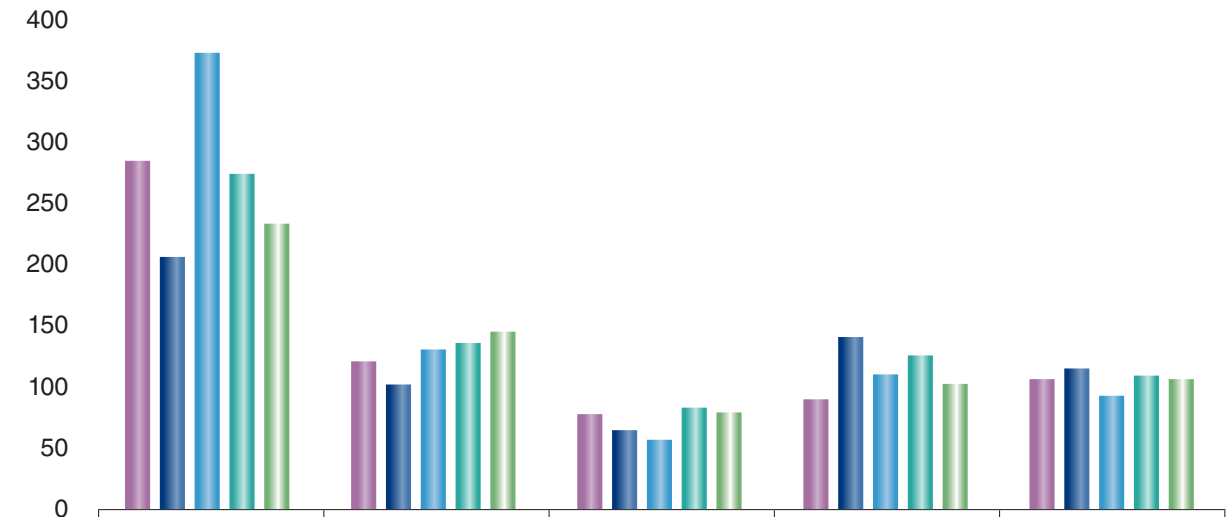
7. Fourie, H. 2020. South Africa's progress towards its development objectives: 2020 assessment report. Bureau for Economic Research, Stellenbosch University available from https://resep.sun.ac.za/wp-content/uploads/2021/02/NDP-Assessment-Report_FINAL.pdf accessed 18 Aug 2025.
8. National Planning Commission. 2022. Report on monitoring National Development Plan (NDP) indicators and targets: December 2022 available from www.nationalplanningcommission.org.za/assets/Documents/Report%20on%20Monitoring%20National%20Development%20Plan%20Indicators%20and%20Targets_December%202022.pdf accessed 18 Aug 2025.

NRF National Research Facility publications

The NRF's National Facilities (NFs) generate substantial research outputs across a range of specialised fields. While some facilities publish in WoS journals, others focus on local journals, policy briefs, technical reports, and related outputs that aim for societal impact in South Africa. Given their diversity in research domains and differences in scale, capacity, and funding, it is important to assess the research performance and contributions of each facility within its specific context.

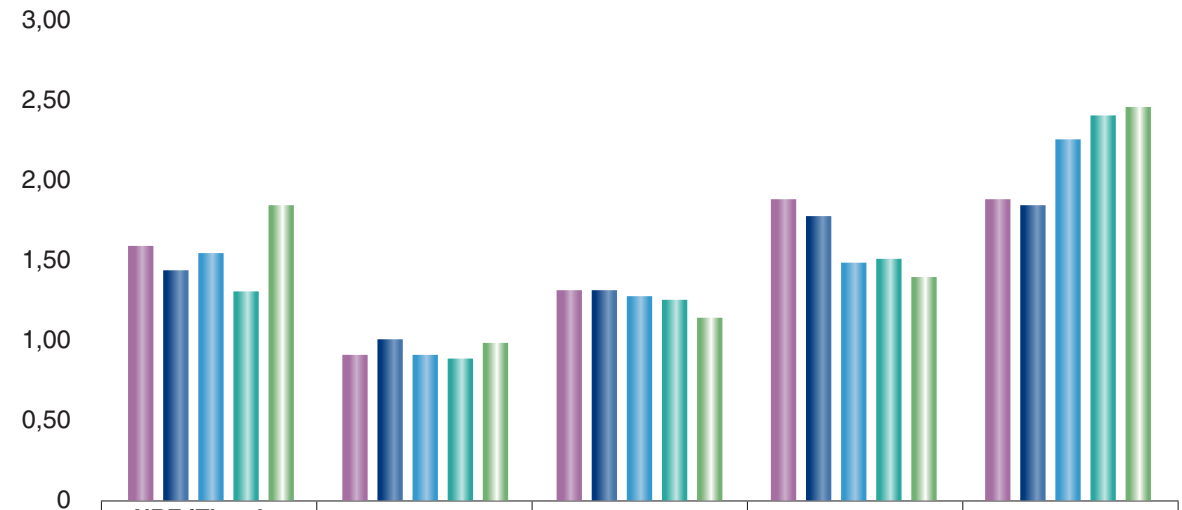
Investment in National Research Infrastructure Platforms has increased from R1.2 billion in 2020/21 to R3.1 billion in 2025/26, which has primarily been directed towards capital expenditure for major infrastructure projects. Notable expenditures in 2025 included three NRF-SAEON Research Infrastructures launched in 2016 as part of the South African Research Infrastructure Roadmap (SARIR), namely: the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON); the Shallow Marine and Coastal Research Infrastructure (SMCRI); and the South African Polar Research Infrastructure (SAPRI). Significant funding was also allocated to NRF-SARAO projects, including the Square Kilometre Array (SKA) Engineering Operations Centre (EOC), the SKA Science Processing Centre (SPC), the SKA Science Operating Centre (SOC), and the National Park (MeerKAT) Game Fence project. Upgrading these NFs enhances research opportunities for local and international researchers and students, leading to increased impact, higher publication output, and postgraduate development, especially among designated groups.

Figure 4 illustrates the WoS research publications from the NRF's NFs from 2021 to 2025, showing fluctuations. The average annual output during this period was 692 WoS publications, with a slight decline to 664 in 2025. While the NRF provides research platforms to support publication efforts, various factors, such as platform availability and open-access archives, also influence these outcomes.



	NRF-iThemba LABS	NRF-SAIAB	NRF-SAEON	NRF-SAAO	NRF-SARAO
2021	287	124	78	93	107
2022	210	105	64	143	116
2023	380	132	55	114	95
2024	227	137	84	128	110
2025	236	146	83	104	107

Figure 4: WoS Publications Emanating from the National Research Facilities, 2021 to 2025



	NRF-iThemba LABS	NRF-SAIAB	NRF-SAEON	NRF-SAAO	NRF-SARAO
2021	1,60	0,92	1,33	1,91	1,89
2022	1,45	1,02	1,33	1,81	1,86
2023	1,56	0,92	1,29	1,49	2,28
2024	1,31	0,90	1,28	1,53	2,43
2025	1,87	1,00	1,17	1,40	2,47

Figure 5: Category Normalised Citation Impact (CNCI) of National Research Facilities' Outputs, 2021 to 2025

Figure 5 shows the Category Normalised Citation Impact (CNCI) of research outputs produced by the NRF's NFs between 2021 and 2025. Overall, the facilities demonstrate strong research influence, with most recording consistent citation impact values above the global benchmark (CNCI = 1.0) and exceeding the average for South Africa of 1.24.[9] NRF-SARAO consistently achieved the highest citation impact, increasing from 1.89 in 2021 to 2.47 in 2025, indicating that its publications were cited more than twice the world average. NRF-SAAO and NRF-iThemba LABS also recorded strong citation performance, although NRF-SAAO's impact gradually declined over time, while NRF-iThemba LABS showed a notable increase in 2025. NRF-SAEON maintained relatively stable citation impact values above the world average, whereas NRF-SAIAB's citation impact remained close to the global benchmark. The NFs operate in different research fields, so citation impact should be interpreted with caution. Some research areas, such as biodiversity and environmental research, may have important impacts that are not fully reflected by citations.

Nevertheless, the analysis highlights the strong international visibility and influence of research produced by the NRF's NFs, particularly in astronomy and nuclear science-related fields. It further demonstrates the value of the NRF's cutting-edge research infrastructure platforms for national research output. Despite these achievements, challenges remain, and stable and sufficient funding is required to maintain and further develop research infrastructure.

South African Radio Astronomy Observatory (NRF-SARAO)

In 2025, NRF-SARAO published 107 WoS papers, matching its 2021 output. This reflects the cyclical nature of large-scale research infrastructure and project-based operations. Most radio astronomy research papers are produced by scientists using platforms such

9. For more information on how South Africa's CNCI compares with those of other African countries and the global benchmark, please see *NRF Data Insights* Volume 1: 2026 www.nrf.ac.za/wp-content/uploads/2026/07/NRF-Data-Insights-Volume-1.pdf

as the MeerKAT telescope[10]. The NFs' scientists enable research by providing advanced platforms for the global research community. As astronomy increasingly focuses on large projects and international collaboration, such as MeerKAT and the SKA, it is also useful to consider alternative measures of research productivity. Below are key highlights about the Facility, showing how it has nurtured emerging researchers (at doctoral and postdoctoral levels) to publish groundbreaking research.

In 2025/26 financial year, three studies led by young South African researchers were published using MeerKAT data. The first study, *'A relativistic jet from a neutron star breaking out of its natal supernova remnant'*, led by Kelebogile Gasealahwe, a PhD graduate and now an NRF-SARAO postdoctoral fellow at the University of Cape Town, appeared in the journal Monthly Notices of the Royal Astronomical Society in August 2025. It focused on Circinus X-1, a neutron star remnant from a supernova explosion. The researchers discovered that high-energy jets from the neutron star interact with the remnants, breaking out of the supernova remnant. This marked the first observations of such jets emerging from a supernova remnant. MeerKAT's detailed radio images revealed that the remnant resembles the African continent, earning it the nickname "The Africa Nebula." The National Aeronautics and Space Administration (NASA) featured this image as the Astronomy Picture of the Day on 3 September 2025.

In December 2025, Isaac Magolego, a former PhD student at the University of the Witwatersrand (Wits) and now an NRF-SARAO postdoctoral fellow at the University of Pretoria, published a study, *'Discovery of a z ~ 0.8 ultra steep spectrum radio halo in the MeerKAT-South Pole Telescope Survey'*, in Monthly Notices of the Royal Astronomical Society (MNRAS). His team discovered a very large, faint radio structure called a radio halo using MeerKAT data. This structure spans more than 1.5 million light-years, making it about 15 times bigger than our Milky Way galaxy. The team showed that this radio emission is likely caused by electrons re-energised by turbulence during galaxy cluster collisions. This is the most distant discovery of its kind so far, located about 7 billion light-years away. This discovery demonstrates the power of wide-field surveys using MeerKAT to meaningfully investigate the origin and evolution of such structures across cosmic time, setting the scene for future studies using the SKA-Mid telescope, into which MeerKAT will be incorporated towards the end of this decade. This will pave the way for future studies of large-scale cosmic structures and the physical processes that shape them.

Finally, in February 2026, Thato Manamela, a PhD student who is now an NRF-SARAO postdoctoral fellow at the University of Pretoria, reported *'the discovery of a record-breaking "cosmic laser" halfway across the universe'* in the journal MNRAS. Hydroxyl (OH) megamasers are natural "cosmic lasers" that give off strong microwave signals. Scientists use them to find places where galaxies are merging or interacting, which are usually very hard to study because they are so far away. In the study "MeerKAT discovery of a high-redshift strongly-lensed hydroxyl gigamaser," Manamela and his team showed that a naturally aligned galaxy in front acted like a magnifying glass, making the distant signal easier to see. Together with the power of the MeerKAT telescope, this allowed them to discover and study the brightest OH megamaser ever found. This discovery shows that MeerKAT and the future SKA-Mid telescope can be used to study very distant parts of the universe in new ways.

South African Astronomical Observatory (NRF-SAAO)

The publication output at NRF-SAAO has continued to fluctuate annually, with 104 publications in 2025. These outputs are generated using NRF-SAAO's telescopes, including the Southern African Large Telescope (SALT) and the Lesedi telescope. NRF-SAAO has progressed in astronomical research, contributing meaningfully to expanding our understanding of the Universe. Over the past five years, this progress is reflected in a body of groundbreaking research that has captured the attention of both the scientific community and the broader public, with key highlights outlined below.

- **DART asteroid-deflection test observed from Sutherland:** In 2022, astronomers at the NRF–SAAO used the Mookodi instrument on the 1-metre Lesedi telescope in Sutherland to capture rare ground-based observations of NASA's Double Asteroid Redirection Test (DART) impact on Dimorphos. Sutherland's darkness allowed them to record the ejecta plume seconds after impact and take measurements before and after for context.

10. The South African MeerKAT radio telescope is a precursor to the Square Kilometre Array (SKA) telescope and will be integrated into the mid-frequency component of SKA. For more information see: https://www.sarao.ac.za/science/meerkat/about-meerkat/.

- **White dwarf pulsar class confirmed with South African observations:** In 2023, an international team announced the discovery of J1912−4410, the second known white dwarf pulsar, with South African observations playing a central role in confirming its nature. Optical work led by the NRF–SAAO, including observations with SALT, revealed pulsed polarisation and key spectral features. In parallel, the MeerKAT radio telescope detected sharp radio pulses at the same spin period, providing decisive multiwavelength evidence. By finding a second member of a previously singular class, astronomers could begin testing how some white dwarfs generate extreme magnetic fields. It also showcases South Africa's optical-radio partnership at full strength.
- **SALT astrocomb first light enables next-generation exoplanet science:** In 2024, the NRF–SAAO announced a laser frequency comb integrated into SALT's high-resolution spectrograph. In simple terms, the astrocomb acts as an ultra-precise ruler for starlight, enabling astronomers to detect the minute "wobbles" in stars caused by orbiting planets. This capability opens a realistic pathway for significantly enhanced exoplanet detection and characterisation with SALT. Beyond its scientific impact, the project represents a strong example of technological capability development and skills transfer. It brought together NRF–SAAO scientists, engineers, and students with photonics specialists from Heriot-Watt University in Edinburgh. Importantly, components fabricated in the SAAO mechanical workshop were directly incorporated into this frontier instrument upgrade, demonstrating how local technical expertise contributes to globally competitive astronomy on African soil.
- **Vela Supercluster mapped using SALT and MeerKAT:** In collaboration with NRF-SARAO, NRF-SAAO published a new reconstruction of the Vela Supercluster in March 2026 showing that a giant structure hidden behind the Milky Way is much larger and more massive than previously thought. The result combines over 65,000 galaxy-distance measurements with more than 8,000 new redshifts, including key SALT optical spectra and MeerKAT radio observations in the dust-obscured Zone of Avoidance. This work both improves the map of the nearby universe and demonstrates how South African facilities can solve challenges that require the combined power of optical and radio astronomy.

iThemba Laboratory for Accelerator Based Sciences (NRF-iThemba LABS)

NRF-iThemba LABS has been the leading contributor to the NFs' WoS publications from 2021 to 2025, peaking in 2023 with 380 publications. Established in the early 1980s, it excels in research and development in accelerator-based sciences and technologies and has developed a network of national and international partners. Significant publications during the period under review are outlined below.

- A new 3 MV Tandetron™ accelerator at iThemba Laboratory for Accelerator-Based Sciences (iThemba LABS) provides a detailed description of the system's configuration and beam energy calibration, highlighting its performance and reliability. The accelerator enables a wide range of high-precision ion beam analysis techniques, including Rutherford Backscattering Spectrometry (RBS), Elastic Recoil Detection Analysis (ERDA), Particle-Induced X-ray Emission (PIXE), proton beam writing, ion channelling, and in situ real-time RBS. These capabilities position the facility as a versatile platform for advanced materials research and microanalysis.
- In Vitro Perspective on Hypofractionated Radiotherapy in Breast Cancer is a study that examines the cellular responses of breast cancer and normal breast epithelial cell lines to hypofractionated and conventionally fractionated radiotherapy schedules. The research evaluates survival, DNA repair capacity, migration, and invasion following radiation exposure and demonstrates that hypofractionation significantly reduces survival in hormone receptor-positive cells, while triple-negative cells may exhibit increased survival under similar conditions. It has significant potential impact on the treatment of breast cancer.
- Interface engineering of activated carbon via nitrogen and nitrogen-sulphur doping for high-performance supercapacitors and dye adsorption reports the development of porous activated carbon materials derived from tondolo biomass through a single-step process integrating carbonisation, activation, and heteroatom doping/co-doping. Nitrogen and nitrogen-sulphur doping strategies were employed to engineer the surface chemistry and enhance electrochemical performance. The resulting materials exhibit improved physicochemical properties, including enhanced surface area, porosity, and surface functionality, which translate into superior performance in supercapacitor applications. In addition, the engineered carbon materials demonstrate strong potential for environmental remediation through efficient dye adsorption. These findings highlight the effectiveness of biomass-derived, heteroatom-doped carbons as sustainable, multifunctional materials for energy storage and wastewater treatment.
- Green-synthesized silver nanoparticles supported on polypyrrole for the electrochemical detection of Pb2+ and Cd2+ ions in water describes a new way to detect very small amounts of lead and cadmium in water. These metals are harmful, so it is important to find them quickly and accurately. The researchers made a sensor by coating an electrode with a material called polypyrrole and adding

tiny silver particles. These silver nanoparticles were made in an eco-friendly way using an extract from eucalyptus leaves, instead of harmful chemicals. The combination of these materials helps the sensor detect lead and cadmium more effectively. This makes it useful for monitoring water quality in a safe and environmentally friendly way.

- Probing the j dependence of angular distributions and N = 20 shell rigidity via the 36S(p,d)35S reaction is an investigation of the N = 20 36S nucleus. It was performed through a detailed study of the 36S(p,d)35S neutron-removal reaction, employing the 66-MeV proton beam at NRF-iThemba LABS and an innovative target design. The researchers found 98 different energy states in the resulting atom (35S), including 47 new ones that had never been seen before. These results improve our understanding of how atomic nuclei are built and how they behave, especially around something called the N = 20 shell, which is important for nuclear stability.
- Studying how nuclear materials are damaged by radiation is important, but doing it with neutron radiation is slow, expensive, and difficult. Scientists often use ion beams instead, but these only affect a small, narrow region of the material, not the whole sample. To solve this problem, researchers at NRF-iThemba LABS developed a new method to spread the ion damage more evenly throughout the material, as explained in Novel methodology of homogeneous ion doping/damage of nuclear materials for structural characterization. They did this by tilting the sample in different directions using a computer-controlled system while it was being irradiated. This new approach allows the material to be damaged more uniformly, making it easier to study how it behaves under radiation.
- Comparative elemental analysis of organic and inorganic fertilisers using the nuclear analytical techniques: PIXE and RBS is a study on the types and amounts of different elements found in organic and inorganic fertilisers. Some of these elements can be harmful if they enter food, so it is important to measure them. Researchers collected organic fertilisers (like chicken, cow, goat, and sheep dung) and inorganic fertilisers from the Zululand region in South Africa. They used special nuclear techniques called PIXE and RBS to analyse which elements were present and in what amounts. The results help determine whether there are any harmful trace elements in these fertilisers and what risks they might pose to human health.

In addition to its publication output, NRF-iThemba LABS continues to strengthen global partnerships and innovation through collaborative research and advanced experimentation. Key initiatives include the Digital Acquisition Signal System for Innovative Experimentation (DASSIE) project with the United Kingdom's (UK) Science and Technology Facilities Council (STFC) to develop a low-cost, scalable digitiser for applications in health, environmental monitoring, and security. This project is supported by an Official Development Assistance (ODA) grant, reinforcing the joint commitment signed by the UK and South African governments in 2021. Collaborations with the ISIS Neutron and Muon Source have advanced diagnostic tools for accelerators and enabled studies on radiation effects in electronic systems, with further experiments planned locally. International engagements include joint research with the University of Oslo on nuclear reactions relevant to astrophysics, participation in the Photo-Absorption of Nuclei and Decay Observation for Reactions in Astrophysics (PANDORA) experiment in Japan, and work with Russia's Flerov Laboratory of Nuclear Reactions (FLNR) on radiation effects in nuclear materials. In addition, the development of a versatile Forced Electron Beam Induced Arc Discharge (FEBIAD)-based plasma ion source has enabled the production of multiple ion beams, demonstrating continued progress in accelerator technology and scientific capability. Another area of impact is the hosting of conferences and symposiums where research infrastructures serve as platforms for global scientific exchange, skills development, and collaboration. In 2025, NRF-iThemba LABS hosted high-profile international gatherings that underscored South Africa's role in advancing frontier science. The ATLAS Tile Calorimeter (TileCal) collaboration (29 September to 3 October 2025) brought together researchers, engineers, and students from around the world to discuss the operation, calibration, performance, and future upgrades of the ATLAS hadronic TileCal detector. Held outside CERN only once every two years, this meeting was coordinated under the SA-ATLAS pillar of the SA-CERN consortium, with NRF-iThemba LABS as the institutional host.

NRF-iThemba LABS also hosted the 4th African Nuclear Physics Conference (ANPC) in November 2025, which gathered established and emerging researchers alongside students from across the continent and beyond to exchange knowledge and foster collaboration in nuclear physics. From 26 to 29 January 2026, NRF-iThemba LABS co-hosted a pre-conference symposium on isotope production, coordinated by the International Atomic Energy Agency (IAEA) in partnership with the South African Nuclear Energy Corporation (Necsa), Nuclear Medicine Research Infrastructure (NuMeRI), and NRF-iThemba LABS. This event, held ahead of the Theranostics

World Conference, brought together experts from 19 member states across Latin America, Asia, and Europe, facilitating knowledge and technology transfer through lectures, round-table discussions, and practical training on radio-labelling and quality control.

South African Institute for Aquatic Biodiversity (NRF-SAIAB)

Publication output at NRF-SAIAB has grown since 2023, peaking in 2025, with an 18% increase from 2021. This reflects stable infrastructure use, expanding knowledge in marine and biodiversity sciences, and ongoing support for research training.

NRF-SAIAB has made a significant contribution to managing freshwater invasive species through the SARChI Chair in Ecology and Management of Freshwater Invasive Species, established in 2024. Key achievements include introducing the biological control agent Cyrtobagous salviniae to manage Salvinia minima, controlling water hyacinth at Hartbeespoort Dam, and successful invasive species management in the Vaal River Barrage, all improving water access and ecosystem health. The programme's impact extends regionally to countries like Zimbabwe and Tanzania, highlighting South Africa's leadership in nature-based solutions. Its research is closely integrated with freshwater science platforms, supporting ecosystem-level understanding and innovation, including award-winning research on ecosystem recovery. Internationally, the Chair contributes to global knowledge through studies linking invasive plants to mosquito spread and human health, and through engagement at major conferences. Overall, the initiative advances scientific innovation, builds capacity, strengthens collaboration, and supports evidence-based policy while delivering lasting ecological and socio-economic benefits.

NRF-SAIAB's Coastal and Ocean Sciences Team (COST) is advancing impactful, transdisciplinary science that enhances societal well-being, biodiversity conservation, climate resilience, and inclusive innovation. By integrating ecological engineering, biodiversity science, Indigenous Knowledge Systems, environmental monitoring, community engagement, and capacity development, COST is helping reimagine South Africa's urban and natural coastal ecosystems to sustainably support both people and nature. A key initiative, the Indigenous Marine Innovations for Sustainable Environments and Economies (IMIsEE) flagship, unites scientists, students, coastal communities, artists, industry partners, and government stakeholders to co-develop nature-based solutions for urban coastlines. By incorporating Indigenous weaving practices and culturally important plant materials such as Cyperus textilis into eco-engineered coastal infrastructure, the programme demonstrates how local knowledge and cutting-edge marine science can jointly address biodiversity loss, pollution, and climate adaptation challenges. Research outcomes have shown that these nature-based interventions can improve habitat complexity, support marine biodiversity, enhance water quality through bioremediation, and strengthen ecosystem functioning in heavily urbanised coastal environments.

Beyond environmental benefits, COST promotes skills development, empowers local communities, and supports inclusive innovation through strong partnerships. Partnerships with communities in the Eastern Cape Province, such as the Keiskamma Trust, ensure that research is embedded within principles of inclusivity, ethical collaboration, and recognition of Indigenous intellectual contributions. Overall, the team's integrated platforms also support broader national and international priorities, including climate resilience, sustainable coastal management, ocean literacy, and the UN SDGs. Through collaborations with government departments, ports, non-governmental organisations (NGOs) and international partners, COST generates evidence-based solutions that inform policy and practice while strengthening South Africa's role as a leader in socially engaged marine and coastal science.

Inland fisheries and freshwater biodiversity research has continued to evolve. From 2019 to 2023, NRF-SAIAB contributed to the Food and Agriculture Organization's (FAO) *Illuminating Hidden Harvests project*, which assessed the role of small-scale fisheries (SSF) in sustainable development. The study revealed a significant lack of reliable data on the sector's contributions, prompting NRF-SAIAB to initiate inland fisheries research to support evidence-based decision-making. Between 2023 and 2026, NRF-SAIAB's Freshwater Field Unit formed part of a Water Research Commission (WRC) funded project to establish the potential for small-scale inland fisheries in public dams in Limpopo Province. Other project partners included the Department of Forestry, Fisheries and the Environment (DFFE), the Agricultural Research Council (ARC), the University of Limpopo (UL), and South African National Parks (SANParks). The research findings are informing the implementation plan of the National Freshwater (Inland) Wild Capture Fisheries Policy (NFWCFP) and support national development goals such as poverty reduction, improved nutrition, and economic growth. The research draws on ongoing

freshwater projects and has contributed key insights into fish species, biology, stock levels, and fishing communities. It also identified major challenges, including poor water management, illegal fishing practices, and weak governance, which undermine both ecosystems and livelihoods. Importantly, the work highlights the often-overlooked role of small-scale fishers in policy discussions. Additionally, the tilapia mapping project, which focused on assessing the current distribution of alien invasive Nile tilapia, *O. niloticus*, and native Mozambique tilapia, *O. mossambicus*, across the Limpopo, Mpumalanga and KwaZulu-Natal (KZN) provinces, is another collaborative project with the DFFE and NRF-SAIAB. This project has provided critical data on the distribution of invasive and native tilapia species across three provinces. The data from this project are being used by the DFFE and provincial conservation authorities to help guide the permitting of aquaculture activities by feeding into an Integrated Environmental Management (IEM) decision-making process that will drive sustainable development, including job creation and food security in the country.

The Aquatic Ecophysiology Research Platform (AERP) supports research on how climate change affects aquatic and terrestrial organisms by providing specialised equipment. It has contributed to modelling how key fish species, such as blacktail *(Diplodus capensis)*, respond to climate change, supporting improved fisheries management. The platform also enhances understanding of how thermal physiology influences fish behaviour, helping predict how marine organisms respond to environmental changes. Current studies in the AERP assess the effects of water temperature on the aerobic scope of two species, namely the invasive Western Mosquitofish *(Gambusia affinis)* and the native River Goby *(Glossogobius callidus)*. These studies have direct implications for fish performance in warming environments.

Understanding the movements and migrations of aquatic animals is crucial to learning more about the ecology of a species. This information is also paramount when establishing one of the most widely accepted methods of spatial management – marine protected areas (MPAs). The Acoustic Tracking Array Platform (ATAP) uses special listening devices placed along 2,300 km of the southern African coast. These devices collect over one million data points each year about the movement and presence of fish, sharks, rays, skates, and turtles. This information helps scientists, conservation workers, and resource managers make better decisions. It supports planning where to protect marine life, how to manage species, and can even help improve conservation laws. Beyond research, ATAP delivers impact through capacity development and collaboration, providing training opportunities for students, supporting early-career and female researchers, and facilitating partnerships across institutions, both locally and internationally. Public engagement activities play a vital role in promoting ocean stewardship and raising awareness about sustainable resource use. They also foster enthusiasm and appreciation for South Africa's unique marine biodiversity, particularly species found nowhere else in the world. Collectively, ATAP's outputs translate scientific knowledge into practical management tools, strengthening environmental governance. In doing so, they contribute to socio-economic well-being by supporting healthier marine ecosystems and more sustainable fisheries. Through its support of diverse projects, ATAP delivers high-impact science with tangible societal benefits. These contributions advance the sustainable use of marine resources (SDG 14: Life Below Water), improving food security with sustainable consumption patterns (SDG 2: Zero Hunger and SDG 12: Responsible Consumption and Production, respectively), and support poverty alleviation (SDG 1: No Poverty).

South African Environmental Observation Network (NRF-SAEON)

NRF-SAEON's publications have increased by 6% from 2021 to 2025, after a slight decline between 2021 and 2023 and a strong recovery in 2024. This reflects improved utilisation of research infrastructure and renewed engagement in environmental sciences. The recovery strengthens the NRF's delivery across key 2030 outcomes, particularly in expanding knowledge frontiers, enhancing research infrastructure capacity, and increasing societal impact through evidence-based environmental research. There is a need for sustained investment and stability to ensure consistent long-term contributions.

NRF-SAEON's research publications highlight its extensive scientific inquiry across terrestrial, marine, and atmospheric domains. Notable works include the BII4Africa dataset of faunal and floral population intactness across Africa's major land uses,[11] which reflects a significant contribution to continental-scale ecological assessment and conservation science. This dataset provides critical insights

11. Clements, H.S., Do Linh San, E., Hempson, G., Linden, B., Maritz, B., Monadjem, A., Reynolds, C., Siebert, F., Stevens, N., Biggs, R. and De Vos, A., 2024. The bii4africa dataset of faunal and floral population intactness estimates across Africa's major land uses. Scientific data, 11(1), p.191. Available from: https://www.nature.com/articles/s41597-023-02832-6.pdf, accessed 20 May 2026.

into how land-use change affects species populations and ecosystem integrity, enabling more accurate monitoring of biodiversity loss and recovery. As a widely applicable and policy-relevant resource, BII4Africa strengthens evidence-based decision-making and underscores the role of NRF-SAEON's research platforms in advancing large-scale, data-driven understanding of Africa's biodiversity and its sustainable management.

NRF-SAEON's ocean science research[12] highlights critical advances in understanding climate-driven processes and their broader societal implications. Notable outputs include work on the subsurface manifestation of marine heatwaves in the southwestern Indian Ocean, communicated through an engaging video abstract that enhances knowledge accessibility and outreach. This research provides important insights into the dynamics and impacts of marine heatwaves below the ocean surface, contributing to improved climate monitoring and forecasting. Complementing this, the Ocean20 policy briefs and the "taking the ocean inland" initiative demonstrate strong science–policy engagement, translating complex ocean research into actionable recommendations and extending ocean literacy beyond coastal regions. Collectively, these efforts underscore NRF-SAEON's role in advancing impactful, interdisciplinary ocean science that supports both global understanding and informed decision-making.

Other notable contributions include the development of GPS-based drifters to improve rip current prediction and enhance beach safety; nationally aligned climate adaptation research through open-source tools and stakeholder engagement; and critical groundwater studies informing the protection of Strategic Water Source Areas. Highlights of work conducted include:

- **Rip Current Research for Public Safety:** The Elwandle Node, in partnership with Sea Technology Services, developed five Lagrangian GPS drifters to study rip currents. These devices were tested with the National Sea Rescue Institute (NSRI) to improve the prediction of dangerous currents and enhance beach safety for the public. To guide public safety and help beachgoers and lifeguards reduce drowning hazards, the system uses advanced data to predict rip current risk.
- **Advancing National Climate Adaptation:** The uLwazi Node's Climate Change Scenarios Project, commissioned by the DFFE, conducted stakeholder workshops across four provinces to inform South Africa's National Adaptation Strategy. The team developed open-source Python scripts for analysing CMIP6 climate projections, promoting transparency and capacity building in climate science.
- **Securing Strategic Water Source Areas:** Research at the Grasslands Node provided critical evidence on how land-use changes, such as commercial forestry and invasive species, impact groundwater recharge in the Maputaland Coastal Plain. This work led to formal recommendations to the Department of Water and Sanitation (DWS) to protect the Lake Sibaya groundwater catchment as a Strategic Water Source Area.
- **Global Leadership in Ocean Governance:** Through the Ocean20 (O20) initiative, NRF-SAEON led the development of a global communiqué and ten briefing notes to inform G20 working groups on critical issues like "Blue Foods," "Ocean Literacy," and "Deep-sea Mining." These outputs synthesised input from nearly one hundred organisations to promote a sustainable and inclusive global ocean economy.
- **High-Altitude Weather Station:** The installation of the highest weather station in Southern Africa on Mont-aux-Sources was highlighted as a notable achievement during the reporting period. This collaboration with the University of the Free State (UFS) provides real-time data for strategic water source areas that supply roughly half of South Africa's river and dam water.
- **Weather-Related Disaster Analysis:** A research paper led by Dr Mary-Jane Bopape, which analysed disaster patterns in South Africa from 1980 to 2023, received notable coverage. The study identified KZN as having the highest number of flood and storm events and highlighted human and urban influences on disaster patterns.
- **Deep-Sea Exploration:** The Around Africa Expedition, featuring innovative deep-sea exploration with OceanX and OceanQuest, was a notable research and public engagement initiative in early 2026. It led to the discovery of new habitats and previously unknown species.
- **Community-Led Ecotourism:** The Phalaubeni Community project in Limpopo resonated as a success story of shifting from human-wildlife conflict to sustainable livelihoods through community-led ecotourism and conservation.

12. Welch, C.B., Malan, N., Mawren, D., Morris, T., Sprintall, J. and Hermes, J.C., 2025. Subsurface manifestation of marine heat waves in the southwestern Indian Ocean. Ocean Science, 21(4), pp.1695-1708 available from https://os.copernicus.org/articles/21/1695/2025/os-21-1695-2025.html accessed 20 May 2026.

Conclusion

Journal publications remain one of the most important mechanisms for disseminating research and assessing the productivity and influence of a research system. The findings presented in this edition of *NRF Data Insights* demonstrate that NRF-funded researchers continue to make a substantial contribution to South Africa's research output, producing 9 693 Web of Science publications in 2025 and accounting for 33% of the country's total publication output. Sustained growth in productivity, despite global disruptions to research systems in recent years, highlights the effectiveness of NRF investments in supporting excellence in research and innovation.

The analysis further shows that NRF-supported research is strongly aligned with national and global development priorities. With 75% of NRF-funded publications linked to one or more SDGs, particularly strong contributions were made in health, climate action, biodiversity conservation, water security and environmental sustainability. The examples highlighted throughout this report demonstrate how NRF-supported research is advancing scientific knowledge while generating evidence, technologies, and solutions that contribute to addressing societal challenges.

The NRF's National Research Facilities continue to play a critical role in enabling high-impact research by providing world-class infrastructure, encouraging international collaboration and supporting the development of the next generation of researchers. The publication performance of the NRF's NFs, their above-average citation impact, and numerous scientific achievements underscore the value of sustained investment in research infrastructure for advancing South Africa's scientific competitiveness and innovation capacity.

The findings also highlight opportunities to strengthen research in areas such as poverty reduction, inequality, gender equality, economic growth and governance, where evidence-based solutions remain essential for achieving national development objectives. Continued investment in researchers, infrastructure and strategic partnerships, together with stronger links between research, policy and implementation, is critical to ensuring that South Africa's research enterprise delivers both knowledge impact and tangible societal benefits.