

RESEARCH AND PhD CAPACITIES IN SUB-SAHARAN AFRICA: SOUTH AFRICA REPORT

Professor Chaya Herman, PhD
Professor Chika Sehoole, PhD

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This report contributes to the theme of alignment between institutional research priorities and the national research agenda, as well as institutional engagement with societal needs, industry and the private sector.

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Foreword



This report forms part of a broader study commissioned by the British Council and the German Academic Exchange Service (DAAD) that surveyed research and doctoral training capacity in Sub-Saharan Africa. The study includes six country reports, namely Ethiopia, Kenya, Ghana, Nigeria, Senegal and South Africa. This report addresses the outcomes of the study in relation to South Africa. The country reports include expanded contextualisation of the national research training landscape,¹ while a synthesis report is also available highlighting the key policy implications for PhD provision specifically.² The aims of the study were to investigate: (i) the availability, quality and thematic priorities of PhD

programmes and how they have changed over the last ten years; (ii) the national level research agenda; (iii) the extent to which research training at the institutional level is aligned with the national agenda; (iv) national-level systems (policies, legislation) that facilitate alignment between institutional level research training and the national agenda; (v) how institutional priorities reflect the needs of universities and emerging research and development systems, including local industry; (vi) funding sources to develop and sustain PhD provision; and (vii) the role of international collaboration in building PhD capacity.

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1. Country reports can be found on the British Council website <https://www.britishcouncil.org/education/ihe/knowledge-centre/developing-talent-employability/phd-capacities-sub-saharan-africa> and DAAD website <https://www.daad.de/en/>
 2. Synthesis report can be accessed on the British Council website at <https://www.britishcouncil.org/education/ihe/knowledge-centre/developing-talent-employability/phd-capacities-sub-saharan-africa>; and DAAD website <https://www.daad.de/download/phd201806>

1. The context of the higher education system in South Africa

1.1 Historical development

Since the dawn of democracy in 1994, South Africa's higher education has undergone a series of reforms. Among these are the various policies that were produced to increase access to higher education, redress past apartheid inequalities and to achieve economic growth (Department of Education [DoE], 1997; 2001). In 2002, policy was passed that reduced the number of universities in South Africa from 36 to 23 through mergers. This process led to the creation of three institutional types, namely: traditional universities with a research mission; comprehensive universities with a research and vocational education mission; and universities of technology which offer mainly vocational degrees, diplomas and certificates. Though all these institutions may offer PhD programmes, all qualifications offered must be approved by the Department of Higher Education and Training (DHET). They also need to be registered with the South African Qualifications Authority (SAQA) and accredited by the Council on Higher Education (CHE). Due to the growing pressure for more access to higher education, the government has established three new universities since 2014, bringing the number of public universities to 26.

Student enrolments increased from 735,000 in 2005 to 983,698 in 2013, an increase of 34 per cent. By 2012 South Africa had a gross tertiary enrolment rate (GTER) of about 20 per cent calculated based on the total population between the ages of 20 and 24 years. This is one of the highest participation rates in Africa. In *The White Paper for Post School Education*, the government set a new target for GTER at 25 per cent by 2030 (DHET, 2013: 30). However, the increased numbers of students admitted to universities in the last decade has led

to some negative impacts especially on academic quality. It has also resulted in decreasing throughput and low graduation rates. This is also attributed to the poor preparation of students for tertiary education arising from the low quality of primary and secondary schools (Taylor and Shindler, 2016). Significant changes have taken place in the demographic profile of university students. Statistical data in South Africa still follows the apartheid racial classification in order to track transformation. In 2014, the student population comprised 72 per cent African, 15 per cent white, six per cent coloured, and five per cent Indian compared to 62 per cent African, 25 per cent white, six per cent coloured and seven per cent Indian in 2003.³ The participation of female students has also grown from 43 per cent of enrolments in 2003 to 58 per cent in 2013.

South Africa subscribes to a funding framework in which costs are shared between the government and direct beneficiaries of university education. The government uses a block grant system which is supplemented by fees from the students. A report by Universities South Africa (USAF, 2016) indicates that universities are underfunded and that government subsidies to universities have declined in real terms by over 30 per cent in the last two decades. This decline has put pressure on the other two sources of income available to universities, namely, tuition fee income, which is currently contested by the 'fees must fall' movement in South Africa, and third-stream income (typically research grants, contract income and donations). The no-fee increase granted to students in 2015 and the student protests that characterised most of 2016 have exacerbated the situation. The government also provides direct funding to poor students through

a funding programme managed by the National Student Financial Aid Scheme (NSFAS).

1.2 Current research and doctoral training landscape

In 2002, the newly established Department of Science and Technology (DST), which was mandated to manage a coherent national system of innovation (NSI) and to enhance South Africa's research capacity, adopted the National Research and Development Strategy (NRDS). The aim was to raise the national investment in research and development (R&D) to two per cent of GDP by 2018 and double South Africa's share of global research outputs from 0.5 per cent in 2002 to one per cent by 2018 (DST, 2002).

In line with these targets, the National Research Foundation (NRF), as the key government agency that funds research in the country, was charged with the responsibility of increasing the production of high-quality PhDs to serve the knowledge society (NRF, 2007). However, a report commissioned by the DST and the NRF (ASSAf, 2010) indicates that in 2007 South Africa produced only 1,274 doctoral graduates. In that year, there were a total of 26 PhDs per million of the population, which compared unfavourably with some other middle-income countries. From 2010 to 2016, new strategic plans and policies were developed outlining plans and priorities for PhD and research production. In particular, the *National Development Plan: Vision for 2030* (NPC, 2011), adopted by the South African government as its macroeconomic growth plan set the national target at 100 doctoral graduates per one million of the population by 2030, which translates to 5,000 graduates per annum, a fivefold increase on the 2007 figure.

3. We use the terms 'African', 'coloured', 'Indian' and 'white' as designators of race. We use the term 'black' as an umbrella term to include 'African', 'coloured' and 'Indian'.

2. Methodology

This report is based on a comprehensive document analysis and interviews conducted with selected key stakeholders in a sample that included representatives of universities, government departments and industry. It should be noted that, in contrast to many other countries in Africa, two key studies on doctoral education in South Africa have been published in the last decade. One of these was based on a number of studies conducted by one of the researchers and the author of this report (ASSAf, 2010), and another which was completed more recently (Cloete et al., 2015). These studies followed rigorous methodological approaches which included large national surveys, as well as interviews with key stakeholders in doctoral education in South Africa. As such, we took an approach that could enable us to complement these prior studies with some new insights. In particular, this report contributes to the theme of alignment between institutional research priorities and the national research agenda, as well as institutional engagement with societal needs, industry and the private sector.

Given the availability of prior research on doctoral education in South Africa, this report is accordingly mainly based on analysis of previous studies and reports on doctoral education in South Africa from the early 2000s to 2016.

The document analysis included policy documents and research reports from national actors such as the Department of Higher Education (DHET), the Council on Higher Education (CHE), Universities South Africa – which replaced Higher Education South Africa (HESA) the National Research Foundation (NRF), the Department of Science and Technology (DST) and the National Planning Commission (NPC). Statistical information was accessed from the Higher Education Management Information System (HEMIS).

In line with the aims of the broader, six-country study to identify institutional experiences in doctoral provision in some depth, data was also collected from a sample of six higher education institutions from three provinces. In order to ensure diversity, the sample criteria included: historical profile (advantaged or disadvantaged); type (comprehensive universities, traditional universities and universities of technology); and modes of delivery (contact and distance). All the institutions award degrees including doctorates, though some are research-intensive institutions and had better research and PhD production capacities. Others could be defined as emergent research-intensive institutions (some previously disadvantaged universities), where there is growing capacity, while some had low capacity to produce and supervise PhDs as is the case with

most universities of technology in South Africa. Table 1 summarises the profiles of the sampled institutions including their PhD provision for 2014.

Data was collected at these institutions via document analysis and interviews. Documents comprised institutional policies and strategies relating to research, and research reports. Interviews were conducted with a purposive sample of senior members of staff comprising those in charge of research (such as the Deputy Vice Chancellor for Research) and used to augment the document analysis and statistical data. Due to the unavailability of some individuals and time constraints of the research project, the resulting interview sample comprised three members of staff, one each at three out of the six institutions. In order to provide cross-sector context to the institutional data, one further interview was also carried out with a representative from industry. In particular, this provided insights into companies' motivations and strategies for becoming involved with masters and doctoral research training.

Table 1: Profiles of the sampled institutions

Institution	Status/type	Location	Size (no. of campuses)	General student population 2014	No. of PhD students enrolled in 2014	No. of PhD students graduated 2014	Number of PhD programmes
Tshwane University of Technology (TUT)	University of technology	Campuses in four provinces	8	56,785	321	46	69
University of KwaZulu-Natal (UKZN)	Merged/traditional	Durban, KwaZulu-Natal	5	45,465	2,453	264	90
University of Limpopo (UL)	Traditional (historically disadvantaged)	Polokwane, Limpopo	2	23,384	249	25	42
University of Pretoria (UP)	Traditional (historically advantaged)	Pretoria, Gauteng	7	56,376	2,155	237	211
University of South Africa (UNISA)	Comprehensive (distance education)	Pretoria, Gauteng	3	328,491	2,100	268	48
University of the Western Cape (UWC)	Traditional (historically disadvantaged)	Cape Town (Bellville), Western Cape	1	20,582	714	104	109

Source: HEMIS (2014) and institutions' websites

3. Availability, thematic priorities and quality of PhD provision 2005–14

3.1 Expansion of PhD production in South Africa

By 2014, South Africa had increased its total number of PhD holders to 34 per million of its population. However, this figure is still low in comparison with other developing countries, such as Brazil (70) (UNESCO, 2015). It is also inadequate to enable South Africa to respond to its development needs. The National Development Plan (NDP) (NPC, 2011: 278) has set a target to produce more than 100 doctoral graduates per million by the year 2030. In 2014, doctoral graduates comprised just 1.2 per cent of overall university graduations and 5.9 per cent of total postgraduates. Doctoral enrolment comprises 1.9 per cent of the overall students' enrolment in the universities and 14 per cent of total postgraduates. The NDP suggests that by 2030, over 25 per cent of student enrolments in the universities should be at a postgraduate level (NPC, 2011: 319).

Table 2 shows the increase in the number of PhD graduates from public higher education institutions in South Africa between 2005 and 2014. The main trends and major shifts are summarised as follows:

- The number of PhD graduates per annum almost doubled over the past ten years suggesting that South African universities responded to the national call to expand the production of PhDs. It further suggests that the NDP's target of 5,000 new PhD graduates per year by 2030 could be reached if this trend is maintained.
- PhD and knowledge production capacity is not evenly distributed in South African universities. Stronger capacities exist mainly in the historically advantaged universities of which nine produced 79 per cent of all PhD graduates in 2014. The differences in PhD production and research capacities has led to debate on the need for differentiation of the institutions (Cloete, et al 2015) on research and teaching universities. South Africa has been reluctant to make that distinction given that the top PhD-awarding universities are former white universities.

- Over the past ten years, selected universities of technology and previously disadvantaged universities have shown a significant increase in the number of doctoral graduates, albeit from a very low base. The same applies to newly-merged institutions such as the University of KwaZulu-Natal (UKZN), which almost tripled its PhD production, North-West University (NWU) and Nelson Mandela University (known as Nelson Mandela Metropolitan University until July 2017). Table 2 presents the shifts in PhD graduate numbers in South African universities between 2005 and 2014.

Table 2: PhD graduates from public higher education institutions in South Africa, 2005 and 2014

Institution name	Institutional characteristics	2005	2014	% increase
Traditional				
University of KwaZulu-Natal*	Merged	96	264	175
University of Pretoria*	Previously advantaged university	192	237	23
University of Stellenbosch	Previously advantaged university	126	234	86
University of Cape Town	Previously advantaged university	182	204	12
University of Witwatersrand	Previously advantaged university	101	199	97
North West University	Merged	82	171	109
University of Western Cape*	Previously advantaged university	35	104	197
University of the Free State	Previously advantaged university	65	104	60
Rhodes University	Previously advantaged university	31	76	145
University of Fort Hare	Previously disadvantaged university	1	66	6,500
University of Limpopo*	Merged	15	25	67
Comprehensive				
University of South Africa*	Distance	92	268	191
University of Johannesburg	Merged	88	106	20
Nelson Mandela Metropolitan University	Merged	30	72	140
University of Zululand	Previously disadvantaged university	18	25	39
Walter Sisulu University	Previously disadvantaged university	1	8	700
University of Venda	Previously disadvantaged university	3	1	–
Universities of technology				
Tshwane University of Technology*		12	46	283
Durban University of Technology		4	18	350
Cape Peninsula University of Technology		6	17	183
Central University of Technology, Free State		6	12	100
Vaal University of Technology		2	1	–
Grand total		1,188	2,258	90

Source: Higher Education Management Information System (HEMIS 2014)

*The asterisk indicates the institutions sampled for this study.

3.2 Demographic changes

A major policy imperative in doctoral training and building research capacity, which might be unique to South Africa, is the transformation agenda for the higher education system. This is mainly focused on redressing the skewed racial and gender imbalances of the apartheid era. Two decades after the transition to democracy, doctoral training changed from being exclusively dominated by white males to being more diverse and inclusive. In 1990, 93 per cent of PhD graduates were white, while by 2015 whites comprised only 37 per cent of PhD graduates. It is, however, important to note that the increase in the number of African students is linked to the increase in the number of international students especially from the South Africa Development Community (SADC) countries and others from the rest of Africa. In 2014, 40 per cent of the doctoral students in South African universities were international students (HEMIS 2014).

3.3 Changing thematic priorities

South Africa has a number of policies that provide guidelines on the priority areas for research. These include the South African Research and Development Strategy which identifies a number of scientific areas in which South Africa

has a regional knowledge advantage (DST, 2002). There are also the five 'grand challenges' of the DST Ten-year Innovation Plan (DST, 2008) and the National Development Plan (NPC, 2011). The documents emphasise poverty reduction, which encompasses water and sanitation, food security and agriculture, education, climate change, marine, space sciences, health and energy, as well as HIV/AIDS research. In recent years there has also been emphasis on community engagement and social responsiveness aimed at poverty reduction (CHE, 2010) and meeting the Sustainable Development Goals (SDGs).

Science and technology are considered crucial for the achievement of these thematic priorities. The government's aspiration is that by 2030 most of the PhDs should be focused on science, engineering, technology and mathematics (NPC, 2011). An analysis of the graduation rates by Classification of Educational Subject Matter (CESM) indicates that Life Sciences and Physical Sciences is the area with by far the highest numbers of doctoral graduates in South Africa, and one of the disciplines recording fast growth between 2005 and 2014. In line with the national priority, PhD production in this area increased from 18 per cent of all PhDs in 2005 to 22 per cent in 2014. Over the same period there was significant growth in the

number of PhD graduates in business, economic and management studies, law, education, computer and information studies. This indicates a shift towards applied subjects aimed at the labour market, employability and entrepreneurship. There was however a decrease in the proportion of PhD graduates in health sciences which is a concern considering the health challenges experienced in the country. Engineering, which is considered to be the vehicle for economic and technological transformation (NPC, 2011) showed steady growth in the numbers of PhD graduates, in line with the overall expansion. Table 3 shows the increases in PhD production in the different subject areas.

A number of institutional discrepancies were identified. There was a greater emphasis on the natural and physical sciences at historically advantaged universities, such as University of Pretoria and University of KwaZulu-Natal. On the other hand, UNISA, as a distance education institution, produced about 50 per cent of its PhDs in education, theology, health and psychology. It was also notable that PhD production capacity was increasing in some of the historically black universities such as University of Western Cape where the number of PhDs in the sciences rose from 12 in 2005 to 39 in 2014.

Table 3: Number of PhD graduates by CESM, 2005 and 2014

CESM	2005	% of total 2005	2014	% of total 2014	Increase in graduates (%)
13: Life sciences and physical sciences	211	18	505	22	139
09: Health professions and related clinical sciences	175	15	244	11	39
07: Education	114	10	229	10	100
04: Business, economics and management studies	65	5	193	9	197
20: Social sciences	91	8	166	7	82
08: Engineering	79	7	154	7	95
17: Philosophy, religion and theology	108	9	133	6	23
11: Languages, linguistics and literature	70	6	111	5	58
18: Psychology	68	6	105	5	55
01: Agriculture, agricultural operation related sciences	51	4	79	3	55
19: Public management and services	48	4	71	3	48
12: Law	24	2	70	3	192
15: Mathematics and statistics	28	2	67	3	139
06: Computer and information sciences	9	1	55	2	511
03: Visual and performing arts	18	2	32	1	79
02: Architecture and the built environment	4	0	22	1	438
05: Communication, journalism and related studies	6	1	19	1	217
Total	1,189		2,258		90

Source: Higher Education Management Information System (HEMIS 2014)

3.4 Quality assurance provisions and practices in PhD training

The higher education landscape in South Africa is not differentiated in terms of PhD programme offerings. Any approved higher education institution can thus offer PhDs in different fields. However, there are stringent national and institutional policies to ensure the quality of the PhD. The DHET determines the programme and qualification mix (PQM) at any institution as a quality control mechanism. It thus places limits on the range of doctoral programmes that institutions can offer. Nevertheless, merely being on the list of PQM cannot be taken as an indication of a subject's quality.

The CHE, through its Higher Education Quality Committee (HEQC), is responsible for quality assurance and quality promotion in higher education. Only programmes that are approved by the DHET, registered with the South African Qualification Authority (SAQA) and accredited by the CHE are funded by the DHET. According to the HEQC accreditation model, responsibility for doctoral programme quality rests on the institutions themselves. Universities are required to ensure that they conform to the standards stipulated by the Higher Education Qualification Sub-Framework (HEQSF) (CHE, 2013). This framework document stipulates the provisions for offering doctoral degrees.

At most universities, students are carefully selected, and need to prepare and defend a proposal before embarking on their doctoral research. Each institution and faculty has its own particular procedures for approving

the research focus of a thesis. Usually research may not be undertaken without prior written approval of an ethics committee or other authorised committee. In most institutions, the doctoral thesis is assessed by peers who should include at least one international examiner. At the University of Pretoria for example, the thesis is usually assessed by three examiners of whom at least two are external, with one preferably being an international scholar. Supervisors cannot be the examiners of the same thesis whose production they have supervised. Doctoral candidates are usually called upon for an oral defence (*viva voce*) of their theses. Usually the same examiners are appointed to assess the thesis and adjudicate its oral defence. The University of Pretoria also requires students to submit an article based on their doctoral research for publication in an accredited journal. To offset the rising trend of publishing in poor-quality journals catering for the 'publish or perish' syndrome, most South African universities (such as University of Pretoria), encourage their academic staff and PhD graduates to publish in accredited journals with a high impact factor. This is another strategy that enhances the scientific research outputs of the country.

However, there are a number of challenges concerning the quality of PhD training and research in South African universities. These include: poor preparation by students for doctoral studies; unrealistic expectations of doctoral students; the absence of mandatory course work in some programmes; a funding formula that encourages institutions to increase

PhD production; inadequate incentives for supervisors, the heavy burden of the supervision, and lack of supervisors in certain disciplines (Cloete et al., 2015; Teferra, 2015; Waghid, 2015; Thaver and Holtman, 2015). One of the main motivations for pursuing a PhD is the fact that it provides better possibilities of employment. Cloete et al. (2015) reported the results of three tracer studies which indicated that the vast majority of doctoral graduates who were not in employment during their studies managed to find employment quite quickly after graduation. However, completion rate of PhD studies was about 45 per cent for the 2007 cohort after six years, with vast discrepancies between institutions and disciplines. For example, UWC had a 60 per cent completion rate, while UNISA had a 25 per cent completion rate (Cloete et al., 2015).

Time to completion is also considered a measure of quality in PhD training. According to Cloete et al. (2015), the average time for completion of a PhD in South Africa is close to five years which compares favourably with international benchmarks. Currently, there is pressure on universities, which is linked to funding, to ensure a three-year completion time for PhDs. This may have a negative effect on the quality of the degree. Brenda Wingfield (2011) from the Faculty of Natural and Agricultural Sciences (NAS) at the University of Pretoria argues that this pressure increases dropout and has an impact on quality since even 'a strong student could require additional time to complete a valuable piece of research'.

4. National research agenda

The national research agenda of South Africa is anchored on three main strategies, namely: (i) transforming academia to retain more black academics; (ii) developing capacity and expanding PhD training and (iii) developing a viable pipeline for postgraduate studies. Internationalisation is also a major national agenda as will be discussed in section 9 of this report.

4.1 Transforming academia

The transformation agenda has become a national priority manifested in a number of policy documents produced by the Departments of Labour, Higher Education, and Science and Technology. Universities, especially previously white institutions, are actively pursuing a transformation agenda to address issues of privilege, exclusion, racism and prejudice.⁴ While there is a definite increase in the number of black and female doctoral graduates, data indicates a very slow change in the number of black South Africans obtaining PhDs (35 per cent growth over the ten-year period from 2005 to 2014). There is also slow transformation in terms of the demographic profile of the professoriate in many previously advantaged universities. It is evident that meeting the equity targets depends on the recruitment of international students from the rest of Africa. Black South African students struggle to secure sufficient funds to support their studies and are in many cases attracted to lucrative positions that do not require PhDs. This raises doubts whether transformation in terms of equity and diversity can be achieved in the short term.

While the equity target of the NRF's scholarship programme is 80 per cent black and 60 per cent female, there are not enough black South African candidates to take up these opportunities. In 2014–15, 59 per cent of the funds went to female doctoral students and 61 per cent were awarded to black students (NRF, 2015: 63). This finding was corroborated by one interviewee who argued that he had funds available for sponsoring students but he could not find full-time black South African students to sponsor. Given that the scholarships are designated for black and female students, they cannot be transferred to other student categories without the approval of the NRF. This allocation of the scholarships is strictly adhered to in order to put pressure on institutions to put more effort into enrolling more black students. It is also hoped that beneficiaries of these scholarships would complete their studies and add to the much-needed pool of qualified black professionals and holders of higher degrees. Furthermore, while redress policies at national and institutional levels have improved access for blacks and women, black academics tend to find themselves marginalised by many institutional environments and cultures, and by the hegemony in the centres of administrative and academic power (committees, disciplines, departments and faculties) of white academics and administrators (HRDC, 2015). Student demonstrations and movements such as 'Rhodes must fall'⁵ and 'fees must fall' have placed additional demands on universities to transform not only quantitatively but also qualitatively by looking at curricular and cultural transformations. This includes the change in language policies at previously Afrikaans-speaking universities.

4.2 Building supervisory capacity

In order to produce more doctoral students to achieve the national target, more PhD supervisors are needed. In 2014, only 43 per cent of academics in South African universities had a PhD. This does, however, represent a substantial increase since 2005, when only 30 per cent had doctoral degrees. It further indicates the responsiveness of the universities to this national priority. Nevertheless, about one-fifth of academics in South African universities are due to retire in less than a decade, including nearly half of the professoriate. This presents a serious challenge to the PhD capacities of South African universities. In response, the NDP (NPC, 2011) has set a target requiring that 75 per cent of permanent academic staff should have a doctoral degree by 2030.

There are vast discrepancies between institutions, especially related to institutional histories (see Table 4). There are four main factors which inform the state and capacity of institutions to deliver PhDs: whether the institution was advantaged or disadvantaged under apartheid, which was closely related to the racial group for which it was established; whether the institution was merged or not post 2004; if so, with what type of institution it was merged; and whether it was originally established as a traditional university or a technikon (Breier and Herman, 2017). For instance while at the University of Pretoria (UP) only 33 per cent of academics do not have PhDs, this figure rises to 84 per cent at the University of Limpopo (UL). Such differences can be best explained by these historical contexts. Table 4 presents the PhD staff capacities in the sampled universities between 2005 and 2014.

4. Proposed transformation priorities for the revised University of Pretoria, 2025.

5. 'Rhodes must fall' is a protest movement that began on 9 March 2015, directed against institutional racism at the University of Cape Town (UCT), where there was a statue commemorating Cecil Rhodes. Similar protests erupted across South Africa.

While developing the next generation of academics, which must be increasingly constituted by black South Africans and women, has become a national priority, academia is not a particularly attractive career option compared with other professions (HRDC, 2015). This is due to, among other factors, the relatively low salaries, expanding student numbers and consequent workloads and institutional culture issues (HESA, 2011).

4.3 Developing the pipeline

Government policy aims to improve undergraduate throughput rates in order to ensure a viable pipeline for postgraduate studies (DHET, 2013). The ASSAf (2010) Report identified a number of constraints associated with the pipeline of doctoral students, such as the high drop-out rates (about 50 per cent) among first-year students and subsequent low graduation rates, especially among black students. This relates to the poor level of

matriculants produced by the school system. Furthermore, the honours degree (the optional fourth year of an undergraduate degree) can often become a bottleneck which leads to low enrolment at master's level. A number of initiatives, such as the NRF's Human Capacity Development Excellence Pipeline, and the DST/NRF Professional Development Programme (PDP) (NRF, 2016b), support students throughout their university years to develop the pipeline for postgraduate studies.

Table 4: Permanent academic staff without PhDs in the sampled universities, 2005 and 2014

Institution	2005			2014		
	Staff without doctorates	Total instruction/research staff	% staff without doctorates	Staff without doctorates	Total instruction/research staff	% staff without doctorates
University of Pretoria (UP)	898	1,575	57	452	1,176	38
University of Western Cape (UWC)	266	465	57	283	615	46
University of KwaZulu-Natal (UKZN)	969	1,448	67	678	1,348	50
University of South Africa (UNISA)	827	1,308	63	1,028	1,718	60
Tshwane University of Technology (TUT)	779	880	89	734	951	77
University of Limpopo (UL)	686	804	85	787	941	84

Source: Higher Education Management Information System (HEMIS, 2014)

5. Linking institutional research priorities, PhD programmes and the national agenda

Most universities in South Africa align their strategic plans and visions to the major national policy documents such as the NDP, the *White Paper for Post-School Education and Training in South Africa* and the DHET's (2014b) enrolment planning. At the same time, through the various funding mechanisms, the government influences and steers the institutions towards these national goals. However, there is recognition that this alignment depends on the availability of expertise and capacity, as well as recognition of the autonomy of individual researchers who pursue their own agenda, choose their own collaborators, and determine how they wish to contribute to knowledge production. The data indicates that increasing research capacity in niche areas is one of the top priorities for most universities. Transformation, achieving equity targets and internationalisation also define the vision and practices in some institutions. These goals are discussed below.

5.1 Increasing research capacity

Following the national target, a significant component of universities' strategic plans is the priority of increasing postgraduate student numbers and enhancing supervisory capacity. Most universities have enabling policies, a dedicated research office and an institutional research plan or strategy which facilitate and strengthen research capacity building and postgraduate studies. Some universities may also have a school or centre for postgraduate studies for the same purposes. UNISA, for example, has established the College of Graduate Studies which is responsible for the facilitation of research training for postgraduate students.

In recent years nearly all South African universities encourage, and even pressurise, academic staff to obtain a PhD degree. Those who do not have a PhD are often expected to complete their PhDs within agreed timeframes. A PhD is in many cases part of academics' performance assessment/agreement and also a condition of employment for new academic staff. In line with this, ample support in the form of funds, which are mostly accessed from the NRF, time off, teaching replacements and skills enhancement is available for the PhD candidates.

Increasing PhD production is a challenge for previously disadvantaged universities and for universities of technology which are mainly undergraduate institutions with very low research and supervisory capacities. Historically, *technikons* (colleges of advanced technical education) were not allowed to offer degrees until the late 1990s. As such, when their status changed to that of a university after the mergers in 2004, the majority of staff did not have PhDs and thus could not supervise PhD students. Subsequently, their main challenge was to upgrade staff qualifications to doctoral level and to recruit staff with doctoral degrees. At TUT, for example, staff were given seven years to complete their PhDs. This was supported by NRF funds which enabled academics to find replacement lecturers or take a sabbatical.

The same challenge applies to previously disadvantaged universities such as the University of Limpopo (UL). As a predominantly teaching-focused university, UL is significantly lagging behind the national standard in terms of doctoral students' enrolments, PhD graduation rates and research output.

In 2014, UL produced only 25 PhDs, one per cent of the national production. This relates to lack of capacity as only 16 per cent of their academic staff possess a PhD. Furthermore, the burden of teaching the large undergraduate classes limits the time available for research. Subsequently, the university cannot accommodate many applications for postgraduate studies. The completion time is also not in line with DHET's expectations. The university chose the route of 'growing your own timber' and focuses on strengthening undergraduate study significantly in order to provide the pipeline for postgraduate studies at the institution.

Singh (2015) points out the various challenges related to building research capacity at a previously disadvantaged university such as UL. These include the 'poaching' of experienced researchers by other established higher education institutions, limited funding and English as a second language for the majority of students and academics. In order to counteract the low publication rate, UL increased the incentives for researchers who publish in accredited journals to 40 per cent of the funding received from the DHET. In 2011, this had a monetary value of R40,000 (which in 2011 was equal to over \$3,800) that the researchers could cash in or use as a research fund.⁶ Furthermore, cash incentives are given to supervisors of completed research master's and doctoral studies and to rated researchers. UNISA follows a similar route which may partially explain the increased number of PhD graduates in the last decade. However, the impact of these incentives on the quality of the doctorate has not been explored and is an area for future research.

6. UL 2010 Incentives and Awards Programme and Procedure document.

5.2 Institutional research priorities

Research and innovation capacity are often enhanced through targeted niche areas. Universities strategically select niche areas that are relevant to national and regional needs, priorities and opportunities, depending on their capacity to work in these areas and their own institutional interests. This applies to universities with low research capacity, emergent research institutions and even to research-intensive institutions. Subsequently, research priorities at each institution are closely aligned to the national priorities as outlined in the Research and Development Strategy, the DST Ten-year Innovation Plan and the NDP. There is also an alignment with regional policies, such as the SADC agenda, the African Union (AU) agenda, and with the global agenda as expressed in the SDGs.

All these agendas basically aim to make research nationally and internationally relevant, focusing on social issues such as alleviating poverty, providing education and employment, as well as issues related to water, climate change, and food and energy security among others. As one of the interviewees explained:

'We will meet those international goals but we need to look at first our locality, the teaching that we are doing, the research that we are doing, how does it contribute to our society, in turn it will be addressing the [international goals] because it will be linking issues relating to poverty ... and issues relating to provision of food, water, energy and all those things. So I don't think it's ideal to focus on them as if they are the ultimate, if you are dealing with issues at local level, I think that is how it will contribute to the international recognised development goals.'

Furthermore, universities also address the research and development needs of the regions or provinces in which they are situated. For example, the Council for Scientific and Industrial Research (CSIR) has established a centre at the UL that looks at climate change to address water scarcity and lack of quality water in the province. Universities with low capacity for research and supervision have to be selective and choose the research areas in which they have some capacity, but also have to align these with national priorities in order to be funded through the South African Research Chairs Initiative (SARChI). However, there is a view that churning out the number of graduates to comply with the enrolment plans is the first priority for institutions with low or emergent capacities and less attention is given to national research priorities.

5.3 National and institutional funding for research

There is a national funding mechanism in place that incentivises universities to increase their research output in support of the national research agenda.

Government funding of research at universities takes place through 'block grants', which include the *research output grants* (New Funding Framework [NFF], DoE, 2004). These funds are allocated according to the number of research master's degrees, doctoral degrees and accredited research publications that an institution produces each year (weighted 1:3:1). The *research output grants* encourage institutions to improve their share of research outputs and also their doctoral graduation rates which carry the greatest weight. The measurement of research output is done centrally and is controlled by the DHET (DoE, 2003). This subsidy framework for postgraduate research has a significant impact on the production of PhDs. Some universities like UL and UNISA directly give incentives to supervisors (as highlighted above) to encourage their productivity.

Institutions themselves adopt several funding or incentive strategies to enhance their academics' research capacity, including upgrading their qualifications to PhD level. South African universities tend to offer bursaries or scholarships from their

own institutional funds (first- and second-stream income) for doctoral studies on the basis of merit or on the basis of student need, with the value of these bursaries varying substantially between institutions. These bursaries are usually awarded for a period of three years (SARUA, 2012). Universities also fund PhD research indirectly by fee waivers and offering accommodation, as well as by providing temporary employment for candidates as junior lecturers or laboratory assistants.

UNISA is a good example of the range of funding opportunities provided for academics to enhance their research capacity. These include paying for replacements to allow academics to attend various workshops and fellowships. It allows academics to spend several months visiting an institution identified as having research relevant to UNISA's aims. There is also support for academic staff who pursue their postgraduate studies at other institutions in addition to financial incentives for completing a PhD. Similarly, the University of Pretoria has the Research Development Programme (RDP) which supports academics without a PhD to take time off to complete their studies and the university pays for their teaching replacement. Further in-house development programmes such as writing for publication workshops are also provided to build research capacity.

Bursaries and scholarships for doctoral education are also awarded by South African universities from earmarked third-stream funds. These funds usually originate from donations, investments and entrepreneurial activities of the universities. It is usually the historically advantaged universities that have the finances to offer these types of bursaries. The size and conditions of these bursaries vary considerably. Most funding received from corporates or state-owned companies is meant for engineering, health, finance and education students (HRDC, 2013), thus channelling the funds to national priority areas. The main strategy that universities employ for attracting more funds is by responding to calls for grants. However, these calls can be restrictive or have co-funding expectations that some institutions are not able to meet. Universities with a strong research focus such as UKZN, UWC and UP are able to attract a higher percentage of private funds, while other institutions may have limited third-stream income.

Section 8 discusses further funding issues related specifically to the cost of participating in PhD programmes, as well as funding opportunities for 'new' entrants not already employed at the universities.

6. National-level systems that enable and facilitate institutions to work to the national agenda and meet the national goals

The main players in higher education in South Africa have developed various initiatives to enable institutions to meet the national agenda. The NRF's Thuthuka⁷ Programme, initiated in 2001, aims to promote the attainment of PhD qualifications, as well as the development of the research capacity of early career academics employed at South African universities. In order to address past inequalities, 80 per cent of all funded grant holders on the PhD track have to be black; and up to 60 per cent female.⁸ During the 2014–15 reporting period a total of 662 students benefited from this funding. Of the recipients, 59 per cent were female and 69 per cent were black, a shortfall of 11 per cent on its equity target (NRF, 2015).

The DST's 'Improve Academic Qualifications of Academic Staff and Researchers' initiative aims at accelerating the doctoral level training of full-time academic staff, including supervisory capacity at public universities and research institutions. It aims to transform the demographic composition of the emerging community of researchers with respect to gender, race and disability. Through this programme academic staff may take sabbatical leave of between six and 12 months in order to complete their doctorates. The programme is only open to South African citizens (NRF, 2014a). This programme was allocated R10 million (\$700,000) for the 2014–15 financial year.

The Department of Higher Education (DHET) has initiated the 'Staffing South Africa's Universities' (SSAUF) programme aimed at transforming the demographics of South African universities. The New Generation Academics Programme (nGAP) was implemented at the end of 2015, and universities submitted 500 applications for nGAP posts to be implemented during the 2015–16⁹

financial year. The nGAP programme recruits new academics who comply with the equity target and priority research areas. However, this has resulted in some institutions with low research capacity, such as UL, losing academics to research-intensive institutions. This has a negative impact on their teaching capacity at undergraduate level which is their core function. From an interview with DVC research at one of the sampled universities, another criticism levelled on the nGAP programme is that it is over optimistic. It questions the level of the requirements that are accepted and overlooks junior lecturers already in the system, who earn less than nGAP academics whose commitment to teaching might be unknown.

In order to address the national research agenda, the NRF introduced three initiatives that have significantly increased research capacity in the country. These are the Centres of Excellence (CoEs), SARCHI, and the National Facilities (NFs). The CoEs, initiated in 2004, focus on promoting collaborative and interdisciplinary research with the aim of enhancing research and knowledge production, as well as capacity development on a long-term basis (NRF, 2016a). SARCHI aims to attract and retain excellence in research and innovation at South African public universities through the establishment of research chairs at these institutions with a long-term investment trajectory of up to 15 years. Evidence shows that research chair holders supervise approximately twice as many PhD students and three times more postdocs than any other grant holders (NRF, 2011). This seems to be an effective way of addressing the need to develop research capacity and the next generation of academics.

The NFs provide a large equipment base and a unique set of critical skills to the broader research community. Between 2005 and 2010, the NFs supervised 938 postgraduate students, published 927 articles in peer-reviewed journals and engaged in 1,056 international collaborations (NRF, 2011). The NRF Annual Report for 2014–15 indicates that there are 150 active chairs, 15 CoEs and seven NFs. These initiatives have helped to increase the number of scientific research outputs of researchers and PhD graduates. Through these initiatives 245 master's and 228 doctoral students were supported between 2010–11 and 2014–15. Of the master's students, 62 per cent were black and 44 per cent female, while of the doctoral students 61 per cent were black and 52 per cent female (NRF, 2015). The NRF Strategic Plan 2015 to 2020 proposes the creation and support of more research chairs, CoEs and NFs. The investments as highlighted above demonstrate the seriousness with which the South African government takes the role of research development and the need to replenish the next generation of academics.

Other science councils such as the Medical Research Council (MRC) and the Agricultural Research Council (ARC) have instituted similar initiatives to support research capacity development in their respective areas. These initiatives and funded facilities seem to have had a positive impact on the qualifications of academics which, as has been indicated before, showed a national increase of 13 per cent between 2005 and 2014.

7. *Thuthuka* is a Zulu verb, meaning 'to develop'.

8. www.nrf.ac.za/division/funding/thuthuka-2017

9. DST-NRF Research Development Grants for 'New Generation of Academics Programme (nGAP)Scholars', NRF March 2016.

7. Relationship between institutional priorities, research and development systems and the needs of local industry and society

South Africa is a middle-income country and is one of the most resource-rich economies in Sub-Saharan Africa. The leading industrial commodities are uranium, palladium, diamonds, coal and platinum. The South African economy is still very much a low-skill, mineral extraction, export-dominated model (Cloete et al., 2015). The DST's Ten-year Innovation Plan (TYIP) and the NDP (NPC, 2011) place significant emphasis on increasing levels of research and development. In 2013, South Africa's total (public and private sector) gross domestic expenditure on research and development (GERD) had declined from 0.89 per cent in 2008 to approximately 0.73 per cent (government 43.1 per cent of total percentage)¹⁰ of GDP. This decline was due mainly to a drop in private sector funding that could not be offset by a concomitant rise in public spending on research and development. By comparison, the average OECD country expenditure is 2.15 per cent of GDP. Finland, for example, with an economy the same size as South Africa, spends 3.5 per cent (government one per cent) of its GDP on research. South Africa also lags behind most of its BRICS counterparts. China spent 1.84 per cent of GDP on research and development, Brazil 1.16 per cent, and Russia 1.09 per cent during the same period. India spent 0.76 per cent of GDP on research and development in 2008, the latest year for which figures are available. The Square Kilometre Array (SKA) initiative that was awarded to South Africa and its partners is expected to boost research and development in South Africa, particularly in astronomy, engineering, ICT and mathematics.

There are numerous collaborations between industry and universities, especially research-intensive institutions. The firms that co-operate with universities spend significant amounts of funds on in-house research and development to intensify their knowledge capacity. The South Africa Synthetic Oil Liquid (SASOL) is one such firm as the bulk of its research and development is carried out locally. Consequently, SASOL is supporting both research that aligns with its own strategic agenda and research that addresses both national and global imperatives such as the SDGs. SASOL has traditionally engaged with research-intensive universities which were formerly advantaged institutions. However, in order to respond to the national imperative of equity and redress, a more recent initiative aims to identify centres of excellence in historically disadvantaged universities.¹¹ The collaboration between the universities and SASOL is done at various levels, from institutional to individual levels, depending on the intellectual property (IP) level of the studies.

Research has demonstrated that while many industries provide financial support for PhDs as a social good, the knowledge at PhD level is regarded variously as 'desirable', 'a luxury' or 'superfluous', with industry in general preferring lower-grade skills. It is suggested that the low level of interest in doctoral education may relate, among other factors, to the 'brain drain' of graduates as many of them seek employment outside South Africa, to the nature of the economy in the country, as well as to the overall low commitment to research and development in South Africa (Herman,

2013). One of the interviewees from the sampled universities supported this argument:

'I think that if you look at societal challenges, I don't think they would require a doctoral student, they require a relevantly trained practitioner. So if you are looking at issues relating to delivery of energy, delivery of water, I don't think the problems that people are looking for are blue sky, they just want clean, running water. And clean running water can be provided by somebody who has been properly trained with a diploma to be able to put together infrastructure, to provide water to society, and also somebody well trained in order to maintain that particular infrastructure. In terms of doctoral students, I think what it will do is increase our profile internationally as an academic institution, but industry is not looking for doctors.'

The HRDC (2015) highlights the need to establish industry-related doctoral programmes which will provide employment support for current postgraduate students in an organisation while allowing the students to complete their PhD degree. It also recommends nurturing innovation and commercialisation in research through the development of a host of 'incubator' environments supported by industry and HE, where students can try the development of new business ventures in a low-risk climate, thus supporting the national agenda to encourage the growth of the small, micro and medium enterprise (SMME) sector.

There are three main agencies that aim to promote industry-higher education partnerships, namely, the Technology

10. Statistical Report 2013/14, South African National Survey of Research and Experimental Development. www.dst.gov.za/index.php/resource-center/rad-reports

11. Interview with company representative, SASOL 15 July 2016.

and Human Resources for Industry Programme (THRIP), the National Advisory Council on Innovation (NACI) and the Technology Innovation Agency (TIA). The THRIP is funded by the Department of Trade and Industry (DTI). Its main role is the training and production of Science, Engineering and Technology (SET) graduates and to facilitate the three-way partnership between industry, academia and the government. Through THRIP, the DTI offers incentives to industry and academia to collaborate in finding technology solutions and to develop high-level skills in national priorities. While it is a successful programme, it experienced a decrease in the number of participating students between 2006 and 2013. Also, while it has a high proportion of black and female students, these numbers still do not mirror the population demographics of the country.¹² It has also been viewed that THRIP funding tends to be concentrated on large historically advantaged universities with strong SET capability (HESA, 2012). As a consequence, the THRIP strategic plan 2014–15 to 2019–20 sets out to address these issues and to increase participation by historically black universities by targeting individuals and

institutions that have not succeeded in accessing the programme. On average, THRIP supports about 1,000 researchers per annum.

The TIA is a statutory agency under the DST that aims to support the development and commercialisation of competitive technology-based services and products. Its role is to encourage partnerships between SMMEs, industries, universities and science councils to develop an enabling environment that supports sector-specific innovations for global competitiveness and to provide funding for such innovations. It invests in the following technology sectors: advanced manufacturing, agriculture, industrial biotechnology, mining, energy and ICT. The NACI is a government advisory body on science, technology and innovation (NACI, 2016). NACI has identified the water–energy–food security nexus as a focus that responds to the NDP, since water is essential for producing agricultural goods and hydropower, and energy is required to produce and distribute water and food.

The Intellectual Property Rights (IPR) from the Publicly Financed Research and Development Act 51 of 2008 provides regulations for the use of

IP emanating from publicly financed research and development through the National Intellectual Property Management Office (NIPMO), the IP Fund, and Offices of Technology Transfer (OTTs) at selected institutions that were established to support the Triple Helix relationships in South Africa.

There is an identified need to ensure alignment between the various national government departments, professional bodies, industry, quality councils and post-school institutions. It is suggested that lack of collaboration between industry, government and universities results in ad hoc donations and grants that are less effective in advancing the national research priorities. Another challenge has been identified by the universities of technology. While traditionally, as previous technikons, they had a close link with industry, the academic drift with the shift towards attaining the status of university has had a negative impact on these relations. For example, at TUT it is mainly the engineering department and its links with the Engineering Council of South Africa (ECSA) that ensures responsiveness to industry.

12. THRIP Strategic Plan 2014–15 to 2019–20 – Enhanced industry competitiveness and broadened collaborations generating skills and technologies.

8. Funding sources to support and sustain PhD training

The NRF, as the main individual provider of postgraduate bursaries, offers a range of bursaries and scholarships for doctoral education in South Africa (SARUA, 2012). It offers so-called free-standing PhD bursaries on merit for any applicant, provided that the applicant has already been accepted by a South African university for doctoral study. The amount allocated for these bursaries by the NRF in 2017 is R70,000 per annum (about \$5,000) for a period of three years. In cases where grant holders are linked to the Scarce Skills Development Fund (SSDF) and the DST research priorities, the bursaries have a monetary value of R120,000 per annum (\$8,750). Both these amounts are inadequate for students who have to support themselves and a family. Only a small proportion of this financial aid is awarded to students with disabilities. Given our previous observations about the high percentage of international students in the doctoral student body, it is interesting to note that these bursaries and scholarships

are mostly awarded to South African citizens with only a small percentage being allocated to non-South African students. In 2015, there were about 2,000 free-standing NRF bursaries for PhD studies. The NRF also provides funds to support PhD training and research capacity, especially in areas of production that are aligned with the national priorities through other programmes. These include the Thuthuka Research Grant, the NRF incentive fund for rated researchers; and the Knowledge, Interchange and Collaboration (KIC) initiative that supports researchers to attend local and international conferences. Funding is also provided by the other science councils such as the Medical Research Council (MRC), the Agricultural Research Council (ARC), the Human Sciences Research Council (HSRC) and the Council for Scientific and Industrial Research (CSIR). Another source of funding is by the DTI which funds activities focused on commercialisation of research.

Universities also receive funding from industry and international collaborators. The latter includes the Erasmus Mundus programme and Horizon 2020, both funded by the European Union. Some of these programmes have a specific focus. For example, the Gates Foundation focuses on malaria research, while others focus on capacity development training. There is an argument that international funds are restrictive and that universities will benefit more if they are given the flexibility to allocate them to support their specific priorities. At some universities, like UL and TUT, funds are needed to invest in the pipeline and support undergraduate studies, to develop mentorship programmes and mentorship for early career researchers, while other funds may be earmarked to address societal needs such as HIV/AIDS and poverty alleviation.

9. The role of international and national collaborations

9.1 Rationale for internationalisation

With South Africa's transition to democracy, the process of internationalisation in its various forms expanded significantly. This included a commitment to regional policies and targets within SADC and the African region (e.g. 2010–2011 to 2014–2015 Strategic Plan of the DHET). There is accordingly a strong emphasis on the need for regional collaboration and partnerships and the establishment of regional networks for academic and knowledge exchanges that support South Africa's national priorities. There are multiple initiatives aimed specifically at upgrading staff qualifications and providing support for doctoral students. A report compiled for the Association of Commonwealth Universities (Harle, 2013) suggests that while there are many collaborations and initiatives to support African students, these are dispersed and relatively fragmented. A comprehensive list of these initiatives and their analysis requires consolidation.

The national goal of internationalisation has a strong grounding in the universities' mission. Internationalisation plays an important role in raising both the international standing and ranking of an institution. For example, UKZN positions itself as a 'premier university of African Scholarship',¹³ UNISA envisions itself as being 'the African university in the service of humanity',¹⁴ and UP's vision is to become 'a leading research-intensive university in Africa'.¹⁵

9.2 Types of international collaboration in building PhD capacity

Universities promote internationalisation by exposing staff and students to global developments and trends, by facilitating mobility exchanges and encouraging collaborative ventures such as co-supervision of students, co-authorship of papers and joint applications for research grants. The NRF, on behalf of the DST, supports numerous inter-governmental agreements, programmes and strategic partnerships. These include bilateral and multilateral international agreements, agency-to-agency collaboration as well as special projects. The agreements and research activities target postgraduate students, especially PhDs, and an exchange of postdoctoral fellows within approved projects. For example the The German Academic Exchange Service (DAAD) in partnership with the National Research Foundation (NRF) is able to offer scholarships for postgraduate studies at South African universities via the NRF/DAAD Joint In-country Masters and Doctoral Scholarship (NRF 2018). The programme is co-funded by the German Federal Ministry of Economic Cooperation and Development (BMZ) and the National Research Foundation (NRF). The scholarship targets (i) young and rising candidates who aim to acquire master's and doctoral degrees, and (ii) future academic staff sector demands for academically trained personnel, and staff members studying towards a doctoral qualification. Staff members studying towards doctoral qualifications should be enrolled for full-time studies and be exempted from teaching.

According to the NRF Report of 2014–15, 52.4 per cent of Web of Science¹⁶ publications by South African authors are published jointly with international colleagues. This indicates the success of these partnerships and the positive impact they have on the South Africa NSI. Examples of recent partnerships and agreements include arrangements with DAAD; the Swedish Foundation for International Cooperation in Research and Higher Education (STINT), the Academy of Finland Partnership, the NRF/Newton Fund collaboration; the British Council; South Africa and South Korea Bilateral Relations; the China/South Africa Joint Research Programme; South Africa and the Joint Institute for Nuclear Research (JINR); and others. Institutions with low research capacity may find it difficult to forge international collaborations, as these are often directed at research-intensive institutions. In order to access international funds some universities like TUT have formed a consortium with other local universities to enable them to derive more impacts from their collaborations with international institutions.

Local and international agencies and funders have initiated a number of programmes to increase PhD production and research capacities in the previously disadvantaged institutions. Some examples include the pre-PhD project organised by the Programme Support for Pro-Poor Policy Development (PSPPD) and funded by the European Union (EU), which conducted workshops at UL. The other one is the VLIR-UOS Project at UL and UWC, which supports partnerships between universities in Flanders (Belgium) and the Global South looking for innovative responses to global and local challenges.

13. UKZN, Strategic Plan 2007–2016.

14. UNISA 2015 Strategic Plan.

15. University of Pretoria, Strategic Plan, The vision, mission and plan of the University for 2025.

16. Formerly ISI.

South African Universities also explore links with other foreign universities which offer opportunities for split-site doctoral studies. For example the French South African Technical Institute (F'SATI) has established a *cotutelle* doctoral programme with UWC. Similarly, UL and Stellenbosch University have entered into agreements with universities in Europe to offer joint or double doctoral degrees. There was also evidence of collaborations between South Africa's research-intensive universities and their counterparts with low research capacities based on funding support from various government agencies. For example, the University of Stellenbosch has developed training programmes for new supervisors and doctoral students which is supported by NRF funding. The programme has benefited several other institutions. However, there is a view that the allocation of funds based on institutional research outputs creates competition among institutions and stands in the way of collaboration. The following interviewee expressed a strong view that collaborations among higher education institutions in South Africa need to be enhanced through a different funding mechanism:

'[We need] to find a funding mechanism that forces collaboration between experienced institutions and those that are not experienced. But I know something like that has been done with DHET and there was a lot of window dressing that happened.'

9.3 Student inflow and outflow

Recruiting international postgraduate students, especially from the SADC region, became an explicit national priority expressed in key South African policy documents such as in the National Plan for Higher Education (DoE, 2001: 25) and the NDP 2030 vision (NPC, 2011). In 2014, 40 per cent of all doctoral graduates were international students. In 2005, there were 290 international graduates in South Africa compared with 914 international graduates in 2014, an increase of 215 per cent. During the same period South African graduates showed a growth of only 53 per cent, from 877 graduates in 2005 to 1,344 graduates in 2014. However, the sustainability of this growth is called into question by the protests of the recent past which have created uncertainty in the sector and could possibly lead to international students choosing study destinations other than South Africa.

There is very little information on the number of South African students pursuing their doctoral studies overseas. Data from 2007 indicate that the NRF provided funds for 49 PhD students to pursue their studies at international universities, mainly in the UK and the US, which are the two major destinations for South African students. A concern regarding this development is the possible consequences of brain drain on the PhD students being trained in the developed countries.

Data from the UK (2016–17) indicates that about 260 South African doctoral students were studying in higher education institutions in the UK. However, there was no indication of the number of students who intended to return to South Africa. The data showed that of these students, 85 were self-financing while 70 had fee waivers from their study institutions.¹⁷ Based on previous trends, many of these students are unlikely to return to South Africa unless there are incentives for them to do so. Graduation rates were, however, available from the US. In 2005, 52 South African doctoral students graduated from American universities. More than half of these intended staying on in the US (Hoffer, et al 2007: 96.). There is no parallel data for 2014 since South Africa was not included in the top 40 countries of origin.

17. Higher Education Statistics Agency (HESA) Student Record 2016–17.

10. Conclusion

This report has analysed the status of research and PhD training capacity in South Africa within the context of the terms of reference of the study. It has shown that South Africa has a clear national agenda for research and PhD training that informs strategies for development at both national and institutional levels. This national agenda is supported by various policy documents, special government initiatives and programmes that are supported with requisite resource allocation. There is also evidence of improvements in alignment of policies between different government departments, and a stronger sense of commitment to implementation. These developments also have impacts on the institutional policies of the universities. An example is the nGAP policy for increasing supervisory and research capacity (DHET, 2014b) which has a clear implementation plan and resource allocation and is currently implemented in universities across South Africa. The nGAP has the potential to create a pipeline for the PhD and to develop the next generation of academics. Another example of policy is the funding framework (NFF) which forces universities to produce more research.

The report also shows that PhD training in South Africa is driven by the pursuit of equity to redress apartheid inequalities in terms of race and gender. At the same time, some policies such as the NDP (NPC, 2011) emphasise economic development to enable South Africa to become a global player in the knowledge economy. The aspiration to simultaneously achieve economic growth and redress historical inequalities has raised many challenges and at times even necessitated a compromise between access and quality. Subsequently, although universities are looking outside for talent and skills, they have to give priority to local candidates when employing academics or funding doctoral students.

Through the various funding mechanisms the government is steering universities towards the national research priorities. In return, the universities are aligning their strategic plans and visions with major government policies. This also enables them to develop niche areas based on their capacities and expertise. The universities' response to government's steering mechanisms, while positive and responsive, raises the question of the extent to which steering affects academic autonomy of the universities. Should universities merely be responsive to the whims of government, or should they lead the research agenda?

It has also been evident that the universities are aligning their institutional agenda to regional policies, such as the SADC protocol, the African Union agenda, and with the global agenda such as the SDGs. All these agendas aim to make knowledge production and human resource development in these institutions nationally and internationally relevant. They call for increasing research capacity and skills and investing in doctoral education. South Africa plays a significant role in developing research in the region. Crucial knowledge and capacity focusing on social issues such as alleviating poverty, providing education and employment, as well as issues related to water, climate change, and food and energy security among others, are produced.

South African higher education is to a large extent an undergraduate system. This limits the doctoral pipeline. Despite this limitation, South Africa significantly increased its postgraduate output between 2005 and 2014. This has been attributed to several strategic plans and policy documents that support and fund PhD production. In this report we suggest that the national target of 5,000 graduates per annum in 2030 could be reached if the rate of increase in the period 2005 to 2014 is maintained. However, the aspiration

to have most of the doctorates produced by 2030 in science, technology, engineering and mathematics, which is deemed necessary in order to achieve the national priorities, may be more difficult to achieve.

There is a commendable change in students' demographic composition both in terms of gender and race. However, there is a slow change in the number of black South Africans obtaining PhDs which suggests that transformation in terms of equity and diversity will be difficult to achieve in the short term. Universities struggle to recruit black South African candidates into doctoral programmes. One of the reasons is that the available funds are inadequate to support full-time black students who have family responsibilities.

The need to increase supervisory capacity to support the doctoral graduation targets is a major challenge to some South African institutions. In this report we suggest that universities may struggle to achieve the government target of 75 per cent of permanent academic staff with a PhD by 2030, since many academics are due to retire in the next decade. Consequently, most institutions encourage, support and even pressurise academic staff to obtain a PhD degree. However, retaining good academic staff is another challenge for some universities, owing to the relatively low salaries, expanding student numbers and consequent workloads, as well as institutional culture issues. Furthermore, universities are currently working in volatile and uncertain contexts due to student protests demanding free education.

Knowledge production capacities are not evenly distributed in South African universities. Production of doctoral graduates is being skewed towards the historically advantaged universities. Nine such institutions, out of the total of 26, produced 79 per cent of all PhD

doctoral graduates in 2014, while the previously disadvantaged universities and universities of technology are mainly undergraduate institutions with very low research capacity. Universities with low capacity for research focus on teaching and find it challenging to develop the postgraduate pipeline and increasing supervisory capacity. Subsequently, they struggle to produce research and develop niche areas in line with the national priorities and to access the available funds.

There are stringent national and institutional policies to ensure the quality of PhD training in South Africa. These include the processes of selection of students, development of research proposals, ethical clearance for research, the supervision process and the examination of the thesis. However, multiple challenges are experienced, including unprepared students and inadequate supervisory capacity. As shown in the report, the pressure on universities to produce more PhDs in a shorter completion time may have a negative impact on quality. Currently, completion rate is below 50 per cent, while time to completion is five years.

There are a myriad of institutional, national and international initiatives to support the national priorities. The main players in higher education in South Africa, namely, the NRF, the DST and the DHET, have developed various initiatives to enable institutions to meet the national agenda. In particular, the Centres of Excellence (CoEs), the South African Research Chairs Initiative (SARChI), and the National Facilities (NFs) are well funded by the NRF/DST and have proven to be highly effective in addressing the need to develop research capacity and build the next generation of academics.

There is significant growth in collaborations between industry and universities, especially in research-intensive institutions. The firms that co-operate with universities spend significant amounts of funding on in-house research and development to intensify their knowledge capacity. However, it is observed that since the South African economy is still very much a low-skill, mineral extraction, export-dominated model with low commitment to research and development, a PhD is not always a priority. The academic drift of the universities of technology has negatively affected their traditional link with industry. Better collaboration between industry, government and universities is required, as well as the production of industry-based PhDs, linked to the national priorities. Furthermore, South African total (public and private sector) gross domestic expenditure on research and development (GERD) has declined from 0.89 per cent in 2008 to approximately 0.73 per cent (government 43.1 per cent of total percentage) of GDP. Increasing levels of research and development could result in increased research capacity.

The bulk of the research funding in most South African universities comes from government subsidies and development grants. This source of funding mainly benefits research-intensive institutions, while universities with low research productivity have unused development funds as there are no suitable candidates for these grants. The NRF is the main funder of PhD training and research, especially in areas aligned to national priorities. There are also international agencies such as the DAAD, the British Council and the EU that augment government funding to research and PhD training. Universities also receive some funding from industry, national and international

donors and through various collaborations. It is noted, however, that (i) the NRF bursaries and scholarships for doctoral education are inadequate for students, especially black students who have to support themselves and a family; (ii) most funds are allocated to South African students while international students find it hard to access funding; and (iii) funding from international collaborators is sometimes restrictive and may require a matching fund from the institutions which has a negative impact on the ability of universities with low research capacity to access these funds.

Internationalisation is recognised as having a strong impact on universities' missions and in raising both the international standing and ranking of institutions. South Africa is increasingly becoming a hub for doctoral education in Africa. The number of international doctoral students is increasing annually and currently accounts for 40 per cent of all doctoral students. Universities are actively pursuing international collaborations. The NRF supports numerous inter-governmental agreements, programmes and strategic partnerships. The increase in the number of collaborative publications in Web of Science accredited journals is evidence of the success of these partnerships and the positive impact they have on the South African NSI. International agencies and funders have initiated a number of programmes to increase capacity in the previously disadvantaged institutions and to train early-career researchers. These include joint or double doctoral degrees. At the same time collaboration between South African institutions to enhance research is limited, owing to competition between them and the absence of a funding mechanism that promotes such initiatives.

11. Recommendations

The above discussion offers several insights into the state of research and PhD training capacity in South Africa, from which important lessons can be learned, forming the basis for the following recommendations:

As South Africa provides a good example of policy alignment between its national research agenda, adopted policies, and institutional policies and practices, it is recommended that future policies on doctoral education and research capacity building should continue to demonstrate commitment through alignment with other policies and allocation of adequate funds to support the processes.

While the building of capacity for research and doctoral education across all institutional types is pursued, South Africa needs to review and consider whether all institutions should be research intensive or whether a differentiated higher education landscape would be better. Universities, especially those with emerging or low capacity for research, could benefit from funds and expertise to develop niche areas.

Universities with low research and PhD production capacities need urgent intervention to enhance their capacity in the short term to allow them to develop their own research and supervisory talent.

This could involve bringing experienced academics and researchers to the institutions for some period of time, such as sabbaticals, to work with current supervisors and to develop research proposals. This could include retired academics from international and national institutions.

Despite the strides South Africa is making in investing in research and development and research capacity development, it is still spending less on research and development relative to other countries at the same level of development. Increasing research and development expenditure to one per cent of GDP would help to increase competitiveness of research outputs.

Initiatives for increasing supervisory capacity should focus more on targeted areas that respond to the national priorities such as the science, engineering and technology fields.

In order to increase PhD outputs, a funding model that sufficiently supports the varied needs of local students needs to be put in place. This could redress the growing drop-outs and lead to better completion rates.

Stronger and more productive collaboration between universities, government and industry is required. This could be addressed by development of industry-based PhDs and increased innovation

and commercialisation of research outcomes to meet the needs of industry.

National collaboration among higher education institutions in South Africa needs to be enhanced through different academic activities and funding mechanisms.

The unique strengths, expertise and needs of universities should be considered when donor partnerships are developed. Donor funding needs to align itself with the unique needs of each university.

Given the role played by South Africa as a regional hub for training doctoral students, one could recommend its replication in other parts of the continent with a view to developing research and postgraduate training capacity in those regions.

Based on the South African experience we suggest that in order to improve PhD production in Africa, funds and human resources should be allocated to create Centres of Excellence and Research Chairs. These could help develop PhDs and research capacities for institutions in other parts of Africa where capacities could be inadequate.

The South African processes for ensuring quality and ethical research could be used as a model by other institutions in Africa, in order to produce PhDs that have practical and scholarly value.

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