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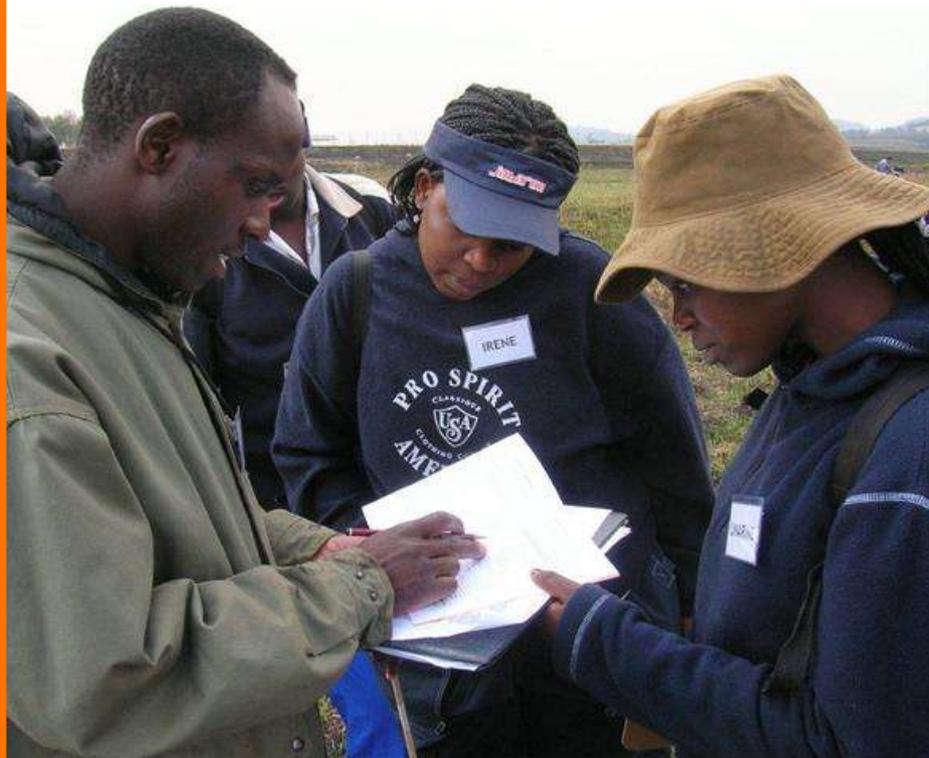
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Higher Education and the Environmental Sector in South Africa:

Quality and Relevance of Provisioning



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November 2009

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1. Executive Summary

This report was prepared as part of a series of reviews of issues of quality in educational provision in the environmental sector. These studies have been commissioned by the Rhodes University Environmental Education and Sustainability Unit in partnership with the Department of Environment Affairs, to inform human capital development strategies currently being planned in the sector.

The report is based on a review of a small selection of literature as well as interviews conducted in 10 universities (including universities of technology) across the country, with academic staff in science faculties that offer environment-related research and teaching programmes, and with student counsellors.

Issues of quality in educational provision are difficult to probe directly. Here they have been linked to the relevance of the content and effectiveness of delivery, which can be deduced, if only directly and partially, from enrolment rates in individual courses, from the success rate of students, and through our judgement as higher education professionals of interviewees' perspectives on their intended learning outcomes and the teaching methods they employ. In the context of human capital development in South Africa, issues of quality can also not be divorced from patterns, size and racial distribution of enrolment and graduation at different levels in the system.

This report responds broadly to three key questions in the context of human capital development for the environmental sector:

1. Do sufficient numbers of people, from all population groups, have the opportunity to participate in HE programmes relevant to the environmental sector? (Access)
2. Do they successfully complete their studies? (A question of efficiency)
3. Do they upon graduation have the required skills and knowledge? (A question of relevance and effectiveness).

Wider Access and Participation

Trends

The number of South Africans enrolled in higher education has increased. However, the overall rate of participation remains at just below 16%, so the general increase reflects the population increase rather than an increasing proportion of the population involved in HE. The national target is 20%. Thus, although there are indications that the system is operating at or near its current capacity (CHE, 2009), there is still pressure to increase numbers. Two population groups - Black African and Coloured South Africans - are still under-represented in higher education, although there is an overall increase in the numbers and proportion of Black South Africans in higher education.

More Black South Africans are enrolled in Universities of Technology and in Certificate and Diploma level courses, and smaller percentages in first degree and Honours programmes. The percentage of Black South Africans in Masters and PhD programmes is disproportionately low, and there is a reported over-supply of Black B.Sc. graduates without a Masters degree relevant to the environmental sector, who cannot find employment.

In line with national priorities there has been a general increase in enrolments in Science, Engineering and Technology (SET) related fields. Most higher education institutions (HEIs) offer environment-related courses and many have custom-made programmes at various levels, from short courses to post-graduate programmes, to respond to identified needs in the sector. However, while numbers of undergraduates in environmental courses are high in some HEIs, where units operate at maximum capacity, others have lower intakes and spare capacity. Intake at Honours and Masters level is often restricted to those with the best marks and access to funding. This tends to exclude most South African Black students.

Factors relevant to Access and Participation

- ✘ School leavers' marks, and subjects taken: These are in turn influenced by the schools attended and the choices of subjects and quality of teaching available at those schools, and proficiency in the language of instruction.
- ✘ The cost of HE in relation to the income of most families, and the opportunity cost in pursuing full-time post-graduate studies, even with financial aid.
- ✘ Availability of bursaries and scholarships: There are several funding sources for students in environment-related fields, but interviewees believe they are too few, and that other fields with greater access to bursaries, draw students away from most environmental study fields.
- ✘ Knowledge of the field: Contrary to popular perception, Black South Africans do enter environmental study fields, although these fields are often not well known, and sometimes a second or third choice. Some study areas, like Ichthyology, seem better known elsewhere in Africa than in South Africa.
- ✘ The availability of jobs and the extent to which a particular programme is regarded to be vocational, influences the number of applications. Cosser (2009) reports that school leavers are reluctant to study in fields that lack a strong possibility of employment. Currently school leavers are being advised (in the PACE Career guidance resource used in government schools) that there is a decline in public sector careers in conservation.
- ✘ Reputations of institutions: Some HEIs enjoy good reputations in the environmental sector and are over-subscribed; others are a second or third choice and the destination of those with poorer marks, who are more likely to fare poorly and not find employment. This may lead to a vicious cycle in which HEIs with poor reputations continue to produce poorer results and struggle to fill courses.
- ✘ Infrastructure of HEIs: While facilities such as residences and laboratories were not noted in this study, the prohibitive cost of some equipment on research and post-graduate training (such as soil sciences) was mentioned.

- ✘ Staff limitations is a significant constraint on the growth of departments or divisions in a number of respects: Suitably qualified staff (with Masters and PhDs) who can supervise research; staff who can teach on relevant programmes (with new orientations and topics) in keeping with a progressive vision; and Black African staff to act as role models.

Success Rate – Graduations and Through-Put

Trends

While the number of university passes in matric have increased significantly in the past 15 years, particularly among Black school leavers, and the absolute number of people enrolled in higher education has increased, throughput rates are poor compared to other developing countries, and extremely poor compared to developed countries. Throughput rates do vary a lot between programmes, however. In some instances more than 50% of students who enrol for a programme fail to complete or pass it; in other programmes throughput rates are between 80-90%. The latter tend to be capped programmes with pre-selected students, and programmes at HEIs with better reputations and higher entry requirements.

Factors relevant to through-put

- ✘ Poor academic performance at university among a majority of students, often related to how their schooling has prepared them, including their proficiency in the language of instruction. Under-preparedness involves both general academic skills such as reading with comprehension, writing logically and interpreting graphs; as well as understanding scientific concepts at sufficient depth; poor understanding of what the discipline entails; underestimating the work required; and also being generally unable to manage themselves in a university context.
- ✘ Most HEIs have extended programmes which allow students with limited academic backgrounds to improve their basic skills, while taking a smaller number of the actual course subjects; these programmes improve graduation rates.
- ✘ Insufficient funds to complete studies.
- ✘ The need to leave university to earn, often influenced by socio-economic circumstances and the family responsibilities of first-generation graduates.
- ✘ Students at undergraduate level being passed when they are not ready for the next level of work.
- ✘ Large intakes making adequate academic support more difficult.
- ✘ Distance learning has a lower graduation rate than contact-based programmes.
- ✘ Universities of technology have a poorer throughput rate than academic HEIs.

The Quality and Relevance of Skills Developed

Trends

Most HEI staff interviewed believe that they are responding to demands in the environmental sector. Industries like mining, forestry, Eskom and Sasol have a direct link to some universities and shape programmes through funding and formalized interactions with faculties. Numerous new programmes and units¹ have been established and in the more successful programmes in particular, there is ongoing curriculum review, to achieve relevance, quality and effectiveness. Higher education for environmental learning is by and large a very dynamic field, with both formal and informal measures for quality assurance, although there are also pockets of stagnation. The latter may include programmes that had already been established in a previous dispensation (e.g. nature conservation) and to historic staff bodies who have not updated their skills and perspectives. There are also clear differences between units which attract good students and have high success rates (in throughput, progression to post-graduate studies and the uptake of their graduates) and units which attract fewer and weaker students, have lower throughput rates and whose graduates are not as sought-after by employers. Employers report that some HEIs produce graduates whose skills in environmental management are inadequate. In some areas universities do not provide the necessary graduates; these include computer scientists with an environmental qualification; soil scientists; 'green' engineers; limnologists; environmental lawyers; curators; and veterinary scientists.

Factors which seem to affect the quality of programmes offered

- ☒ Quality of leadership – dynamic and with an up-to-date, positive vision for the programme or unit, that takes the external environment into account.
- ☒ Post-graduate qualifications and relevant environmental sector experience among faculty members.
- ☒ A culture in the department of inspiring (as opposed to stifling) monitoring, evaluation and reflection.
- ☒ Teaching methods that encourage engagement and “the application of the mind”, critical thinking, problem solving and analysis: research, fieldwork, data analysis, reflection, group work, and an emphasis on reading and writing.
- ☒ Innovative methods to address the above despite large numbers, e.g. Web-based self-tests of knowledge of readings and chat-room style discussion groups on readings or subject content.

¹ In the report the term *unit* will be used generically to refer to departments (e.g. Department of Biodiversity and Conservation Biology at UWC, Department of Conservation Ecology and Entomology at University of Stellenbosch); units (such as the Unit for Environmental Evaluation at UCT); schools (such as the School of Natural Resource Management at Nelson Mandela Metropolitan University); centres (e.g. Centre for Environmental Studies at University of Pretoria); chairs (e.g. Chair of Environmental Education at Rhodes University) and institutes (e.g. Institute for Water Management at Rhodes University).

- ☒ Selection and capping of numbers in post-graduate programmes, commensurate with the number of staff available for research supervision.
- ☒ Availability of individualised academic support, curriculum and career advice.

Factors which seem to affect the relevance of programmes offered

- ☒ The extent to which faculty members are in touch with professional requirements in the world of work outside the higher education institution.
- ☒ Cost of some programmes and resources (such as journals).
- ☒ In scarce skills programmes there may be too few students due to limited Mathematical skills.
- ☒ Lack of agreement and clarity on the relative merit of natural sciences and social sciences, and how to combine them in environmental programmes.
- ☒ Challenges in offering cross-disciplinary programmes, including lack of established models and theoretical frameworks for cross- and multi-disciplinary research and teaching; and structural arrangements that encourage competition between institutions and between units in an HEI, for credits (FTEs) and funding.

What is Being Done?

- ☒ Outreach to schools to promote particular study areas.
- ☒ Little by way of environmental career guidance by student counselling divisions, but some exceptions within faculties themselves, where teaching staff are given formal study guidance roles.
- ☒ Young Scientists, Young Biologists etc programmes, mostly by service providers outside the universities. Examples include the Two Oceans Aquarium and SAEON (South African Environmental Observation Network).
- ☒ Successful programmes include LEAP Schools of Science, Maths and Technology and SAICA programme of intensive support for black Maths students from school throughout higher education and into their career.
- ☒ Innovations in distance learning – a move towards ‘open learning’ models rather than traditional correspondence courses.
- ☒ Bridging years e.g. a year of general science orientation.
- ☒ Four-year degree incorporating Honours, based on the sense that B.Sc. skills are too limited for the workplace.
- ☒ Extended programmes, as noted above.
- ☒ National Student Assistance Fund Scheme (NSAFS).
- ☒ NRF (National Research Foundation) bursaries and scholarships for sciences and now also social sciences.
- ☒ NRF Research Chairs Initiative (SARCHI) to promote research, research supervision and the production of more PhDs.
- ☒ DST (Department of Science and Technology) Centres of Excellence with similar aims, as well as innovation.
- ☒ Teaching development grants and research development grants, for higher education units that are not doing well.
- ☒ Development of a number of multi-disciplinary programmes (e.g. Conservation Biology with Botany and Zoology or Botany and Freshwater Ecology) and cross-

or inter-disciplinary programmes (e.g. Environmental and Geographical Sciences with subjects ranging from Anthropology to Zoology).

- ✘ Short courses to meet workplace-related needs, often at level 6.

Recommendations

Any investment in Higher Education needs to strongly consider alignment with schooling, and alignment with the workplace. For example, enrolment in certain programmes cannot be encouraged, if we are not sure that there are definite employment opportunities associated. Similarly, it is important for HEIs to advise the Department of Education on the need to develop stronger academic skills, including English and mathematical proficiency, and science concepts including Biology. Bear in mind that curriculum *delivery* and attendant factors such as teacher knowledge and skills, teacher guidance and management at all levels of the system, may be even more critical factors in the results of schooling, than the written curriculum policy. The content of textbooks is also critical.

Patterns of race distribution are complex and vary across institutions, disciplines and levels of study (see *Meeting Equity Targets* in Section 4). Thus Human Capital Development Strategies should guard against a one-size-fits-all approach and against setting simplistic targets. Pursuing and monitoring such targets in a one-dimensional manner may have unintended negative effects (e.g. impact on quality and success rate, and hence confidence and reputation). The reputation of the HEI is a very significant factor which exerts material impacts on what the institution can offer, and the learning outcomes it can produce.

Invest in initiatives that will build:

- ✘ In addition to proficiency in English and Mathematics, greater depth in school leavers' understanding of scientific concepts, and promote and strengthen the teaching of Life Sciences/Biology, because "universities cannot lower their standards to meet those of the schools".
- ✘ The quality of teaching of maths and science (with environmental content and values), as well as educators' ability to develop learners' language skills.
- ✘ Greater awareness among all South Africans and particularly high school students, of the variety of study and career options in the environmental sector, and the many ways in which these can provide life satisfaction. Include study and career paths that are not well known, but highly relevant to the country's sustainable development, such as Ichthyology and Fresh Water Studies.
- ✘ Greater knowledge of these study and career options among student advisory bureaus that serve both schools and universities.
- ✘ Computer and information management sciences relevant to the environmental sector, including systems analysts, modellers and population statisticians.
- ✘ Curators of plant and animal collections.

- ✘ Wetland specialists (such as soil scientists, freshwater ecologists, limnologists, hydrologists and 'green engineers') as well as generalists.
 - ✘ Animal health specialists including wildlife veterinary scientists.
 - ✘ Environmental lawyers.
 - ✘ Sustainable agriculture specialists.
-
- ✘ An understanding of philosophies of science, research methodology and data collection strategies suitable to purpose.
 - ✘ High level communication, advocacy and lobbying skills – like other skills, these will only develop fully in the workplace, but higher education needs to align graduates towards them.
 - ✘ Skills in interpreting and analysing data, finding trends and meaning, integrating (across data sets and disciplines) and designing research, management and evaluation systems accordingly. For most candidates, doctoral level studies would be required to build the necessary depth of insight and breadth of vision.
 - ✘ The capacity of people already working in the environmental sector, who may be either under-qualified or under-skilled for their responsibilities, or need to develop new skills for changing workplace requirements in the sector. Enhance the skills of these individuals through high quality and relevant short courses, and through high quality, relevant part-time and modular Masters programmes.

Also consider the following:

- ✘ HEIs and students can benefit in a number of ways from the participation of students from elsewhere in Africa in the local post-graduate programmes.
- ✘ A primary role of the Masters degree may be to teach research skills, rather than to produce research outputs, and invest in well-taught research methodology courses and adequate research supervision.
- ✘ Collecting and sharing examples of 'best practice' in relation to academic support and innovative methods to develop the above skills. Identify potential in under-performing units that are able to benefit from relatively limited interventions, but be cautious of investing in units that require wider systemic support to succeed.
- ✘ University-linked internships for unemployed graduates, in agencies that can use their existing skills, and provide further learning opportunities in a workplace that meets their personal interests and aptitudes.
- ✘ Supporting inter – or cross-disciplinary programmes at universities and invest in the development and sharing of models and theoretical frameworks for inter-disciplinary research and tuition, as well as application in the field.
- ✘ The National Human Resource Development Strategy and the National Innovation Plan, which aims to address the obstacles from Honours level to Masters and PhD studies, in order to grow the aggregate number of scientists in the country, women scientists and Black scientists.

Key strategies to assist HEIs with human capital development for the environmental sector are:

- ✘ Providing adequate funding support for post-graduate study and research costs

- ☒ Strengthening the capacity of employers to identify suitable long or short courses for staff and organisational development purposes and strengthen HEIs capacity to access funding to run such programmes optimally.
- ☒ National forum(s) to encourage more HEIs to interact and collaborate with each other and with employers in the environmental sector.

When considering which HEIs to support, take into account:

- ☒ The capacity of the institution to produce value out of resources invested, based at least partly on their track record.
- ☒ Whether the institution can produce more with its existing staff capacity.
- ☒ Capacity of the institution to provide *quality* teaching and research supervision.
- ☒ Changing conceptual frameworks for managing and studying the world.
- ☒ Curriculum relevance and quality involves not only content, but also the methods used, so that they meet (for example) the needs of a broader student body, and the need for more higher order and interpretive skills in the world of work.
- ☒ Track record in graduating students across the racial groupings.
- ☒ Capacity of the institution to administer financial aid.
- ☒ Capacity to expose students to the environmental field and where relevant, provide links to work placements. When students must rely on luck and personal social networks for the work placements to complete their studies, or the supervisor to open a pathway into post-graduate research, there is discrimination against Black South Africans and others who lack 'the contacts'.

2. Introduction and Methodology

Introduction

This document is part of a series of four research reports. The other titles cover Schooling (Rosenberg, Nsubuga and Burt, 2009b); Vocational and Further Education and Training (Rosenberg and Burt, 2009a); and Career Guidance in Schools (Rosenberg et al, 2009c).

These reports are based on probes into the quality and relevance of educational provisioning at the various levels, and the associated implications for human capital development in the environmental sector. They have been prepared for the Rhodes University Environmental Education and Sustainability Unit, which commissioned the research in partnership with the Department of Environment Affairs (DEA). These partners are developing an Environmental Sector Skills Plan (ESSP) and associated Human Capital Development Strategy. Other partners are developing Human Capital Development strategies for the biodiversity conservation and research sector (see www.skillsforbiodiversity.org) and for natural resource management. The Biodiversity Sector HCD Strategy is focussed on research and management skills at graduate level, and hence this report is of particular importance for that process.

Methodology

This report is informed by a review of a small selection of the literature that is relevant to the topic. This review was conducted by Dr Eureka Rosenberg.

The desktop review was extended with interviews with lecturing staff and management (e.g. departmental heads) conducted by Dr Glenda Raven, Presha Ramsarup, Jane Burt, Karen Ellery and Eureka Rosenberg, at the following institutions:

- ✘ Cape Peninsula University of Technology
- ✘ University of the Western Cape
- ✘ University of Cape Town
- ✘ University of Johannesburg
- ✘ Nelson Mandela University's George (Saasveld) Campus
- ✘ University of the North West
- ✘ Pretoria University
- ✘ Rhodes University
- ✘ Stellenbosch University
- ✘ Tshwane University of Technology.

Natural and Social Science faculties were targeted, with an emphasis on the former, and learning programmes, units and departments covered in the interviews include: Conservation, Biodiversity, Conservation Biology/ Ecology, Marine Biology and Water

Sciences, Environmental Sciences, Environmental Management, Geography, Botany, Horticulture, Entomology and Zoology. Interviews focussed mostly on learning programmes at B.Tech., B.Sc. and Masters level as well as short courses for non-degree purposes.

Academic support and financial aid divisions of the universities were also consulted, either through personal interviews or telephonically or electronically, but on a smaller scale. Aspects of academic and financial support were also probed in some of the interviews with the teaching staff.

Field researchers generally found it very difficult to secure interviews with university staff. This was especially the case at historically disadvantaged institutions, which was a particular concern, given the importance of including these institutions in the study. Although efforts to set up interviews with relevant staff at the University of Fort Hare were unsuccessful, even after two months, we did have a short but useful discussion with an academic staff member from Fort Hare at the launch of the draft Biodiversity Human Capital Development Strategy.

Dr Glenda Raven, Coordinator of the C.A.P.E. Capacity Development Programme, contributed to the study through that programme's component on curriculum innovations in higher education.

3. Context of Higher Education in South Africa Today

“Believe in your capacity to make history.”

Former state president Mandela, quoted by Drew Faust, president of Harvard, in an address at the University of Johannesburg (Soweto Campus), 26 Nov 2009

Re-Considerations of the Role of Universities

The university is a century-old institution and throughout its history there have been debates about its role in society. In Africa this decade there has been considerations of the university's role in development, following the work of Professor Mahmood Mamdani on 'the developmentalist university', which has at its heart the project of national(ist) development (Mamdani, 2007, pp.209-213). The most recent discussions in South Africa are about the so-called New Generation University (*Mail and Guardian* Higher Education Supplement, December 2009, pp.2-3). This is described as “an arrangement that combines the scholarly [research and higher degree teaching] environment with ... instruction, community and industry response, open access, the use of advisory groups and work experience” (p.2).

In relation to the environmental sector, many South African universities may already meet requirements for a 'new generation university'. For example, the Environmental Education and Sustainability Unit at Rhodes University has been conducting post-graduate research in environmental education and offering graduate and post-graduate teaching (scholarly functions) through the Murray & Roberts Chair of Environmental Education in the Education Faculty, while also offering open-access courses at Level 5/6 through the Gold Fields Environmental Service Centre², to meet the need of organisations in the sector for entry-level environmental education staff. These functions, as well as its local community projects and provincial emphasis, led the United Nations University to recognise the Unit as a Regional Centre of Expertise in the Makana municipality and Rural Eastern Cape. Similar examples at other universities abound, e.g. the traditional teaching and research functions at the University of the North West, being supplemented with short courses to meet the demand of industry, at its Centre for Environmental Management.

It is the administrative and incentive functions of the higher education system that often lag behind these innovations among the academic staff. For example, many universities have failed to obtain accreditation for short courses through the South African Qualifications Authority (SAQA) system, and most have no mechanisms for rewarding staff for their mandated 'community outreach' work, comparable to the rewards for publishing research or graduating students. Academic staff find the diverse demands of the 'new generation university' stimulating and intrinsically rewarding, but at times also exhausting and confusing.

² Note the corporate funding relationships, reflected in the names of the entities.

Institutional Landscape Changes and Transformation of Race Policies

After the mergers of 2004-2005, the landscape of public higher education institutions (HEIs) in South Africa now consists of 23 institutions, as follows:

Type of University	No.	Types of programmes offered
Academic University e.g. Rhodes, Fort Hare	11	Career oriented professional and degree programmes, general formative programmes, research masters and PhDs
Universities of Technology e.g. Vaal, Cape Peninsula	6	Vocational programmes at degree and diploma level
Comprehensive Universities e.g. University of Johannesburg, UNISA	6	Combines the above functions and offers a range of programmes from diplomas to research based masters and PhDs
Total number of HEIs in SA	23	

The mergers were motivated by a need for economic efficiency as well as undoing the historic racial identities of South Africa's higher education institutions. Considerable resources including energy have been expended on the mergers, but the CHE (2009) reports that it is still too early to comment on whether the effort has been worthwhile. The report notes that while some historic boundaries established on the basis of race and language are being blurred, the project is still incomplete.

In her address to the University of Johannesburg Harvard President Drew Faust suggested that in terms of undoing racial discrimination, South African institutions have already done much of what it took institutions like Harvard 350 years to achieve (*Mail and Guardian* Higher Learning supplement, Dec 2009, p.4).

Overt discrimination has been abolished by de-racialising entry criteria. However, institutions that make high levels of academic achievement an entry requirement do discriminate against applicants who received an inferior schooling, and these are with few exceptions Black South Africans. However, the number of Black South Africans in higher education is climbing, and their graduation rates are improving. The number of Black South Africans in post-graduate programmes is still disproportionately low, and the majority of the students in Masters and PhD programmes are White South Africans, or from elsewhere in Africa.

South African universities do play in some instances and in particular disciplines, a 'leading role in Africa'. Students from across Africa study at South African universities, and make up a significant number of the student body, particularly in post-graduate science programmes. There are inter-university links within African and between continents. For example, in the field of natural resource management, a number of South African institutions, along with the University of Zimbabwe Centre for Applied Social Sciences (CASS), play a significant role, and all have extensive links with United States and British universities facilitated through funding agencies based in those countries.

South Africa has many features that make it a sought-after research destination for international academics. These individuals may bring funding and partnership opportunities with them, as well as opportunities to enrich local teaching programmes and provide co-supervision. The country's universities have also been targeted by international institutions keen to establish partnerships as part of a growing 'green economy' in which the establishment of 'green markets' for technologies developed in the northern hemisphere may be playing no insignificant role. Local staff must weigh up the risks of distraction against the benefits of new opportunities; institutional support may be vital in making the most of the opportunity, without over-burdening individual staff.

Curriculum Transformation

In the natural and earth sciences, all HEIs in this study have responded to environmental concerns, and more recently to what is now seen as a 'poli-crisis' in which climate change provides a particular focus (see the background to the DST Global Change Grand Challenge initiative, at www.dst.gov.za).

Universities have introduced new courses and in several cases whole departments or units have been re-oriented around these. New centres, schools, chairs and institutes with an environmental focus, have been set up. Examples include the Department of Biodiversity and Conservation Biology at the University of the Western Cape; the Unit for Environmental Evaluation at the University of Cape Town; the Centre for Environmental Studies at University of Pretoria, the Centre for Environmental Management at the University of North West, the Africa Centre for Climate and Earth Systems Science at UCT; the Chair of Environmental Education at Rhodes University and the Sustainability Institute at Stellenbosch University. Other longstanding environmental (conservation) programmes have been historically established at what was then Saasveld, Pretoria Technikon and Cape Technikon, among others.

In some instances the response to the environment and sustainability issues has been limited to the introduction of new topics in existing courses. In other cases the curriculum changes introduced in the universities may resemble the 're-orientation' of education the United Nations calls for in its Decade of Education for Sustainable Development. This includes a call for programmes and even qualifications which combine disciplines which had traditionally only been offered separately (e.g. Botany and Zoology, or Botany and Anthropology), which actively integrate between disciplines (inter-disciplinary programmes) or which transcend disciplinary boundaries altogether. The calls for inter- and trans-disciplinary offerings have been heeded and mandated by most universities, and implemented with considerable enthusiasm in some instances, with some scepticism in others, and often with considerable difficulty. Staff, students and administration all lack exposure and expertise in this venture. We discuss this further in relation to the findings outlined in Section 4.

4. Trends and Patterns

Trends in Numbers Generally and in the Sciences

The percentage of South Africans enrolled in higher education (nearly 16% of the population of 20-24 year olds in 2006, compared to 14% in 1999) is significantly higher than in other sub-Saharan countries, but significantly lower than comparable countries in Asia (25%) and the Caribbean (31%) or in Western Europe and North America (70%). The Ministry of Education's 2001 National Plan for Higher Education had set a target of 20% over the next 15-20 years.

While infrastructure (residences, lecture halls, laboratories) is an obvious limiting factor, perhaps the most significant constraining factor in universities is the ability to appoint suitably qualified academic staff. In 2007 there were 761,090 students in public higher education institutions. The system employed 108,687 staff, of whom 41,383 were academic. Of these, the majority (66%) did not have a Masters level qualification, and were thus unable to supervise research.

Although there are some departments that are operating below their capacity, there are indications that the HE system at a whole is operating at or near its current capacity (CHE, 2009). A number of HEIs or units within HEIs are capping intakes according to available staff and other facilities.

Meeting National Priorities

While there is a lack of statistical information on labour markets with which to monitor whether graduations are meeting national needs, there is general acceptance that the country needs more skilled people in the sciences, engineering and technology (SET); and in high (graduate and post-graduate) skills generally.

The number of people graduating from public HEIs is increasing; and in line with national goals, the system is producing more graduates in science, engineering and technology, but doing less well in computer sciences.

Between 2004 and 2007, graduate numbers in priority areas changed as follows:

- ☒ Engineering ↑ 39%
- ☒ Life sciences and physical sciences ↑ 17%
- ☒ Mathematical sciences ↑ 16%
- ☒ Computer sciences ↓ 14%.

The national plan has been to increase the proportion of students in SET compared to social sciences and business studies, to 30%. There has indeed been an increase in the proportion of SET enrolments, but enrolments have been short with about 2% of the target in the past five years. Of perhaps greater concern is the graduation rate,

which is also below target. However, the numbers of enrolments and graduations have been increasing, as have the percentages of Black African students and women enrolling and graduating in SET.

There has been an increase in the numbers of Masters and PhDs graduating, but not in keeping with the increase in undergraduates. Although there has always been a significant fall off from under-graduate to post-graduate enrolments, the gap seems to be widening.

The percentage of all first year students who enrol in the Natural Sciences is 15% (Cosser, 2009). Areas in which respondents report that there are not enough graduates include:

- ✘ Veterinary sciences (Kraak, 2008 reports that only 59% of government veterinary posts are filled, but one interviewee believed that this is a relative scarcity rather than an absolute scarcity, as there are many veterinary specialists in private practice.
- ✘ Soil sciences; wetland sciences.
- ✘ Environmental law.
- ✘ Computer sciences, also combined with Life Sciences, e.g. population statisticians. SANBI staff reports that it takes months and several advertisings to fill a post for a project manager with the necessary skills in biodiversity information management.

In addition to the number of graduates being produced being inadequate, other factors like skills migration out of the country or into other sectors, also play a role.

Graduation Rates

Graduation rates are not an accurate reflection of quality (in the form of efficiency) in the system, because of fluctuating enrolments. However, it is disconcerting that half of all students admitted to higher education in South Africa drop out without receiving a qualification, and that two thirds take more than five years to obtain a first degree. The Council on Higher Education (CHE, 2009) report cohort studies that indicate that 30% of students who enrolled in 2000, had graduated five years later, and that 56% left the institution without graduating. Taking into account that on average 10% of those who left would graduate from another institution, and that the ones still in the system would also graduate, they conclude that 44% of enrolments will eventually graduate. This compares very poorly with, for example, the English HE system, where similar cohort studies predict a 78% graduation rate of the 2000 enrolment.

Throughput rates vary between departments and between institutions. The throughput rate in minimal time in Engineering is around 35% at the best institutions and between 5-10% at the others. The comparable throughput rates in United States, Indian and East African institutions are 80-90%.

The quality of schooling seems to have a direct influence (see *Quality of student academic preparedness*, Section 5, p.24).

Meeting Equity Targets

The percentage of Black South Africans in the general population is an estimated 79%. In 1995, 59% of students in public HEIs were Black South Africans. By 2007 this percentage has grown to 63%. Progress has thus been made, although there is still a considerable way to go.

The state's target for participation in HE is 20% of the population. For four population groups, the participation rates are currently as follows:

☒ White	54%
☒ Indian	43%
☒ African	12%
☒ Coloured	12%

While the percentage of Black students increased significantly at many institutions, this has not always been the case in specific departments or schools, including the sciences, and there is also a great disparity between institutions, with most Black African students being enrolled at Universities of Technology rather than Academic Universities, and in Diploma and Certificate level courses.

In the Science, Engineering and Technology fields of study, enrolment is 60% Black African, 26% White, and the remainder about equal percentages of Coloured and Indian students.

There has been a decrease in the past five years in White students (particularly at Universities of Technology) of about 4,000. The National Plan for Higher Education indicates that equity should not be achieved at the expense of White students; there is thus not necessarily a need to decrease the number of White and Indian students in the system, but to increase the number of Black African and Coloured students.

The academic staff complement is also not representative of the general population. For example, in the Sciences there are fewer women and in many departments there are no Black teaching staff.

International Students

Higher Education is increasingly a global phenomenon. Foreign universities (like Monash Australia) operate in South Africa; South African universities participate actively in international research networks; we send students to study at overseas universities, and attract students from universities outside the country, particularly elsewhere in Africa. In 2006 South Africa had 53,738 foreign students, most of them from sub-Saharan Africa, constituting 5% of the student body, and represented particularly in post-graduate studies.

In the fields of wildlife and natural resource management, and environmental management, for example, South African HEIs provide significant masters and doctoral training for African researchers. Our scholarly and professional expertise in these areas, as well as progressive environmental policies and significant infrastructure (such as functioning marine and terrestrial protected areas), put the country in a good position to play a leading role in research and policy development in the region and expand Africa's research contribution in the world. At the same time, South African institutions and students benefit from the wider experience these international post-graduates (often mid-career professionals) bring to courses.

The National Plan for Higher Education targets increased recruitment of students from the SADC region, especially for post-graduate studies. The participation of foreign southern African students in South African universities is considered valuable for the development of the region and for South African students' experiences. Foreign students are counted for subsidy and graduation purposes and are in some instances eligible for National Research Foundation (NRF) bursaries.

However, at some HEIs our study revealed that South African bursaries for foreign students seem to be a contentious issue, and staff experience "an ethical dilemma" about granting local funding when the most suitable candidates are foreign students. Problems experienced by foreign students include the higher fees (compared to South African students' fees), difficulties with student visas issues through the Department of Home Affairs, and emerging xenophobia on campuses (CHE, 2009).

Distance Education

Distance education remains a significant component of the provisioning of access to higher education in South Africa. In 2007, 37,6% of students in higher education were studying via distance mode, it is less costly and a growing choice among young people. There are however widespread concerns about the quality of distance education in South Africa, and about courses being offered that are of little benefit to the student or country.

There is unfortunately not much information on the quality issues in distance education. Graduation rates have declined from 11,0% in 2004 to 9,5% in 2007, but the CHE (2009) notes that this is a crude measure of quality. While the number of students in the sciences and environment studying via distance education is relatively small, there are a number of distance education programmes in environmental education and nature conservation. Here students may struggle particularly to find placements for work experience (see Case Example 1).

An important trend to note is that the boundaries between distance education and contact education are increasingly blurred, with the introduction of learner-centred models for distance learning, with greater student support, flexibility of delivery modes, and more opportunities for interaction with the institution and other students. This model is often referred to as open learning, in contrast to the traditional correspondence course model. As a result distance learning becomes more

expensive, but it receives less state funding because the traditional correspondence course model is cheaper to provide.

Case Example 1: Natalie Baker's B.Tech. Experience

Environmental conservation officer Natalie Baker grew up in a family of nature lovers and always knew she wanted to study nature conservation. When the time came to enrol at a tertiary institution, however, she faced a number of obstacles. Her first choice, the then Saasveld College, was discouraging female enrolments. Money was also an issue and, failing to get a bursary, she applied at a distance education institution. The then Technikon SA offered a B.Tech. Diploma in Nature Conservation that Natalie could complete over a number of years, while working to pay for her studies. Although she worked hard, she failed to complete her studies in the minimum time. This time the obstacle was work placement, for the compulsory year of experiential training that precedes the completion of the B.Tech. programme. Natalie simply did not have the contacts to find a placement in one of the parks or nature reserves that offered students internships. And, as a distance education institution, Technikon SA did not have the same links to protected areas as the then Cape Technikon (now Cape Peninsula), or Pretoria Technikon (now Tshwane).

It was only once her father's friend contacted his friend, that a placement was found for Natalie in the then brand new Gouritz River Nature Reserve. It took luck and a personal social network to complete the B.Tech. By another stroke of good fortune, she had an excellent mentor at Gouritz NR, who recognised her skills and capacity and motivated that she be employed on completion of her course.

Natalie is now thriving and contributing wholeheartedly to CapeNature's conservation effort. But clearly, the distance education system in particular is not an easy 'pipeline' for students to glide through into employment. Similar placement issues also apply to studies at contact institutions. Vass et al (2009) suggest that Black students and Black women in particular may struggle to find supervisors for post-graduate research (as one of the reasons for the large drop in numbers from undergraduate to postgraduate studies) and a lack of relevant social connections through which to find pre-requisite work experience and eventual employment, may similarly lay obstacles in the path of many aspirant environmentalists.

Environmental Ethos and Curricula

Among the many trends we could follow for this study, we decided to include a focus in our interviews on the extent to which there is an environmental ethos at South African HEIs. The rationale was as follows: At institutions with a strong environmental ethos (as reflected in environmental activities, actions, campaigns, projects, environmental management on the campus and the visible values of staff and students) there is likely to be a stronger chance that students would choose to study (further) in environmental programmes, and look for employment in an environmental field. The quality of environmental programmes offered is also likely to be

stronger, if there is congruence between information taught and associated values. Perhaps most importantly, the *relevance* of the training offered is enhanced if it is underpinned or complemented by a strong environmental ethos, given that many employers regard environmental values or commitment as an essential part of the 'package' of an environmental professional (as reported by Vass et al, 2009).

Some universities (e.g. Rhodes, Cape Town) report a growing environmental awareness among the student body, and among a growing number of staff members. This is reflected in environmental policies at these institutions and in the existence of formal student environmental groups, actions and campaigns. However, interviewees indicated that this trend is not yet widespread, and even in those institutions where environmental awareness was said to be high, some staff noted that it did not necessarily affect people's lifestyle decisions.

In relation to the question of relevance it is also important to consider the numerous new 'environment-related' courses being offered at South African HEIs. All 10 HEIs included in this study have some environmental programmes. Many have adjusted, built on or expanded existing science programmes. Sometimes this was prompted by funding considerations and broader institutional restructuring, as in the case of the formation of the Biodiversity and Conservation Biology programme at UWC, by merging the Botany and Zoology departments. The Geography department at UCT, was extended to an Environmental and Geographical Sciences department. This department offers a compulsory course in environmental sciences for all first-year B.Sc. students in the Sciences, Humanities and Commerce.

As has historically been the case, individual lecturers' interests also significantly shape what is on offer, as does the desire to retain historically offered, and foundational programmes.

There seems to be, generally, an increasing flexibility in learning programmes, providing increasing job options and exposure to a wider variety of careers. An example is an integrative programmes offered in Geographical Sciences, which is consciously situated in the interface between nature and society, with an Honours programmes on Economics, Politics and Nature. These courses are seen (even by those who offer them) as 'not part of the mainstream', but are regarded as relevant, because they bring in issues and themes that have hitherto been ignored, and are thought to develop 'more rounded' students who are better able to explore and work with the multi-faceted, multi-rooted issues of the time.

Topics for post-graduate programmes in several universities reflect an up-to-date understanding of current issues and needs in the environmental sector, e.g. at Rhodes one could do post-graduate training in sustainable rural livelihoods, integrated catchment management, or human adaptations to climate change. Even in a strongly science-driven programme like Ichthyology it is reported that all courses cover sustainability issues, e.g. in relation to aquaculture, environmental legislation, conservation, governance and economics. Such 'up-to-date' programmes were not evident in all departments and at all institutions, however.

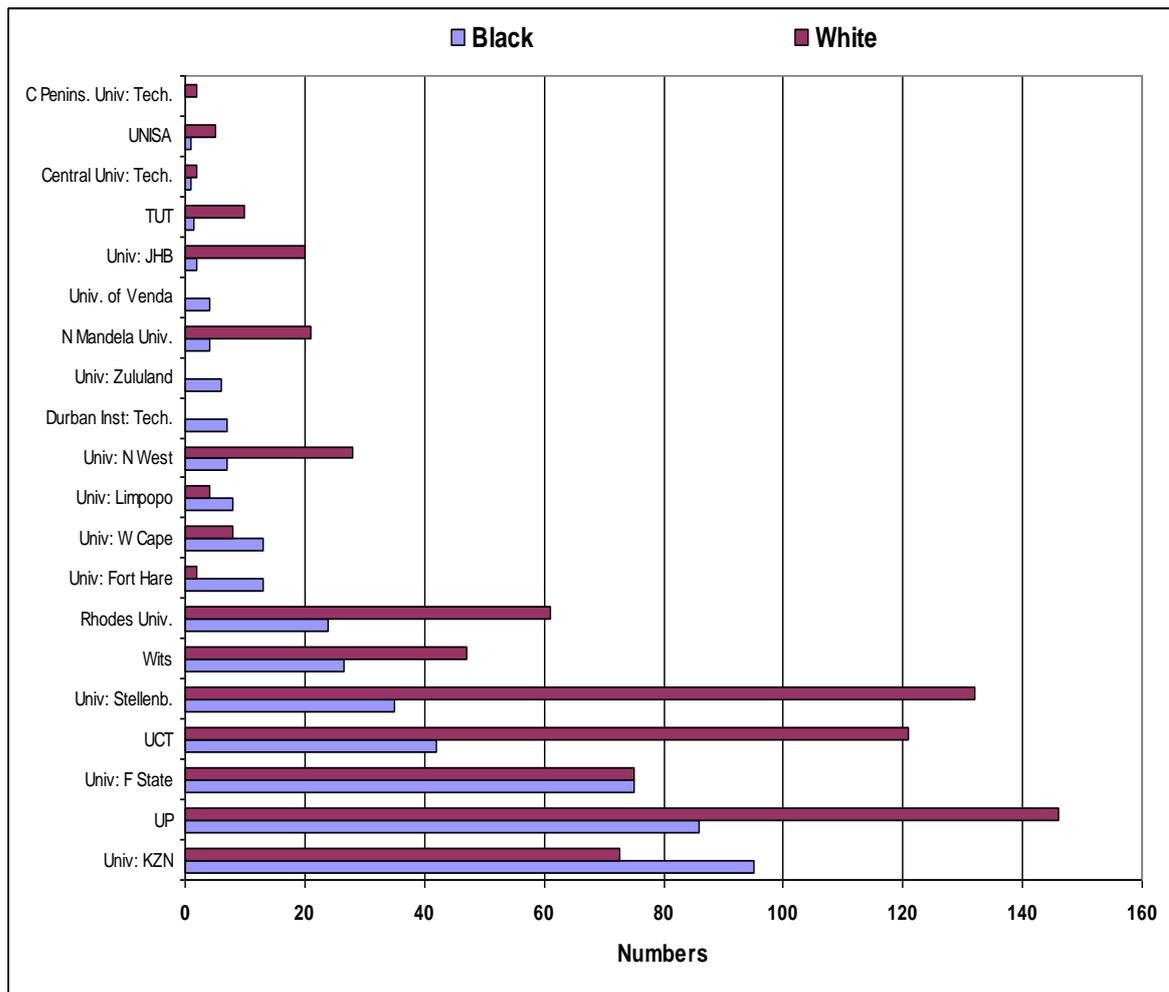
Lecturers at academic universities generally report a strong interest from students in environment-related courses – often based on an interest, and/or a desire to ‘make a difference’. Some courses like marine biology are described as ‘romantic’. Lecturers at universities of technology were more inclined to indicate that these institutions, and/or the student’s subject choices (such as horticulture) were not their first choice; it was simply what the institution’s selection process gave them access to after reviewing their marks and application forms (on which most institutions require up to three course choices from applicants). Sometimes students had no idea what these courses were about, and little motivation, and this also seemed to demoralize staff.

Students tend to choose courses that they perceive will lead to jobs; environmental sciences are popular for that reason (and have to be capped for the existing staff to cope with the demand – i.e. with more staff they could take more students), and in one Botany department a new course in Conservation and Biodiversity has sparked new interest, because students perceive they can be employed as consultants and impact assessors. Other courses have less demand, e.g. Ichthyology and Water Studies (at undergraduate level), which are not well known study and career options in South Africa. These study options could thus feature more strongly in career guidance packages, given their relevance to the environmental sector.

Which universities produce post-graduates for the environmental sector?

Figure 1 shows that the Pretoria University produces the highest number of PhDs in (broadly) biodiversity-related fields of study, closely followed by Stellenbosch University. The University of Kwazulu-Natal is in a leading position when it comes to graduating students from all race groups, in more balanced proportions.

Figure 1: Average number of Doctoral degrees in biodiversity related fields of study by tertiary institution and race (2000, 2007)



Source: HEMIS, 2000 – 2007; calculations by Vass et al, 2009

Figure 1 also shows that currently, historically disadvantaged institutions consistently produce the lowest number of doctoral qualifications in this field. In the past, both Fort Hare and University of Venda have had considerable successes in environment related studies, however. Today it is reported that some of these institutions produce skills that are ‘too shallow’ to meet the demand in the workplace. Similarly named courses at other HEIs produce highly sought after graduates, who are at times offered work before they even complete their courses. According to employers, the quality of graduate skills produced varies across South Africa’s HEIs.

5. Challenges

Cost of Higher Education

At an average total cost per annum of R35,806 in 2007 (ranging from R25,982 at Walter Sisulu University to R49,253 at Wits) higher education in South Africa is regarded as expensive. The cost is certainly high compared to the income of most South African families, and thus a significant factor in excluding potential students with adequate marks. The cost of studies, transport and accommodation puts greater pressure on those who do enrol, to leave as soon as they are able to get a job; or to give up before completing their studies.

Every year students raise the issues of fee increases, exclusion based on inability to pay, and lack of financial assistance. In 2008, for example, there were student protests relating to the cost of higher education, at seven HEIs.

Some courses are also regarded as more affordable than others, and some short courses in the environmental field offered by academic universities are among those cited as too expensive. Shortages in skills such as earth sciences have been attributed to the cost of study.

The problem ends up with academic staff when students (particularly at post-graduate level) apply for a course, are admitted – and then request their lecturers to help them find funding. Most interviewees believed that there are too few bursaries available for environment-related studies; that students get drawn to areas such as Geology where there are more bursaries (from the Mining Sector); and that providing more dedicated bursaries would be the most important strategy to increase the number of Black South Africans studying in the field. On the other hand, one lecturer believed that there were ample bursaries in the Life Sciences and that bursaries were not a significant factor in determining students' study choices.

The state's response to the problem includes the National Student Financial Aid Scheme (NSFAS) which was introduced in 1995 and established as statutory agency in 2000. It offers low interest loans, up to 40% of which can be converted to bursaries based on academic performance, and which only get paid back when graduates' income exceeds a certain amount. In 2007, 15% of students enrolled in HE received NSFAS assistance; 93% of these were Black African applicants, 4% Coloured, 2% White and 1% Indian applicants. The number of people who apply for but do not receive NSFAS assistance is increasing.

A joint report by the Parliamentary Committees on Higher Education and Training and Basic Education (quoted by Dibetle, 2009) revealed that a number of HEIs are unable to distribute all the financial aid at their disposal. In both 2008 and 2009, a total of R50 million in student aid remained unallocated. (FET colleges left R95 million unallocated in 2005.) A number of factors may be responsible, including a

short two week registration period during which rural students in particular struggle to submit applications on time; an overlap between the registration period and experiential training; and poor communication between NSFAS and universities. Nine universities including Stellenbosch and Wits were able to distribute their funds effectively; those that were unable to do so include Fort Hare, Venda and Durban University of Technology.

Higher Education Funding

Higher education receives a fraction (0,65%) of the Gross Domestic Product in fiscal allocations (2007/2008 figures). At least eight other sub-Saharan countries spend a bigger portion of their GDP on higher education. For most South African HEIs, state funds make up about 40% of the income stream, student fees 28%, and other sources 33%. HEIs differ in their capacity to attract additional funding and Universities of Technology depend most heavily on the state funding.

Funding availability often prompts research directions. Interviewees indicated that there is a lack of recognition of the environment sector when funding is allocated.

Government and corporate support for short courses is an important source of funding for skills development through universities. Here there are two significant challenges which need to be addressed if universities are to play a stronger role in human capital development for the environmental sector:

- ✘ HEI leadership setting up and administering streamlined systems for accessing this funding (some university administrations are more 'entrepreneurial' in this regard than others), and
- ✘ Human resource (HR) departments of government environmental agencies identifying and wisely choosing suitable short courses for appropriate staff development³.

Staffing Constraints and Diverse Demands on Academic Staff

In 2007 HEIs produced 86% of all academic papers with an Institute of Scientific Information index (the remainder is by scientific councils), most of the basic research produced by the National System of Innovation, as well as applied and experimental development research (which exceeds basic research in universities). In that year they also produced more than 1,274 PhDs and 3,442 research Masters (CHE, 2009).

The National Plan for Higher Education prioritises and calls for increased output in the form of post-graduate students, as well as research outputs such as books,

³ Interim findings in the Environmental Sector Skills Planning research (Lotz-Sisitka et al., in press) have indicated that HR departments tend to allocate skills levies to generic work-related and personal development training, often at too low a level. Although operational staff themselves are usually clear about their environmental training needs, funding for such, more specific environmental training usually has to be sourced from elsewhere.

papers and conference proceedings. Research and training is however but one component of the work done at universities. Another priority in the National Plan is cooperation, particularly in the SADC region (CHE, 2009). Dr Glenda Kruss⁴ describes demands on HEIs as “great, multiple and complex” (*Mail and Guardian Higher Learning Supplement*, December 2009, p.3).

The demands are experienced acutely by academic staff in environmental units whose roles include teaching; additional academic support to students who are under-prepared for their studies; counselling students; supervising student research; conducting own research; publishing; managing units and the administration of these units; fund raising through consulting services or seeking donors or both; counselling and mentoring staff; contributing in various ways to the institution (e.g. serving on curriculum or research review committees); providing a variety of professional services to their field, such as short courses, reviews, commentaries and quality assurance; and conducting ‘outreach’ (e.g. liaising with schools, the media, developing communities, general public).

Higher education enrolments have been growing with 5% each year and the CHE (2009) reports that there are indications that the system is now operating at or near its capacity. Between 2000 and 2005 the average number of research masters students per supervisor increased from 3.8 to 5.2; and the average number of PhD students per supervisor, from 1.3 to 2.2. The NRF’s Centres of Excellence and Research Chairs (SAARCHI) are aimed at addressing this constraint; it is still too early to tell whether these initiatives are being effective in this regard (CHE, 2009). Although the CHE does not provide further details, an advertisement in the press reflects the challenge: The Vaal University of Technology recently published an “Urgent and Open Call for Supervisors”, calling on “experienced supervisors who may be senior academics, about to retire or retired academics across the country to be supervisors to postgraduate students at VUT” (*Mail and Guardian Higher Learning Supplement* December 2009, p.2). The 17 fields in which this one institution requires supervisors range from established areas like Microbiology, Computer Systems, Human Resource Development and Chemical Engineering to newer areas like Household food insecurity in urban areas.

The pressures seems to be particularly challenging where there are too few qualified or active staff (not necessarily reflected in the staff numbers) and where the particular unit is very active in developing the field, as is often the case with the environmental units responding to the diverse and burgeoning demands in this sector.

Poor Graduation and Throughput Rates

These were discussed in *Trends and Patterns* in Section 4, but need to be listed here as a critical challenge in higher education, and certainly in the endeavour to build human capital for the environmental sector.

⁴ Dr Kruss is a chief research specialist in the Human Sciences Research Council’s research programme on education, science and skills development.

While there is generally an improvement in graduation rates (Vass et al., 2009), the rates vary considerably across HEIs. At one historically disadvantaged academic university the graduation rate in a relatively small environmental degree programme is as low as 33%. One interviewee in this study indicated that students are sometimes advanced for 'structural reasons' when they should fail – a factor which complicates teaching and quality assurance at higher levels in the system. Graduation rates are also affected when students exit early because they cannot afford to study further; this has been discussed earlier. Next we explore the issue of students' academic preparedness in some detail, as it is a significant element of the quality of higher learning in South Africa.

Quality of Student Academic Preparedness

"We need to deliver a first world course to students with third world schooling"

This statement is not entirely accurate. Many southern African countries have superior educational outcomes to the majority of South African schools⁵. South African universities' challenge is to help students succeed at world-class higher education, when their schooling has been affected by the lingering legacy of Bantu Education, as well as a variety of new problems.

Commentators often lay the poor outcomes of schooling at the door of the outcomes-based education (OBE) framework introduced in 1995, or the current National Curriculum Statements (NCS). Such conclusions however do not explain that fact that South African schools' results form a bimodal curve in which a sub-population of learners (across race groups) compare well to the rest of the world (Gustafsson, 2005). A report to the Office of the President (REF) notes that many teachers are in fact not implementing the NCS, and various studies have shown that poorly trained teachers fail the tests they are meant to set for their learners. The aftermath of Apartheid education seem to have a greater influence than the introduction of a new curriculum policy, as does poor management. Schools that are well managed produce better results, regardless of their resources or the socio-economic circumstances or racial background of students and staff (Gustafsson, 2005). In other schools and districts, poor management is so entrenched that general investments (or curriculum policy changes) are unlikely to improve the quality of education.

In 15 years, systemic inequalities in schooling have not been wiped out, and the constructivist OBE framework that has been adopted in South Africa may indeed be entrenching inequalities, by failing to give children adequate access to new knowledge (see Lotz-Sisitka, 2009). 'Scrapping OBE' or continuous curriculum review will however not solve all the issues. Some 90% of teachers and a majority of the officials currently serving South African schools have received their basic training

⁵ The 2000 SACMEQ comparative review placed South African school pupils ninth among 15 southern Africa countries. See Gustafsson, 2005.

in the Bantu Education system. Research⁶ shows that the training and professional development efforts of the Department and HEIs have by and large not effectively addressed issues like teacher subject knowledge or officials' curriculum knowledge.

Schooling certainly has a significant impact on higher education results. Earlier this year, for example, the Wits University School of Mathematics reported the pass rate among first year Engineering students on mid-year tests dropping from 71% to 35%. This was ascribed to the Department of Education's decision to make a third matric Mathematics paper voluntary rather than compulsory in 2008.

Does the school curriculum provide an adequate preparation for environmental studies at university?

On paper, the National Curriculum Statements specify considerable environmental learning content and outcomes⁷. However, the actual coverage of this content in schools vary considerably, based on the teachers' environmental knowledge, which in turn depends on exposure to environmental education, outside of departmental structures (Rosenberg et al, 2009b). Education officials have, with some exceptions, very little environmental education knowledge. General science and maths coverage also vary according to teachers' subject knowledge. Teachers admit that they leave out content of which they are not sure; in the past few Black teachers were trained in Maths and Science; and today South Africans with a background in Science and/or Maths can choose among a variety of career options more attractive than teaching.

Academics accordingly report that students have been prepared to varying degrees for the environmental programmes at universities, depending on the schools from which they come. At the University of Pretoria a lecturer in Environmental Management had seen clear differences between learners from different schools; most were "completely under-prepared" by their schooling for studies in Environmental Management, but there were also some exceptions, for example students from Hoërskool Waterberg.

At the University of the Western Cape, which does not access the 'top of the crop' of the school leavers, lecturers report that the students entering Biology-related study field are inadequately prepared by their schooling. They are said to find scientific names intimidating, and the subject generally very difficult. The interviewees believe that "the minimum [of the intended Biology curriculum] is done" in the feeder schools, and as a result students experience a "huge gap" between school and university. This 'gap' refers not only to students lacking the required foundational knowledge,

⁶ For references to some of these studies and reports, see Rosenberg et al, 2009b.

⁷ Dr Kevin Winter of the University of Cape Town Department of Environmental and Geographical Sciences does however argue that the developers of the NCS have not found an appropriate means for including the open-ended, contentious and developing concept of sustainable development in the NCS.

but also to them under-estimating the level at which they need to engage with the subject.

Interviewees thought that the deciding factor was the varying subject knowledge among Maths and Science teachers, rather than inherent features of the curriculum. However, some lecturers reported a recent “drop” in school leavers’ academic readiness, across the spread of schools. A recommendation was made, that the teaching of Life Sciences be promoted and strengthened in schools, because “universities cannot lower their standards to meet the standards being set at schools”.

Many school leavers who want to pursue studies at an academic university, but are turned down because of their marks, study at a University of Technology (UoT) in the hope of eventually making their way to academic university. The system is indeed increasingly set up to provide access from UoT to academic or comprehensive universities. It is an important study pathway for the environmental sector, where many diplomands or certificate holders are employed, only to find that their position increasingly requires higher level skills and post-graduate qualifications. However, our interviewees heard that at least one comprehensive university is no longer accepting B.Tech. graduates into its Environmental Management Masters programme, as these students cannot cope with the more rigorous demands:

- ✘ The “jump” between B.Tech. and post-graduate studies is too big.
- ✘ They lack the necessary background in research.
- ✘ They struggle to write essays and are not able to write research essays.
- ✘ They do not read as much as they should, struggle to read and to synthesise.

Further findings regarding subject-specific academic preparedness across courses are as follows:

- ✘ In the environmental sciences, students seem to consider environmental content as “general knowledge” and as a result they perform more poorly than they expect.
- ✘ School leavers are poorly prepared to deal with complexity (in environmental sciences).
- ✘ Botany undergraduates have “extremely poor” content knowledge. There seems to be very little botany in the school curriculum and understanding of ecology is “poor”.

Findings regarding the general preparedness of students for university life is also relevant, as it indicates that support is required for most students, and not just those from impoverished schools. One lecturer in Environmental Sciences, whose department draws from among the top school leavers academically, reports that:

- ✘ Many students are generally not well prepared for university; they struggle to follow their timetable, or to manage themselves in an open forum, and some remain “confused” for up to six months.
- ✘ As many as 50% come to class seemingly unprepared and simply wait to absorb what is on offer.
- ✘ Some students ‘lose’ themselves in the relatively free and unstructured environment of the university and do not cope with the lack of monitoring. The

students from privileged backgrounds may find this even harder than their peers with a less supported home and school background.

- ✘ When students fail in their first semester or first year they do not know how to recover from the experience, and this is generally not well supported in the HEI either.

Findings regarding general academic preparedness include:

- ✘ There is a variation in the levels of the general skills with which students enter university (science and environmental departments).
- ✘ Writing skills, for example, are variable but generally poor; many students struggle to put a document together and one observation is that “mathematicians can’t write”. Writing skills are better at post-graduate level if the undergraduate training has been at a ‘good’ university.
- ✘ Many students are not able to work with references – to find relevant sources and reference them, and to link and use them together.
- ✘ Language skills are often so poor that engaging with the taught content is a ‘huge challenge’, and reading skills are ‘superficial’.
- ✘ Many students lack basic skills e.g. cannot develop a logical argument, even at post-graduate level.
- ✘ Poor observation and interpretation skills, poor analytical and critical thinking skills.
- ✘ There is ‘resistance’ to numeracy and students struggle with population modelling.
- ✘ Students lack curiosity (although others observed “a willingness to learn”).

Academic support (provided either by the lecturing staff or by specialist academic development staff, or both) is thus required for both general academic skills (e.g. general writing skills - how to use paragraphs and headings in reports, and referencing) and more subject-related skills (scientific report writing, using graphs).

Efforts to address academic under-preparedness are introduced in Section 6: *What is Being Done*. Here it remains to be noted that:

- ✘ Human capital development efforts in higher education need to take cognisance of the trends, issues and developments in schools.
- ✘ The school curriculum policy is not the only factor to be blamed for the dire results of the majority of schools; actual curriculum delivery and attendant factors such as teacher knowledge and skills, teacher guidance and management at all levels of the system, may be even more critical.
- ✘ Schools’ results vary according to a bimodal distribution. Some schools are well managed and produce better results than others regardless of factors like race and resources. In other schools, poor management is so entrenched that general investments or national policies are unlikely to improve quality.
- ✘ Improving the quality of teaching of maths and science (with environmental content and values), as well as educators’ ability to develop learners’ language skills, are urgent priorities.

Higher Education's Alignment with the World of Work - Matching Expectations

There is a lack of empirical data with which to determine the actual demands in the workplace, and therefore, whether HEIs are meeting the demand (CHE, 2009; Vass et al, 2009). Although the Sector Skills Plans (SSPs) of the Sector Education and Training Authorities (SETAs) are meant to reflect sectoral skills needs, the SETAs do not use empirical research extensively or uniformly and the SSPs are generally regarded as too generic and not sector specific (CHE, 2009). In the case of the environmental sector, there are additional issues such as limited coverage of the sector in official statistics, the cross-sectoral and cross-occupational nature of environmental management, vague or outdated job descriptions, and so on.

However, the current research for the Environmental Sector Skills Plan and Human Capital Development Strategies aims to address the lack of empirical data as far as possible, and the initial indications are of high vacancy levels in the sector, which in at least some instances are due to a lack of absolute skills shortages. We also know that many professionals are appointed without the necessary qualifications; the biodiversity sector, for example, has been described as “under-qualified” for its mandated responsibilities (Vass et al, 2009).

Are universities responsible for a lack of appropriate skills? A number of areas were reported in which universities were not producing sufficient numbers of graduates, at the right levels, who were also interested in working in the environmental sector.

There could however be a variety of reasons for high vacancy levels and under-qualified staff, including ones that relate more to employers' budgets and HR (human resource) practices, than to what universities offer. This is not an insignificant point. For example, environmental units may produce graduates who do not find work because there is no money to appoint them, and this will have a negative feedback. The Institute of Water Research, for example, reports a perception of the Department of Water Affairs as a “sinking ship”, reducing the popularity of water studies; this despite there being a shortage of qualified water quality managers in the country.

In this report, however, we do not address factors in the workplace. Our concern is whether universities are producing the necessary graduates, at the right levels (See also *Encouraging Post-Graduate Studies*, below) and specifically, whether the skills developed are relevant and of sufficient quality.

Are universities giving adequate attention to the relevance of their courses and curricula for the world of work? There is a popular perception that they do not, but our research suggests that while this varies across study fields and institutions, many course and programme convenors do give considerable attention to the relevance of what they offer.

A study that included veterinary sciences and engineering (Kraak, 2008) concluded that HEIs are generally ‘in touch’ with the sectors into which they feed and that they

do respond to meet national demands. In the environmental sector, there are close links between study fields like Forestry and Ichthyology, and employing industries. The George (Saasveld) campus of the Nelson Mandela Metropolitan University has a long-standing relationship with the forestry industry, for which it trains at Certificate and Diploma level. Curriculum changes and student quotas are discussed at an annual forum involving the School of Natural Resources and the industry, which also provides bursaries directly to the institution.

The Ichthyology Department at Rhodes University works closely with industry and claims to “know its needs”. The researchers who teach here are actively involved in the industry, and this seems a significant factor in establishing links with the workplace, ensuring the relevance of training, and facilitating employment for graduates. This Department, like many others, also provides on-demand short course training for various agencies.

In other study fields, like environmental sciences, the more varied market makes it more difficult to stay in touch with all potential employers. There seems to be such a demand for employment in the environmental sciences, that students do get jobs, even though the departments do not “train for a profession”. Several of the staff we interviewed were actively involved in the world of work (e.g. through consultancies, which are used as training opportunities for student projects). Through these links, promising students were sometimes identified by employers before they graduated, and were ensured of employment. The readiness with which graduates find work in turn contributes to these courses being a popular choice among students.

As noted before, however, the quality of skills produced in environmental management are reported vary among HEIs, and graduates from some historically disadvantaged institutions in particular are said to have competencies that are “too shallow” for the demands of the job (e.g. processing environmental impact assessment applications). We were unable to probe deeper into this situation, to explore for example whether the staff at these institutions were less involved with industry than at the more reputable institutions.

Based on our limited review, Universities of Technology (UoT) staff seem to have less extensive involvement in the environmental employment sector, and less incentives to review their curricula in relation to the world of work. Traditionally, UoTs have had closer ties to employers and their graduates were regarded as practitioners who can ‘hit the ground running’, better prepared for the world of work. Universities of Technology still provide the backbone of training for entry-level biodiversity conservation management, for example, but several UoT staff reported that their students found it difficult to find placements for the compulsory work experience component of their courses. This, and the fact that many environmental diplomands are unable to find work, might reflect a mis-alignment between training and employment. Environmental agencies might be increasingly requiring higher-level skills and therefore more readily engage with universities. A number of academic or comprehensive universities are now offering short courses that are tailor made for employers (such as protected areas or the mining and chemical industries). Some

commentators also expressed concerns that some UoT curricula are not keeping pace with the rapidly changing demands in the world of work (e.g. a new focus on conservation in urban contexts, social ecology, etc). The demands from the modern nature conservator are considerably different from what they were two or three decades ago, when some of the existing programmes were first put together.

The challenges of curriculum reform are discussed later.

Next we look at what kinds of skills academic staff believe they should be developing in their students, in order to meet the demands of employment in the environmental sector. The perspective of employers was not extensively probed in this particular study, but observations elsewhere suggests that:

- ✘ In government departments there is a great lack of knowledge and skills. We heard that “Staff often use a check box approach due to poor understanding”.
- ✘ In NGOs there is a need for both technical knowledge, and advocacy skills (the latter seems to be a ubiquitous need, across agencies).
- ✘ The private sector seems to be housing a considerable portion of the existing skills and knowledge, but the depth of knowledge among consultants can also be poor, and the clients may be unable to discern this.
- ✘ Given the nature of the knowledge demands, the field needs more people with degrees – particularly higher degrees.
- ✘ Short courses at university-level are useful in a demanding and rapidly changing field; they can be used to update employees’ knowledge, and to build the expert knowledge required in particular contexts, once the generic knowledge has been built in a graduate or post-graduate programme.

Skills that universities need to build (according to academic staff interviewed):

- ✘ Research skills
- ✘ Population modelling
- ✘ Project management
- ✘ Monitoring, valuing resources and working with trade-offs
- ✘ Strong leadership
- ✘ Dealing with complexity, unpredictability, rapidly changing field and risk (responsive, environmental decision making, problem solving, application, adaptive management, risk analysis, lifelong learning); it was noted that scientists who return to university for short course training were unable to think beyond a narrow disciplinary perspective, and to ‘see a bigger picture’.

Knowledge required:

- ✘ Deep understanding of functioning of the bio-physical environment, socio-ecological systems
- ✘ Multi- and trans-disciplinary knowledge as well as deep knowledge of the subject
- ✘ Understanding different spatial and temporal issues (e.g. in relation to global climate change, local issues)
- ✘ Climate change
- ✘ Renewable energy
- ✘ Food security
- ✘ Resource economics

- ☒ Sustainable urban environments
- ☒ The theory to design rapid surveys, inventories and monitoring programmes (e.g. as part of adaptive management strategies).

Values and interests:

- ☒ Commitment / passion for the environment
- ☒ Integrity, a strong work ethic and professionalism – including taking responsibility for own decisions.
- ☒ Being comfortable in the natural environment (so as to be able to do and therefore understand fieldwork, even if this is not part of the eventual employment).

Based on the above, and our interactions with the sector in the Human Capital Development stakeholder meetings, there is a strong correspondence between what is needed in the world of work, and what some of our interviewees at university described as their intended learning outcomes. Two factors are significant, however.

Firstly, lecturers were not confident that they were able to develop these skills, for a number of reasons:

- ☒ Students come to university poorly prepared academically (see above)
- ☒ Large classes combined with the above factor makes the development of some skills more difficult
- ☒ Students often do not progress to higher education, and many higher order skills can only be developed at Masters and PhD level
- ☒ The cross- and trans-disciplinary training that is required is new and difficult (see *Curriculum Transformation*, p.34).

Secondly, not all interviewees were as comprehensive in their responses about the skills that they needed to develop among environmental graduates. Some seem to focus almost entirely on a mastery of the technical/factual knowledge of the discipline and regarded lecturing as the only teaching method that could provide the required coverage of extensive content.

This correlates with findings in the Graduate Attributes Study by Griesel and Parker (quoted by Pretorius, 2009) on how employers rate attributes of recent graduates (with an undergraduate qualification) in the workplace. The study, undertaken by SAQA and HESA (Higher Education South Africa), suggests that in terms of knowledge and intellectual ability – what many would regard as the core business of universities – the HEIs are fairly adept at meeting the expectations of employers (although we have seen some exceptions, as in the case of environmental management graduates from some universities, quoted above). However, when it comes to work place skills and applied knowledge, employers found graduates wanting in their “ability to choose appropriate information to address problems” as well as their “ability to plan and execute tasks independently”. In the category of basic skills and understanding, which includes “communicative competence in English”, numeracy, computer literacy, and the “ability to find and access information” (a highly rated attribute) employers generally reported that they get less than what they expect (for the full report, visit www.mg.co.za/graduates).

Griesel and Parker's report goes on to recommend:

- ✘ A formal mechanism – a higher education/ business association that could ensure ongoing collaboration between the sectors
- ✘ A more porous boundary between universities and businesses so that students have a clearer idea of employers' expectations
- ✘ Better development of career literacy at university, and
- ✘ An honest engagement about employer perceptions that all institutions do not offer the same quality of training.

Challenges in the Short Course Environment

One of the ways in which HEIs respond to the demands of the professional and occupational world, and the demands arising from the environmental crisis, is through changes to their traditional under-graduate and post-graduate programmes and course curricula (see curriculum transformation, below). Another mechanism that has been widely employed has been the development of short courses that address new areas in the environmental arena (such as the introduction of new policies or systems such as integrated environmental management and environmental impact assessment; or community-based natural resource management; stewardship or catchment management) and meet new needs in the workplace.

Challenges experienced by HEIs that offer short courses include the following:

Quality Assurance for Short Courses

While concerns have been expressed about the quality of short courses offered to the environmental sector, it would seem that these concerns relate mostly to courses offered by private companies. The HEIs we interviewed make significant efforts to ensure quality courses (see *What is Being Done*, p.45). There are challenges, however. Among them is the need to find suitable additional staff when necessary to offer such courses, particularly when there are budget constraints. An example is the Gold Fields Environmental Education Course that has been offered at Rhodes University for more than a decade. The course has had to rely on corporate funding in order to keep costs low, but its expenses are relatively high given that it has a semi-distance and 'open' learning format, and requires experienced regional tutors to support students. Ongoing research and evaluation has been a strategy for quality assurance. Institutional criteria for short-course registration have been less useful.

Assessment is also used as a feedback mechanism to inform quality assurance (and to conform to accreditation requirements). Short course convenors have struggled with suitable assessment strategies that both enhance learning, and meet regulatory requirements (see Case Study 2 in Rosenberg et al, 2009a) The Centre for Environmental Management at the University of Pretoria uses examinations as a means to ensure quality of courses and give feedback to students and employers.

They find that the examination is threatening for many, because it is not content-focussed, but requires high level integration of learning. If course participants lack such skills, it would be difficult to develop them in a short course or two, unless there is careful attention to the design of the courses. It would almost certainly require the courses to be offered over an extended period of time, with 'work away' tasks, workplace application and reflection between contact sessions. However, this format is the exception rather than the rule.

Accreditation

Accreditation of short courses offered by universities have presented a particular challenge, in that there has not been integration between the education and training quality assurance body for higher education, and the ETQAs for the other sectors. In many instances it is not clear whether a short course offered by an HEI is accredited or not; those who are registered with the Sector Education and Training Authorities are recognised and accredited by them, and others are not. The latter registration is usually effected where the HEI has staff dedicated to this role; where academic staff who develop and offer courses are tasked with seeking accreditation outside the institution, this has often been a bridge too far.

Selection

In order to ensure that participants are able to have maximum benefit from a course, and that they are able to progress and made contributions, it is important to select them well: Do they have the necessary qualifications or prior learning, are they in a suitable position to apply their learning, etc. Course convenors experience a number of challenges in this process: CVs are often misleading; often the most suitable candidates cannot afford the course; and employers send students on short courses simply for compliance reasons, and/or make poor choices in course and student selection.

Cost of Courses

Short courses are often expensive. Sometimes course costs are affected by efforts to customise the content for particular clients or participants, or to measures to improve the course quality. Costs are also affected when the course must provide an income stream for the HEI. In the environmental sector concerns have been expressed that some university-based short courses are too expensive.

Sequencing of Courses

Where a range of short courses are necessary for the individual's career path or to address the needs of the workplace, it is important to think through what courses are selected and in what order they are completed. Course convenors find that this is seldom done, and courses are often taken in an ad hoc and haphazard manner.

Pace of Delivery and Duration of Courses

There are often discrepancies between the pace at which courses are delivered, and the “work ethic” of the students, or their ability to keep up. At the Centre for Environmental Management at Pretoria University, for example, students are on course from 8 am to 6 pm, after which they have homework for the next day. At the Rhodes Investec Business School a short course in environmental management lasts all day and is followed with group assignments in the evening. Many are not used to this pace, or cannot fit it around other responsibilities. The capacity of the organisation to release staff for study is one of the most critical considerations in what HEIs can offer the field, and HR practices in this regard need consideration.

Readiness of Students

Like undergraduates, mature students too are often not academically prepared for the level at which short courses are offered – or enter a course thinking of it as merely a ‘gap filler’. Most short courses seem to be offered at Level 6 and whereas employees who attend them are generally appointed at levels that require Level 6 or above qualifications, they often struggle. Areas in which participants struggle include:

- ✘ Lacking basic content knowledge assumed to be in place (here some convenors are considering offering bridging courses below Level 6).
- ✘ Inability to read a reasonable amount of material, to read and form an opinion.
- ✘ Inability to analyse, synthesise and integrate within a “holistic vision”; inability to see the ‘big picture’ – noted among specialist scientists, e.g. biochemists.
- ✘ Writing and referencing skills – ability to acknowledge sources; one convenor reports “copying from the internet” and a “cut and paste mentality”.

Curriculum Transformation

Several interviewees described their courses as ‘evolving’ in response to a variety of factors including “the challenges of the changing world”. Academics noted that not all their colleagues were equally enthusiastic about curriculum change, however, and that some “seem to subscribe to the old adage: ‘if it aint broken, why fix it?’”

Why indeed are curriculum changes needed?

Firstly, there is the need to review curricula to ensure adequate quality of learning outcomes given the challenges of a changing student body, as wider access to higher education is promoted. This would not mean a lowering of standards or changes in content, but rather heightened attention to educational methods to ensure quality learning outcomes among a range of students, some of whom have been disadvantaged by their formative education, and language background. A minority of lecturers interviewed spoke about such curriculum changes. Their responses are reflected in the discussion about quality of delivery, below.

Secondly, in response to growing environmental issues, awareness and sustainability practices, new areas of research and work have opened up, and new courses – or at least new content in some courses – are necessary to address these.

Staff offering environment-related HE programmes report that they need to take cognisance of developments such as:

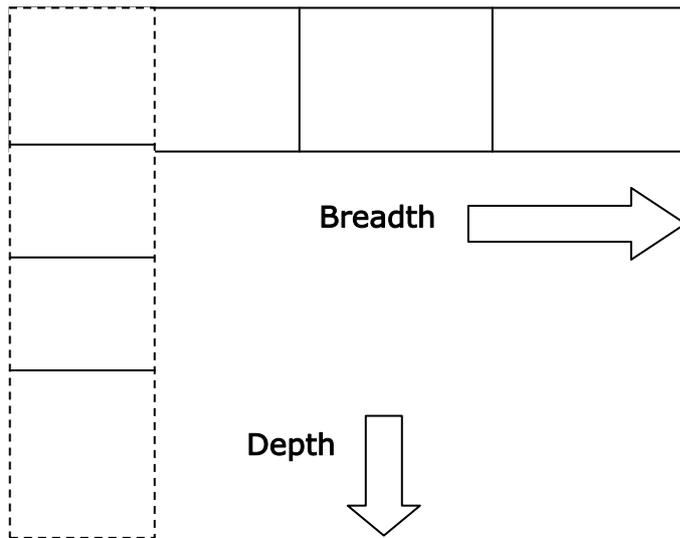
- ☒ A rapidly changing field
- ☒ The economic growth imperative and macro economic trends
- ☒ Scarcity of resources
- ☒ Increase in environmental impacts (of all kinds)
- ☒ Recognition of links between poverty and environment
- ☒ New legislation in South Africa
- ☒ Urbanisation and the need for urban conservation.

In some departments and HEIs, curriculum change seem to involve little more than the introduction of new topics, and there the challenge is how to fit these in 'on top of' existing content, which is still regarded as relevant. It would seem that the result is often a rather sketchy introduction to important new areas of learning and work.

In other cases there are calls for more fundamental curriculum transformation – what UNESCO termed a 're-orientation of education' in the light of the challenge of environmentally sustainable development. This may include changes in the selection of what is taught in courses, and how it is taught, as well as how curriculum offerings are structured across programmes and departments. In particular, HEIs have started to develop more multi-disciplinary programmes (e.g. Conservation Biology with majors in Botany and Zoology or Freshwater Ecology) and cross- or inter-disciplinary programmes (e.g. Environmental and Geographical Sciences with subjects ranging from Anthropology to Zoology – across the Sciences, Commerce and Humanities).

In the field of conservation biology, Soule and Oriana (2001) wrote: "Twenty years ago the tendency was to study pristine systems in isolation from the human and global matrix in which they were embedded". Today there are new frameworks for studying and managing the environment. The sciences have in some instances moved on from the Newtonian understanding of a universe of discrete components that can be studied in isolation in order to solve problems. Conservation biology, for example, has seen a shift from the 'command and control' approach in game management, to process-based and adaptive management of what is now perceived as complex socio-ecological systems in wider scales of space and time.

The Millennium Ecosystem Assessment of 2000 reported that changes in our social systems in order to better manage our bio-physical environment were not keeping pace with man-induced changes in ecosystems. Scientists involved in the application of their knowledge in some advisory or physical management capacity report that they need a better understanding of the social components of environmental issues in order to make decisions. Professionals faced with the challenges of the workplace report that there is a need for both a breadth of environmental and associated knowledge, and a depth of knowledge in particular subject areas.



Calls for curriculum transformation therefore include (from higher to lower levels of change):

- ☒ Different paradigmatic frameworks – complexity vs reductionism
- ☒ A broader scope of disciplines/approaches, from the biological to the social
- ☒ The development of breadth as well as depth as desired learning outcomes
- ☒ Inclusion of new programmes and new topics (e.g. philosophy of science, social ecology, complex systems, plant ecology and conservation, disturbance ecology, freshwater ecosystems, urban conservation ...)

But while many subscribe to the need for these changes, interviewees and the literature report that crossing disciplinary boundaries, in particular, has been difficult for faculty and students alike. Cummings (2006) notes that “The standard risk-averse strategy is to remain in disciplines rather than to break new ground and meet recognised priorities in conservation research”.

Associated quality challenges observed in this study include:

The challenge of transforming curricula with existing staff bodies

Several faculties, schools, departments and other units seem to have dynamic leadership who want to introduce curriculum change, but staff who do not share their vision and enthusiasm for such changes, form significant barriers to such change. Some units have such entrenched cultures and conservative staff bodies that not even bringing in new staff could turn the situation around; the new staff found the situation stifling and left. Units that have been successful have started afresh and built up a body of diverse staff who complement each other’s areas of expertise.

Curriculum design and pedagogic challenges in inter-disciplinary courses

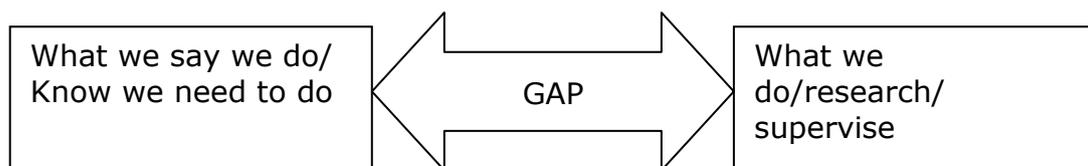
Diverse learner backgrounds present a teaching challenge in inter-disciplinary learning programmes. Interviewees report that where students enter programmes

such as Geographical and Environmental Sciences at third year or post-graduate level, via different disciplinary learning pathways, there are differences in their background knowledge and competencies. This would require considerable pedagogical and programme design skills.

Experience has also shown that when *different faculty members* with different specialities teach a variety of discrete modules in a programme, there is a need for integration in that programme, both through a coordinating person or process to help students ‘hold it all together’, and through a coherent conceptual framework through to sense of the diverse inputs, and gain tools for understanding and application across fields and disciplines. In the absence of such integrative frameworks people have difficulty in applying their learning. An example is when young professionals attend a variety of disparate short courses (Rosenberg and Sisitka, 2007).

It was also noted that there is often an *‘imbalance’ in students’ knowledge*; they might know the biological or other technical knowledge ‘inside out’, but while they have a sense of social dynamics, they are not conceptually equipped to develop a balanced perspective. This not only reflects on the fact that technical knowledge is not the same as conceptual knowledge and the ability to apply, but also on the differences between technical sciences and social sciences. As one interviewee put it, “The challenge is to bring together things that don’t necessarily meet; the two – [social and natural sciences] - often have different initial aims”.

Interviewees noted that “inter-disciplinary research is difficult”, and one person reported that there is often no relation between taught (new) theory and chosen theses; the ‘imbalance’ in knowledge may extend from students’ knowledge, to supervisors’ knowledge, and may be a factor in this scenario reported in new or revised programmes:



Practical challenges for inter-disciplinary programmes

One interviewee indicated that, while ‘inter-disciplinarity’ was needed, it was ‘not provided for in our programmes’. While many universities have given academic staff a mandate for inter-disciplinary work, working across departmental and disciplinary boundaries remains a challenge. It seems most difficult when it is the initiative or responsibility of individuals, without support from colleagues and/or leadership, and there seems to be a lack of practical (as opposed to on-paper) institutional arrangements for cross-disciplinary programmes.

The situation is exacerbated by battles for territory (students, credits and funding): because subsidies are based on the number of students per department, there is competition between departments for students and this mitigates against the sensible running of cross-disciplinary programmes. Subsidising schools rather than departments might be one practical way to overcome this pervasive problem which at times results in decisions that are not in the interest of the educational offering. Many such practical institutional changes are required, before the rhetorical agreements can translate into the smooth running of meaningful programmes.

Related practical challenges in designing, funding and running inter-disciplinary programmes are:

- ✘ Time tabling difficulties.
- ✘ Staff availability
- ✘ Staff loyalties and the need to 'protect' the more traditional as well as foundational subjects
- ✘ Lack of funding for newer initiatives (through subsidies)
- ✘ The need to find a balance between too much structure (to ensure adequate curriculum coverage) and too much flexibility (to meet student interests)
- ✘ The need for a grounding in some foundational knowledge
- ✘ Meeting professional accreditation requirements (currently the only option for environmental scientists is to register with SACNESP, which requires them to major in the traditional subjects).
- ✘ At a post-graduate level, coursework formats provide for the opportunity to develop multi-disciplinary knowledge and inter-disciplinary understanding, but these programmes are often very 'full' of content and the research component reduced. For example, the UP School for Environmental Sciences has a masters programme in which coursework leads to 160 credits and research to 100 credits (for a short research report – less than a half thesis). At the University of Johannesburg, in a similar Masters programme, the Masters is only one third of the course, but students are meant to "publish at least one" article from their mini-thesis. Convenors find that the research produced is superficial and the skills developed limited.

'*Paradigm wars*' between the Bio-Physical and Social Sciences might be conceptual in nature but they have a practical impact on the readiness and ability of academics to collaborate in inter-disciplinary programmes. There is unfortunately, with some exceptions, a lack of useful environment-related research and theoretical frameworks in the Social Sciences, and few academics with a breadth and depth of experience in both the Social and Natural Sciences. Yet a growing number of students with a social background want to study and research in the environmental arena, and similarly large numbers of students with a natural science background, want to undertake research with social science dimensions. The results are often poorly supervised and conceptualised studies that do little to advance our collective understanding of the socio-ecological issues of our time. They also do little to quell the lingering scepticism on both sides of the paradigm 'wall'. As one interviewee noted: "What we need to do is first to acknowledge the validity of each of these as a valid science. The

willingness is not quite there. ... We all need to understand things better.” Studies that address both social and ecological dimensions of the environment and sustainability (e.g. studies on biodiversity conservation and governance of wetland use in communal areas) are in their infancy and given the enormity of the need for a better understanding, precious few people are working in these areas.

Mechanisms for Recognising Academics’ Achievements

In this study and elsewhere in the Human Capital Development stakeholder engagements, researchers noted that the current system for evaluating and rewarding academics represented a challenge in the quest for delivering more environmentally relevant research, and needed to be revised, in order to better match new understandings of the kind of scholarship required at this time.

The number of publications produced by a scientist is taken as a proxy for the quality of his or her work, and the impact of that work is measured as the frequency of it being cited by others. Yet this may be a poor indicator of the quality and relevance of that work. In many instances the ‘publish or perish’ model of advancing science encourages narrow research that can be easily sliced into publishable chunks; it often mitigates against inter-disciplinary research and working outside traditional disciplines, for which there is not always a demand in established academic journals. Other modes and avenues of publishing may encourage the wider practice and sharing of ground-breaking, inter- and trans-disciplinary work.

Publications often also carry a disproportionate weight in the evaluation of university staff’s achievements and the allocation of research funding. Yet Prof George Philander⁸ (2009) suggests that scientific innovation is likely to come from an investment not in those who write the most papers, but from investments in those who mentor the most students. Experience in innovation hubs like Silicon Valley suggests that it is the students who become innovators and entrepreneurs, not their professors. An uncritical focus on more PhDs and more publications, may not actually improve the quality and impact of science in South Africa.

However, the environmental sector does need the confidence, credibility and higher level analytic, leadership and strategic skills that are more likely to be developed through doctoral studies (see below). Perhaps the issue is more where we place the emphasis in what we reward as academic output. One could argue that publications (and other engagements) that reach wider stakeholder groups and audiences, contributing to policy development, governance or public awareness (for example), should receive similar recognition to contributions to the discipline itself, and that mechanisms should be found for encouraging exploratory work into hitherto unrecognised areas of work, the importance of which is however general accepted. Multi-disciplinary and “relevant” research are noted as priorities in the National

⁸ Prof Philander is research director of the Africa Centre for Climate and Earth Systems Science (Access), www.africaclimatescience.org.

Research Foundation's Focus Area Programme, but interviewees wanting to work on such areas reported that there was not enough funding to support them.

Prof Philander argues for the importance of mentoring students, from whose work innovation (and other benefits) may spring. Research supervision is an important mentoring process, but time consuming and often largely un-rewarded, in comparison with producing one's own research. When attempting to combine the two, by endeavouring to co-publish students' work, one runs into the problem of the need to first build the students' research competencies, particularly in the more demanding cross-disciplinary contexts.

Encouraging Post-graduate Studies and Equity

There are a number of indications that the environmental sector needs more higher level skills, that are developed through post-graduate higher education. Yet studies (e.g. Vass et al., 2009) show that there continues to be a significant drop between the numbers of students who graduate with a first degree, and those who graduate with an Honours and particularly, a Masters or PhD.

In the South African HE system about 64% of qualifications are awarded at undergraduate level (CHE, 2009). Although post-graduate degrees at Universities of Technology have been steadily increasing over the past five years, they are still a very small proportion (see Fig 1, p.20). Post-graduate qualifications at Comprehensive Universities have remained the same in this period, but the number of post-graduate qualifications have been decreasing at Academic Universities, from 42% of qualifications in 2004 (23, 578) to 36% of qualifications in 2007 (21,430).

Despite the growing numbers and proportion of Black students in under-graduate programmes, proportionately more White and Indian South Africans enrol for and successfully complete postgraduate studies, than Black South Africans. The pattern carries through into doctoral research; of the 1,100 students who were awarded a PhD in 2006, 56% were White and 30% Black Africans. Considering that 13% of doctorates in South Africa are awarded to foreigners, and most of these foreigners are Black Africans, very few Black South Africans are emerging from the South African HE system with a PhD. Of the researchers currently rated in the NRF system, a mere 12% are Black Africans, and 90% of scientific papers are produced by white authors (CHE, 2009).

At a micro-level, our interviews illuminate the situation in one environment-related graduate programme at a previously disadvantaged institution (UWC). Here, very few of the university's own undergraduates move into its post-graduate programme; the 20 MSc and 10 PhD students currently in the programme come mostly from other

universities in and outside South Africa⁹. A similar pattern has been observed at Fort Hare University.

Why are so few students, and particularly Black South Africans, completing post-graduate studies? As noted at the start of this section on Challenges, the direct and indirect costs of studying at university are a significant deterrent. Many South African students are first generation graduates and there is tremendous pressure on them to enter the job market as soon as possible, often before they enrol for or complete a higher degree.

But cost is not the only factor. Many students struggle academically to complete their studies. For example, students may complete the course work half of a Masters programme, and then fail to complete the research component. In the University of Johannesburg's Environmental Management course at Masters level, some 50% of students 'drop out' before completing their mini-thesis. In most institutions the more unfamiliar demands of conducting research is almost certainly a factor, as is the availability of suitable supervisors, and the quality of supervision offered to students, both within traditional disciplines, and across disciplinary boundaries.

Prof Rob Slotow¹⁰ argues that the Masters should be seen primarily as a training ground¹¹ for basic research skills, rather than an opportunity to produce research outputs (papers). With such an orientation, more attention might be given to quality supervision and tuition. This is not always the case, e.g. in many Masters programmes the students is required to produce "at least one" publishable article. But in other cases, the issue is simply the availability of suitably qualified staff to supervise research (see *Staffing Constraints*).

Reputation of and Disparities between Institutions

Post-Apartheid reforms have tended to focus on wiping out funding imbalances between the White Afrikaans and English speaking universities on the one hand, and the former 'homeland' HEIs. Unfortunately other disparities remain. Among them is the reputations of the institutions. Both prospective students and employers believe that there are considerable differences in the quality of education offered and skills developed at different institutions, and this is a significant factor in determining choice of university (Cosser, 2009).

⁹ Some previously disadvantaged universities also claim that their best graduates are being 'poached' by other HEIs who might have better reputations, and (possibly as a result) greater access to research funding and bursaries.

¹⁰ Prof Slotow teaches in the life sciences at the University of Kwazulu-Natal.

¹¹ It is interesting that masters by coursework is often not regarded as a significant route to building research capacity, even though it can be the basis for a PhD, and is particularly useful in cross-disciplinary study fields, where a course-work component establishes a common core of cross-disciplinary knowledge.

As a result of a poorer reputation, the under-graduate environmental programmes at historically disadvantaged institutions we were able to visit in this study, tend to attract mostly those students who have poorer matric pass marks, and thus fail to get a place in their first choice university. Some departments are “dying” with numbers as low as 20 first year students. Of this small number of under-graduates, a mere third is likely to pass, thus further damaging the reputation of the institution; it is a vicious spiral of note. Some staff we interviewed seem under-utilised, and consider that they have the capacity to double their numbers of first year students¹².

On the other end of the spectrum, an institution with a strong reputation offers a similar environment-related programme which had previously (in 2004) had similar numbers of first year students (12) but which has since the introduction of new staff, been growing steadily and now have an intake of 60 first year students. These numbers exceed what the current staff complement can cope with. There is a 80-90% pass rate (in a 4-year BSc Hons course). However, the racial profile of these students is unrepresentative, with the great majority of Black African students being from outside South Africa.

The latter course is described as “attractive to students” and it is clearly a success: it has a high enrolment rate, high throughput rate, and high conversion to post-graduate studies (one third of Honours students register for Masters studies and 5% of Masters students progress on to PhD studies).

What makes for popular and successful courses? Here we note only that the reputation of the institution has a significant material effect on what staff are able to do. But what is being done in the institution, including staffing and teaching methods used, is obviously also important. We consider these factors in Case Example 3 in Section 6, *What is Being Done* (p.49).

Career and Study Guidance

Elsewhere we explored the extent of guidance to school pupils on study choices and career possibilities in the environmental sector in the school context itself (Rosenberg et al, 2009c). This study has not gathered a large body of information on the extent of career and study guidance in the university context, partly because it was not its main focus, and partly because it was difficult to secure and fit in additional interviews with student guidance bureaus. However, the following has come to light:

- ☒ Most of the study and career guidance around environmental options we encountered in this study, are done by academic staff themselves.
- ☒ The environmental career and study guidance done by student guidance bureaus at universities, to either schools or university students, seems far more limited.

¹² As noted above, these HEIs may also lose potential research students to other institutions, for similar reasons. It was also noted that UWC, Fort Hare and Venda have in the past decade lost the strong reputation they had before, in some related Departments.

Guidance by academic staff

In several departments we visited, with active programmes in the environmental sciences, academic staff do outreach work to schools (with the main focus being on attracting more Black South African students to those programmes). Best practice with regards to study guidance is to have academic staff with a dedicated student support role, with good knowledge across various departments and programmes, advising both first year and final year students, about appropriate subject choices, and further study and career possibilities. In these examples the staff have a good sense of practical possibilities in the world of work, through their own active engagement in the field (consultancies, research projects). These staff also set up interactions for students with environmental agencies (e.g. local government) to give them a better sense of what is involved in the job, and what employers look for. This is reported to be difficult to set up and time consuming, but worthwhile. It was noted that many students entering university have no sense of the requirements for practising as an environmental scientist. A lecturer from Fort Hare reports that he would like to do something similar, through fieldwork at potential employers, but that a lack of funding is a constraint.

Guidance about possibilities in post-graduate studies seem to be often informal through word of mouth and networking between students, and students and staff, but some institutions (e.g. University of Pretoria) have an internal Open Day to promote possible post-graduate studies. This institution has the highest number of doctoral degrees in environment-related fields, in South Africa.

Guidance by Student Advisory Bureaus

These bodies seem to have limited knowledge of environmental study and career options, and limited incentives to promote them.

Case Example 2: Career Guidance to Schools at Rhodes University

The Director of Guidance at one academic university reports that he has met with 600 scholars or undergraduate students in the past year (on a one to one basis). He notes that only two of them had enquired about environmental study fields. He knows very little about environmental studies and careers, and has virtually no advice and no materials to offer. He also does university outreach visits to schools, but he had never been asked to talk about environmental careers.

An academic staff member at another university reports that it has been difficult to get the student advisory bureau to promote that institution's environmental science centre, despite the academic staff requesting increased marketing. The more traditional science subjects are more readily promoted at this institution, and only one environmental professional (that of environmental officer) is listed in the university's marketing material. This staff member argues for involvement of academic staff in the

marketing committees who plan the promotional materials. The institution's intent in growing environmental programmes also seems to be a factor, and some HEIs seem to be ambivalent about their intent to grow their environmental offerings. One comprehensive university invested considerably in a staff member to set up an environmental management programme, but is now not promoting this programme. Diverting students away from traditional science subjects could perhaps be a concern.

A point was also made that when environmental study fields are promoted to schools, it should be done with reference to possible careers, given that scholars make study choices according to knowledge of careers, and that students define their subject choices in terms of "What will I become?"

6. What Is Being Done

Efforts to Ensure Quality Despite School Leavers' Academic Weaknesses

All universities we interviewed had programmes to address the gap between the academic skills of students from disadvantaged schools, and the requirements of higher education. Some institutions seem to have more extensive programmes than others, however. It was notable that despite the HEIs with strong reputations (such as UCT) being able to attract and select the strongest students, they still had extensive academic development programmes.

The following types of academic development and academic support initiatives are offered at HEIs:

Extended Programmes

Most of our interviewees' undergraduate and several post-graduate programmes have an extended option: an additional year is added to the 'normal' duration of a diploma or degree during which 'weaker' students take the required subjects more slowly, and supplement them with academic development courses. The latter are in English/Language proficiency; Statistics/Mathematics; and Computer Use. Entry tests identify which students will need the extended programme. Once they score below a cut-off point the extended programme is compulsory. All HEIs, academic and UoT, historically advantaged and disadvantaged, offer the extended programmes.

A variation is the opportunity to do a bridging year, which provides a general academic (or science focussed) orientation.

Do the extended programmes help to improve quality? They may be an important mechanism to help students with deficient educational backgrounds to graduate, but they are not without problems. At UWC the extended programme group was anticipated to be the smaller group, but it is now bigger than the normal 3-year programme, and as a result, difficult to manage and offer the required support. In the School of Natural Resources at the George Campus of the Nelson Mandela Metropolitan University, lecturers note that they are still not confident with the English communication skills of students who graduate from their certificate and diploma courses, although the extended programme does give the School an 80% pass rate.

Tutorial Support

HEIs have a long-standing tradition of using tutors. Most interviewees indicated that this was an effective strategy, but the experience and availability of the tutor seemed important factors in its success.

- ✘ Tutors usually lead practical sessions e.g. on statistics and computer skills. In the Rhodes University Environmental Science programme the effectiveness of these practical tutorials are evident in the students' assessment.
- ✘ In the Botany Department an extensive practical programme includes tutorial support with writing, oral communications, maths, field work and projects. Relying on a single tutor who is a post-graduate student did not work as well as when the tutor has educational experience. The effectiveness of this support is seen in the pass rates of the students, and post-graduate students who go through the under-graduate programme tend to write better than graduates who join the department from other HEIs.
- ✘ In the Ichthyology programme at Rhodes tutorial programmes are also used to strengthen writing, oral presentation skills, numeracy, as well as proficiency in experimental design, data analysis and statistics; this department noted that post-graduate students, particularly those who graduated in other HEIs, need considerable support in experimental methodology.
- ✘ In the Institute for Water Research post-graduate students who need support work either individually with tutors, or in small cohorts on writing, computer and library use and communication skills.
- ✘ The Rhodes Environmental Education and Sustainability Unit uses tutors throughout the country to provide regional support to students on its semi-distance/open learning courses.

Student Counsellors and Advisors

Student counsellors and advisors were mentioned by interviewees at several HEIs. As a specialised function in the university they provide individual students who seek them out with guidance on social-psychological matters, or career and study guidance. However, as noted above, the formal student advisor services in at least some HEIs have very little knowledge about environmental study and career paths. It was notable that academic staff also provide additional counselling. At UWC a science lecturer felt that academic staff have to play the role of “social workers” on many occasions. At UCT faculty members are appointed as student advisors; lecturers have additional roles to advise either first year students, or post-graduates, particularly about study choices in the complex area of environmental sciences. This is regarded as a time consuming but worthwhile job, and there is formal recognition for this function in the institution.

Web-based Support

A number of HEIs offer web-based support for courses. In one university the programme called CLICKUP provides students with presentations, lecture notes, study guides, group activities, critical thinking questions, seminars, talks, short electronic tests, and self-assessment questions per chapter. It seems important to

work out how to use the e-learning resources well. While it can perpetuated a “why go to class” attitude, according to one staff member, it can also be used to deal with large classes and large volumes of content. In one department, compulsory web-based tests are used to check whether students have engaged thoroughly with the prescribed readings, and the ‘chat room style’ forum is used to encourage small groups of students to discuss issues with each other – thus addressing skills development in addition to the mastery of content.

Quality Courses - What Works?

What are the ingredients of a good quality course in the environmental field? Some of the elements mentioned by interviewees are:

- ☒ Good affinity with the discipline
- ☒ Good mentoring and role models for students
- ☒ A solid knowledge *and* skills base, both at graduate and post-graduate level
- ☒ Combine theory with practice
- ☒ Research component
- ☒ Enable students to deal with real life problems (see below).

Elements that are thought to strengthen the quality of short courses are very similar:

- ☒ Use of suitably qualified, informed and experienced facilitators
- ☒ Passion for the subject and inspirational teaching
- ☒ Well-structured course material
- ☒ Quality management
- ☒ Regular revision and update of courses
- ☒ Comprehensive student assessment and moderation
- ☒ Combined theoretical and practical teaching philosophy.

Factors that seem to distinguish between institutions in terms of the reputation of the quality of the courses they offer include:

Opportunities to engage with real life problems and contexts

This seems to be one of the elements that distinguish the quality of tuition at better-reputation and poorer-reputation HEIs. At the latter, staff noted that there is a need to expose students to potential work contexts, where the issues they learn about are evident and the skills they need to develop, are needed. The interviewer noted that a lack of funding (for transport, accommodation, stipends for students) was preventing this fieldwork component at his institution. At the more renowned HEIs, staff spent considerable time to get involved in private sector work, in order to create learning opportunities (projects) for students. This is evidently easier in urban than in rural HEIs, as there are more project opportunities. In smaller urban areas such as Grahamstown, there are opportunities to engage with local authorities and NGOs.

HEIs that offer short courses targeting particular employers consistently use consulting in the field to develop a good understanding of the work place, and to build up case examples which are then used for teaching purposes.

Staff

Being qualified for the job is obviously important, as is an up to date vision for a department/school/unit, well communicated to staff. Inspirational leadership helps but is not enough; the unit also needs to be able to attract suitable talent (teaching and research staff). 'Old wood' is cited as a significant problem in helping departments and schools to move forward to implement a new vision and ensure relevant, quality courses. The presence of dynamic staff is noticed by students and numbers grow, although funding is sometimes slow to follow.

The Reputation and Success of the HEI

Although differences in the quality of tuition and learning outcomes between departments within an HEI may be as big – or even bigger than – differences between HEIs, both prospective students and potential employers seem to distinguish strongly between institutions. Some have a good reputation, others have a poorer reputation. This reputation – which would seem to be based on actual experience – also becomes a causal factor in itself. HEIs with strong reputations can access stronger students, staff, partnerships, and research funding. Thus they are able to do more and produce better results - a 'virtuous cycle'. By contrast, units within HEIs with a poor reputations seem to be caught in a downward spiral: they can only select weaker students, they do not seem to find as many opportunities for partnerships, and their results are poorer. Having said this, it is important to note that previously disadvantaged institutions are currently on an equal funding base with other HEIs (as far as government funding is concerned) and that they are generally strongly supported with scholarships, bursaries, national and international partnerships and development aid.

These considerations are significant for decisions about where to invest – those units which are growing and ready to use more funding (have already done more with less) are likely to use investments more effectively; whereas units caught in a downward spiral may need a large range of interventions to become fully effective, and this might entail either a lot of money, or more than money.

Case Example 3 compares two Units – one which currently enjoys a good reputation, is popular with students and has a high pass rate; the other which is struggling to attract students and which has a much lower pass rate. The units are in fact composites of actual units, so neither refers to one specific unit (or institution). The factors listed do not relate directly to financial resources. The comparison aims to help us understand the elements of quality courses better.

Case Example 3: Comparison of Units Running Programmes with Similar Focus: Features associated with Quality and Success

	Unit A	Unit B
Indicators of Quality and Success:	High numbers of undergraduate students (capped), high throughput rate and conversion to post-graduate studies	Low numbers of undergraduates (below capacity), low throughput rate, few go on to post-graduate studies
Leadership:	Dynamic leadership (numbers increased since appointment of new director)	No evidence of dynamic leadership; leader who does not support progress
Vision and staffing:	Vision for unit and ability to recruit new staff to meet it	No evidence of vision for unit, or new staff
Recruitment:	Active involvement in recruiting undergraduates	No involvement in recruiting undergraduates
Student body:	Attracts students with better academic record; most students are taught in their home language or strong second language	Attracts only students with weaker academic record; most students not taught in their home language
Teaching methods:	Innovative group field work and group assignments; web-based tests and discussion groups; essays to encourage literacy and critical thinking; research projects and data analysis; emphasis on reading and writing.	Lectures to cover content; some group discussion.
Engagement with outside agencies:	Extensive efforts to engage 'real world' contexts for student practice, projects and illustration of content.	Few opportunities to engage with 'real world' contexts; focus is "on the discipline".
Curriculum:	Evolves on an ongoing basis, emphasis on reflexive review. Shaped by what staff regard as necessary for students to know, based on good knowledge of their discipline, current realities, and (only in specific cases) employer requirements.	Less evidence of change and less clarity on what shapes the curriculum; seems mostly lecturers' understanding of what the technical body of knowledge is that needs to be mastered and what has been taught before.
Staff:	Qualifications match or exceed the requirements for the job; visionary leadership; room to appoint new staff according to vision; not a large body of 'historic' staff.	Staff who are inappropriately or inadequately qualified for the job; leadership has dated views so new staff cannot bring about change; leaders inherit historic staff who do not share their vision.
Organisational	Organisational quality assurance	No reference to quality

systems:	systems that are supportive rather than restrictive (e.g. QMS facilitated by a Teaching and Learning Centre) and which prompt curriculum innovation, rather than prevent change.	assurance; narrow 'compliance' type of quality control, or reliance on student preferences alone.
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Centres that specialise in short courses for industry have a very focussed approach to quality assurance. These courses are expensive and it is important that clients feel they are being offered a quality product. The Centre for Environmental Management at the University of Pretoria (UP), for example, employs a "360 degree approach" to quality, which means they strive to provide the best available content, tutors, venues and food – giving constant attention to detail and being culturally sensitive. All complaints are recorded and investigated, and the causes fixed. There is a particular emphasis on giving the correct information to students, and staff are encouraged to keep themselves updated through information forums, libraries and the use of accredited journals¹³.

The UP Centre makes use of a formal quality assurance programme (ISO9001). This includes a scoring system, also used in undergraduate programmes at other HEIs, whereby students evaluate lectures. A guest lecturer who does not score 75% is 'blacklisted' by the Centre and not used again! Tutors and the curriculum are also scored; scores are plotted onto graphs and these are monitored by the Centre. Lecturers are encouraged to be consistent in their behaviour, grading and assessment procedures.

Such a structured system for ensuring quality through compliance and uniformity may not be suitable for all programmes, and relying on students to vote on a lecturer's future does have limitations. For example, a senior lecturer at UWC reported that this system encouraged him to steer away from more challenging course activities, which he knew the majority of undergraduate students would not rate highly.

The UP Centre of Environmental Management however also invests in staff by providing a structured staff training programme. No other HEI mentioned such a strategy for quality assurance.

Several centres and departments mentioned that they constantly review their courses and course materials. This can take up considerable time and resources. In the case of the Centre for Environmental Management, the reason for this is to keep abreast of the latest developments and at the 'cutting edge'.

¹³ Note that HEIs that are not able to afford journals (such as many Universities of Technology) do not have access to this vital source of information and teaching materials.

Bursaries, Grants and Scholarships

We noted that one of the most significant challenges for convenors of environmental learning programmes at universities is the availability of bursaries and scholarships to pay for post-graduate students' tuition, research and living expenses. A number of initiatives exist to encourage post-graduate studies and research in the sciences, the social sciences, and the environmental arena. Examples are:

- ✘ National Student Assistance Fund Scheme (NSAFS), which makes available R1,7 billion in bursaries per annum (2008).
- ✘ NRF (National Research Foundation) post-graduate bursaries and scholarships, and supervisors' grants, for focussed and general research in the sciences and now also the social sciences.
- ✘ South African Research Chairs Initiative (SARCHI) - National Research Foundation (NRF) - to promote research, research supervision and the production of more PhDs.
- ✘ DST (Department of Science and Technology) Centres of Excellence with similar aims, as well as innovation.
- ✘ Teaching development grants and research development grants, for higher education units that are not doing well.
- ✘ Innovation fund, THRIP (Technology and Human Resources for Industry Programme).

With some exceptions, most staff's experience has been that there are not enough financial support available, and that most grants (such as the NRF bursaries) were inadequate to allow post-graduate students – particularly mid-career professionals – to engage in full time study in South Africa.

7. Considerations and Recommendations

The Council on Higher Education (2009) notes that patterns of knowledge production have their roots in historical, cultural and political legacies; also that gender, race and age profiles are different for different study fields and different institutions and therefore, a single approach or simplistic solutions will not be appropriate.

Thus one should guard against a one-size-fits-all approach and against setting simplistic targets. Pursuing and monitoring such targets in a one-dimensional manner may have unintended negative effects (e.g. impact on quality and success rate, and hence confidence and reputation).

Although a depth of knowledge in a particular area remains a highly relevant outcomes of higher education, the nature of the environmental crisis also calls for a breadth of insight and ability to work across disciplinary boundaries. This is a reason for supporting high quality inter – or cross-disciplinary programmes at HEIs. These programmes can benefit from developing and sharing stronger models and theoretical frameworks for inter-disciplinary research and tuition, strategies to eliminate intra-institutional competition, stronger practical systems and organisational support, and student support.

Invest in initiatives that will build:

- ✘ In addition to proficiency in English and Mathematics, greater depth in school leavers' understanding of scientific concepts, and promote and strengthen the teaching of Life Sciences/Biology, because "universities cannot lower their standards to meet those of the schools".
- ✘ The quality of teaching of maths and science (with environmental content and values), as well as educators' ability to develop learners' language skills.
- ✘ Greater awareness among all South Africans and particularly high school students, of the variety of study and career options in the environmental sector, and the many ways in which these can provide life satisfaction. Include study and career paths that are not well known, but highly relevant to the country's sustainable development, such as Ichthyology and Fresh Water Studies.
- ✘ Greater knowledge of these study and career options among student advisory bureaus that serve both schools and universities.

- ✘ Computer and information management sciences relevant to the environmental sector, including systems analysts, modellers and population statisticians.
- ✘ Curators of plant and animal collections.
- ✘ Wetland specialists (such as soil scientists, freshwater ecologists, limnologists, hydrologists and 'green engineers') as well as generalists.
- ✘ Animal health specialists including wildlife veterinary scientists.
- ✘ Environmental lawyers.
- ✘ Sustainable agriculture specialists.

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 - ✘ Sustainable agriculture specialists.
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- ✘ An understanding of philosophies of science, research methodology and data collection strategies suitable to purpose.
 - ✘ High level communication, advocacy and lobbying skills – like other skills, these will only develop fully in the workplace, but higher education needs to align graduates towards them.
 - ✘ Skills in interpreting and analysing data, finding trends and meaning, integrating (across data sets and disciplines) and designing research, management and evaluation systems accordingly. For most candidates, doctoral level studies would be required to build the necessary depth of insight and breadth of vision.
 - ✘ The capacity of people already working in the environmental sector, who may be either under-qualified or under-skilled for their responsibilities, or need to develop new skills for changing workplace requirements in the sector. Enhance the skills of these individuals through high quality and relevant short courses, and through high quality, relevant part-time and modular Masters programmes.

Also consider the following:

- ✘ HEIs and students can benefit in a number of ways from the participation of students from elsewhere in Africa in the local post-graduate programmes.
- ✘ A primary role of the Masters degree may be to teach research skills, rather than to produce research outputs, and invest in well-taught research methodology courses and adequate research supervision.
- ✘ Collecting and sharing examples of ‘best practice’ in relation to academic support and innovative methods to develop the above skills. Identify potential in under-performing units that are able to benefit from relatively limited interventions, but be cautious of investing in units that require wider systemic support to succeed.
- ✘ University-linked internships for unemployed graduates, in agencies that can use their existing skills, and provide further learning opportunities in a workplace that meets their personal interests and aptitudes.
- ✘ Supporting inter – or cross-disciplinary programmes at universities and invest in the development and sharing of models and theoretical frameworks for inter-disciplinary research and tuition, as well as application in the field.
- ✘ The National Human Resource Development Strategy and the National Innovation Plan, which aims to address the obstacles from Honours level to Masters and PhD studies, in order to grow the aggregate number of scientists in the country, women scientists and Black scientists.

Key strategies to assist HEIs with human capital development for the environmental sector are:

- ✘ Providing adequate funding support for post-graduate study and research costs
- ✘ Strengthening the capacity of employers to identify suitable long or short courses for staff and organisational development purposes and strengthen HEIs capacity to access funding to run such programmes optimally.
- ✘ National forum(s) to encourage more HEIs to interact and collaborate with each other and with employers in the environmental sector.

When considering which HEIs to support, take into account:

- ✘ The capacity of the institution to produce value out of resources invested, based at least partly on their track record.
- ✘ Whether the institution can produce more with its existing staff capacity.
- ✘ Capacity of the institution to provide *quality* teaching and research supervision.
- ✘ Changing conceptual frameworks for managing and studying the world.
- ✘ Curriculum relevance and quality involves not only content, but also the methods used, so that they meet (for example) the needs of a broader student body, and the need for more higher order and interpretive skills in the world of work.
- ✘ Track record in graduating students across the racial groupings.
- ✘ Capacity of the institution to administer financial aid.
- ✘ Capacity to expose students to the environmental field and where relevant, provide links to work placements. When students must rely on luck and personal social networks for the work placements to complete their studies, or the supervisor to open a pathway into post-graduate research, there is discrimination against Black South Africans and others who lack 'the contacts'.

8. Bibliography

CHE (Council on Higher Education) Advice and Monitoring Directorate. 2009. *Higher Education Monitor: The State of Higher Education in South Africa*. CHE, Pretoria.

Cosser M. 2009. *Studying Ambitions. Pathways from Grade 12 and the factors that shape them*. HSRC Press, Cape Town.

Cumming DHM. 2006. The M.Sc. in Conservation Biology, University of Cape Town: Is curriculum change necessary? Draft for comment, 6 August 2006. Percy FitzPatrick Institute of African Ornithology, Cape Town.

Dibetle M. 2009. More bursary millions unspent. *Mail & Guardian* Nov 27 – Dec 3 2009, p.16.

Gustafsson M. 2005. The relationship between schooling inputs and outputs in South Africa: Methodologies and policy recommendations based on the 2000 SACMEQ dataset. www.jet.org.za visited January 2008.

Kraak A. 2008. *Human Resources Development Review 2008*. HSRC Press, Cape Town.

Lotz-Sisitka H. 2009. Epistemological access as an open question in education. *Journal of Education*, Vol.46, in press.

Mail & Guardian Higher Learning Supplement. Into the Future. December 2009. www.mg.co.za

Mamdani M. 2007. *Scholars in the Marketplace. The dilemmas of neo-liberal reform at Makerere University 1989-2005*. HSRC Press, Cape Town.

Philander G. 2009. How many scientists do we need? Opinion piece in *Mail & Guardian* Higher Learning Supplement, November 2009, based on paper in *South African Journal of Science*.

Pretorius C. 2009. Degrees out of sync with jobs. *Mail & Guardian* Higher Learning Supplement, December 2009, p.1. www.mg.co.za/graduates

Rosenberg E and Sisitka L. 2007. The Table Mountain Fund Capacity Building Program for the Cape Floristic Region. End of Programme Evaluation, January 2007. WWF and TMF, Cape Town.

Rosenberg E and Burt J. 2009a. *Vocational / Further Education and Training in South Africa: Quality considerations for the environmental sector*. Rhodes University Environmental Education and Sustainability Unit, Grahamstown.

Rosenberg E, Nsubuga Y and Burt J. 2009b. *Quality and Relevance in South African Schooling: Implications for human capital development in the environmental sector*. Rhodes University Environmental Education and Sustainability Unit, Grahamstown.

Rosenberg E, Raven G, Nsubuga Y, Mosidi S, Ramsarup P and Burt J. 2009c. *How about a ... Biologist? A short report on career guidance for school leavers*. Rhodes University Environmental Education and Sustainability Unit, Grahamstown.

Soulé ME and Orians GM. 2001. Conservation biology research: Its challenges and context. In Soulé ME and Orians GM (Eds) *Conservation Biology: Research Priorities for the Next Decade*, pp.271-285. Island Press, Washington DC.

Vass J, Roodt J, Wildschut A, Bantwini B, Reddy V. 2009. *Guidelines towards a Human Capital Development Strategy in the Biodiversity Sector*. HSRC, Pretoria.