

EXECUTIVE SUMMARY

Introduction and background to the study

DST
commissioned
CREST in
January 2003
to undertake
the study

AIMS
Profile of HR in
SET
disaggregated
by sex

Explore
contribution of
research to the
needs of
women

Research
findings to
inform work of
SARG

Aims and objectives

The National Department of Science and Technology (DST) commissioned the Centre for Research on Science and Technology (CREST) at the University of Stellenbosch in January 2003 to undertake an investigation into *Women in Science, Engineering and Technology (SET) in South Africa*. The aims of this research were twofold:

1. To develop a sex-disaggregated profile of the human resources for science and technology in the public science system in South Africa, and
2. To explore the nature and extent of the contribution of research in the public domain to understanding the specific needs and problems of women in general.

As such, the research aimed to develop an understanding of the *status of women in science*, and the *potential benefits of science for women* in this country. These aims translated into the following objectives:

- To collect and analyse sex-disaggregated statistics on women's participation in public sector SET in terms of: Masters and Doctoral enrolments and graduations; human resources; publication outputs; funding allocations; scientific rating; and, emigration
- To identify the range and scope of initiatives in the public science system in South Africa, and internationally, which are designed to promote and support women's participation in SET, and
- To analyse a sample of research projects conducted in higher education institutions and government SETIs in terms of the extent to which they have women as their primary users or have the potential to make a positive impact on the lives of women in this country.

An important aim of this research was to inform the activities of the South African Reference Group (SARG) for women in science and technology, a sub-committee of the National Advisory Council for Innovation (NACI), which was launched in March 2003.

Scope and data sources

Focus on public sector S&T

The study focused on women as postgraduate students, researchers, scientists or academics within universities, technikons and government SET institutions (SETIs) in the public sector. As such, this project did not include people, institutions or organisations within business and industry, professional associations, or the schooling system. In addition, in most cases, the institutional data are aggregated to the level of sector (e.g. university, technikon and science council sectors).

DATA SOURCES

This investigation utilised a wide range of data sources across the spectrum of the public science system, resulting in the most comprehensive study of its kind in South Africa to date. These data sources are listed below. The limitations of these various data sources are outlined in detail in the main report, and are highlighted in the synthesis document.

SAPSE/HEMIS datasets

- Student enrolments and graduations in the higher education sector (1990-2001), disaggregated by sex, race group, institution type (universities and technikons), and field of study

SAPSE/HEMIS data

- Permanent instruction/research staff in universities and technikons (1990-2001), disaggregated by sex, race, age, rank, highest qualification, and scientific domain

Institutional data

- Non-permanent instruction/research staff in universities and technikons (1990-2001), disaggregated by sex
- Permanent R&D personnel in government SETIs (1990-2001), disaggregated by sex, race, age, rank, qualification, division/unit
- Non-permanent R&D personnel in government SETIs (1990-2001), disaggregated by sex

Statistics SA

- Emigration of professionals (1990-2000), disaggregated by sex and by occupational field

SA Knowledgebase (CREST)

- Publishing scientists and their publication outputs (1990-2001), disaggregated by sex, race, qualification, rank and scientific domain

NRF

- Funding allocations disaggregated by sex, race and monetary value of funding

Web-based survey

- National Research Foundation rating of male and female scientists, disaggregated by rating category

CREST databases

- Initiatives for women in SET
- Database of 17 000+ research projects in the public sector

MAIN FINDINGS

Women's participation in public sector SET

STUDENT DATA

Female students constitute 53% of all HE enrolments in 2001.

White women still constitute the majority of female students – especially at the doctoral level.

Female students constitute the majority of students at the undergraduate level in universities.

Women are over-represented in Health and Social Sciences, but under-represented in Natural Sciences and Engineering.

Student enrolments and graduations

Over the past decade, the higher education sector in South Africa has expanded substantially. This growth is reflected amongst both male and female students. In 2001, women constituted more than half of all enrolments (53%) and graduations (58%) in the sector as a whole. However, a finer analysis of the data reveals that these figures mask some glaring disparities at different levels of the higher education system.

Race: Despite marked growth in the number of African, Coloured and Asian female students, in 2001 White women still constituted the majority. This was particularly so at the Doctoral level: in 2001, White women constituted 65% (1570 out of 2402) of all female Doctoral enrolments and 76% (221 out of 292) of all female Doctoral graduations. African males have a greater share of Doctoral enrolments (31%) and graduations (25%) than African females do (21% and 15%, respectively).

Graduate level: Within the university sector in 2001, female students were in the majority at the undergraduate and lower postgraduate (i.e. Honours) levels, but in the minority at the Masters and Doctoral levels. In the same year, female students enrolled at technikons were in the minority at both the undergraduate and postgraduate levels. Although just over half of all graduations at the undergraduate level were amongst female students, women were in the minority (39%) at the postgraduate level.

Scientific field: While women are over-represented in the Health Sciences and Social Sciences, they are under-represented in the Natural Sciences & Engineering. The majority of female Doctoral enrolments (47% or 470 out of 991) and graduations (49% or 62 out of 128) in 2001 were in the Health Sciences. It should be noted, however, that most of these students are likely to be found in fields such as nursing and occupational therapy, as opposed to medicine or surgery. By contrast, two thirds (69%) of the enrolments and graduations in the Natural Sciences & Engineering were amongst men. Within the Natural Sciences & Engineering disciplines, the majority of women enrolled for (75% or 500 out of 669) and graduating with (73% or 66 out of 91) Doctoral degrees in 2001 were in the Life Sciences & Physical Sciences. Only 7% of female Doctoral enrolments and graduations were in Engineering, compared to 23% amongst men.

Human resources for SET

HR in SET

The proportion of female researchers in universities and science councils has increased significantly over the past decade.

Women's participation in the public SET workforce has improved markedly over the past decade. The proportion of female instruction/research staff with permanent positions in universities and technikons grew from less than a third (30%) in 1992 to two-fifths (40%) in 2001. Within the science councils and other government SETIs, female R&D personnel increased from 35% in 1996 to 42% in 2001. Despite these improvements in the overall proportion of women working in these SET sectors, some important inequities remain.

White women continue to make up the bulk of female academic staff in higher education.

Although there was increased participation amongst Black women over the decade, in 2001 the race distribution of these women still reflected the legacy of apartheid, with White women comprising more than two-thirds of female instruction/research staff (70% or 19161 out of 14409) and female R&D personnel (67% or 665 out of 995).

Women remain underrepresented within the natural and engineering sciences and over-represented in the social sciences and humanities.

Less than one third of instruction/research staff (27% or 1292 out of 4777) and R&D personnel (32% or 82 out of 257) with Doctoral degrees were women.

Within the natural sciences and engineering, women are best represented within the field of computer sciences

Women are under-represented within the Natural Sciences & Engineering, and even more so within Engineering specifically. While the majority of instruction/research staff in universities and technikons are located in the Social Sciences & Humanities, this skewed distribution is far more pronounced amongst women: in 2001, 61% (3370 out of 5514) of female instruction staff were in the Social Sciences & Humanities, compared to 50% (3970 out of 7938) of the male staff. This pattern was inverted for the Natural Sciences & Engineering, with 38% (3020) male and 21% (1154) female instruction staff.

The highest ranks of academic staff at universities in 2001 were still dominated by men: 26% of men compared to 7% of women were professors.

Within the Natural Sciences & Engineering, female instruction and research staff were best represented in the Computer Sciences, and the least represented in Engineering: in 2001, only 9% (75 out of 831) of instruction staff and 14% (33 out of 230) of research staff in Engineering were women.

In 2001, there were relatively few women in the senior ranks within the higher education sector, despite marked improvements since 1992. Within the university sector in 2001, only 7% (260 out of 3894) of female instruction staff was Professors, compared to 26% (1535 out of 5896) of the male staff.

EMIGRATION STATISTICS

Female professionals made up a quarter of all professionals leaving SA in the 1990's.

Women constituted the majorities of skilled emigrants in the fields of education, art, health, sport and entertainment.

PUBLICATIONS

Women formed less than a third of all actively publishing scientists between 1990 and 2001.

There are marked differences between female and male authors as far as field, qualification and rank are concerned.

Female scientists authored only 19% of all scientific articles in SA. between 1990 and 2001.

During the period 1990 – 2001 the average article output of women was lower than that of men.

Emigration of the highly skilled professionals

The official SSA emigration statistics indicate that the gender profile of skilled emigrants has changed over the past three decades, with female professionals constituting a quarter (26%) of all skilled emigrants in the 1970s, to just less than half (43%) in the 1990s. This trend reflects the changing gender profile in the domestic labour market insofar as more women are taking up formal employment and a growing number of South African women are entering the ranks of the highly skilled.

Women constituted the highest percentage of skilled emigrants between 1990 and 2000 in the education and related occupations, the health services, and the art, sport and entertainment occupations. These trends are not surprising and reflect the sex composition of the domestic labour market where a large proportion of women are located in fields such as teaching and nursing. By contrast, emigration in the engineering and architecture, and the natural science occupations, was largely among professional men.

Publication outputs

Despite the growth in the numbers of female staff in higher education institutions and government SETIs, over the period 1990-2001 less than one third (29% or 2187 out of 7574) of the sample of actively publishing scientists were women:

- Half of all publishing female scientists hold a Doctorate compared to more than two thirds of the male scientists.
- The distribution of publishing scientists across scientific domains reflects that of the SET workforce, with the majority of women (47%) in the Social Sciences & Humanities, and the majority of men (44%) in the Natural Sciences & Engineering.
- Only 14% of female publishing scientists, compared to 44% of male scientists, were at the rank of Professor.

Between 1990 and 2001, female scientists published less than male scientists:

- On average, female publishing scientists contributed to only 19% of all the outputs produced in South Africa
- The majority of women produced a low output while the majority of men produced a high output: 44% of female publishing scientists, compared to only 29% of male scientists, produced less than 1.5 published article equivalents. By contrast, the majority of male scientists (38%), compared to only 21% of female scientists, on average produced more than four published article equivalents.

Funding allocations

FUNDING

Between 1995 and 2001 women received 21% of all research grants and 43% of all Masters and Doctoral scholarships awarded by the NRF.

The only comparable and relatively complete datasets of the distribution of funding applications and allocations, and their monetary value, amongst male and female students and staff, were those of the National Research Foundation and the Medical Research Council. These are two of the main public funding agencies for research and, therefore, provide a useful indication of the sex differences in funding allocations in the public sector. Two types of funding were investigated for each institution, namely (i) research grants, and (ii) scholarships for Masters and Doctoral students. It should be noted that the funding categories in each institution analysed in for this study are only two among a number of other funding mechanisms. The study are therefore cautious in assuming that the sex distribution of funding allocations described below is representative of all funding in these agencies.

Between 2000 and 2003 the MRC awarded the majority of post-graduate scholarships to women.

Between 1995 and 2001, women consistently received far fewer research grants and scholarships from the NRF than did men: in 2001, women were the recipients of 21% (364 out of 1736) of the research grants, and 42.5% (1062 out of 2499) of the Masters and Doctoral scholarships.

With regard to the MRC, between 2000 and 2003, women consistently received a larger number of Masters and Doctoral scholarships, and self-initiated research grants, than did men. In 2002, for example, women were the recipients of 57% (33 out of 58) of the scholarships awarded, and 59% (20 out of 34) of the research grants. In part, this favourable picture for women is explained by the general over-representation of female students and staff in the Health Sciences – the scientific domain within which the MRC operates.

SCIENTIFIC RATING

The vast majority of rated scientists in South Africa are men. Women are under-represented in all rating categories and especially so in the highest categories.

Scientific rating

Since the early 1990s, the National Research Foundation (and previously the Foundation for Research Development) has been rating scientists – first in the Natural Sciences & Engineering, and more recently in the Social Sciences & Humanities. There are six rating categories: three are restricted to established researchers (A, B & C) and the remainder to young researchers (P & Y) and researchers within a previously disadvantaged context (L). Researchers who are rated by the NRF are eligible for funding for a period of five years with every successful application to the NRF. There are thus considerable advantages to being rated, especially if one is an A-rated researcher (the most prestigious of all rating categories).

Between 1996 and 2002, the vast majority of rated scientists (all categories) in the Natural Sciences & Engineering were men. In 2002, women were under-represented in all the rating categories, but especially in category A (5% or 2 out of 44) and category B (9% or 24 out of 256).

Preferential policies, programmes and funding mechanisms for women in SET

POLICIES AND PROGRAMMES FOR WOMEN

Few HE and government institutions in SA have policies in place that target female scientists or academics specifically

A few exceptions to this finding:

- Thutuka (NRF)
- Women in Water Awards (WRC)
- Leadership training programme (UPE)
- Women's Executive Development Programme (AUSAID)
- Gender Mentoring Programme (TELP)
- HERS-SA
- Enhancing women in HE (Carnegie)
- Programmes at PenTech and VaalTech

Initiatives for women in SET in South Africa

Universities, technikons, government SETIs and selected international funding agencies were surveyed in terms of any policies, programmes and funding mechanisms designed to increase the participation of, and to retain and promote women in SET. A number of institutions reported having gender equity policies in place, or that they were in the process of developing such policies. However, it became clear that where these policies are in place, they are often the only policies favouring the advancement and promotion of women in SET. The study found no evidence of separate policies which focus solely or explicitly on women as academics, scientists or postgraduate students.

There were also very few preferential programmes or funding mechanisms for women in SET that came to light during the survey. Those that were reported are listed below.

- The Thuthuka "Women in Research" Programme of the National Research Foundation is the most significant preferential funding mechanism for women in SET in South Africa. Funding is provided to women with Doctorates, who do not have an NRF rating, but who wish to undertake postdoctoral research
- A more focused preferential funding mechanism for women in SET is the "Women in Water Awards", awarded by the Water Research Commission in conjunction with the Department of Water Affairs and Forestry. Each year, the awards are made to women who have played leading roles in water research.
- The annual leadership training programme for women at the University of Port Elizabeth
- The Australian Assistance for International Development (AUSAID) Women's Executive Development Programme
- The Tertiary Education Linkages Program (TELP) Gender Mentoring Programme
- HERS-SA
- The Carnegie Corporation of New York's International Development Programme initiative entitled "Enhancing women's opportunities in higher education".
- Peninsula Technikon's "Women in Engineering Day" and five full bursaries to female engineering students
- Vaal Triangle Technikons "Women in Engineering Forum", and the "Malesela Taihan Electric Cable Women in Engineering Awareness Project.

INTERNATIONAL INITIATIVES

A database containing detailed information on 92 international initiatives that target women in SET has been compiled.

Initiatives for women in SET internationally

A web-based survey of initiatives and opportunities for women in SET in other countries was conducted that culminated in a searchable database of initiatives for women in SET in selected countries. The database includes the title of the initiative, the host organisation, the geographical reach of the initiative, the activities, resources and target group(s) of the initiative, and contact information where available. A total of 92 initiatives are included in the database, operating at either the global, regional, national or institutional levels. Initiatives range from non-profit organisations operating in multiple countries and engaged in a variety of activities, such as information dissemination, funding, professional development and science awareness campaigns, to small informal groups located within universities, targeted at women in specific disciplines such as Physics.

RESEARCH PROJECTS

The majority of research projects with a gender perspective, focused on issues relating to women.

The two biggest categories of research projects identified are Gender and employment (34%) and Gender and Health (20%).

Nearly a quarter of all gender projects have a SET focus.

Research projects with a gender perspective

A database of more than 17 000 research projects in the public sector, across all scientific domains, was analysed in order to assess the extent to which public sector research has a gender perspective – in other words, whether projects focus on the specific needs, roles and perspectives of women and/or men in particular contexts. This involved coding projects as focusing on women-specific, men-specific or gender-specific issues. The study also attempted to establish what aspects of women's and men's lives these 'gender projects' addressed, via the development of 'research focus categories' within these identified projects.

- Less than one tenth (6.4%) of all the research projects were identified as having a gender perspective. The majority of these 'gender projects' focused on issues relating to women (62%)
- A total of nine research focus categories emerged, including gender and employment, health, sport, people at risk, rights and status, art, literature and the media, life experiences, and population demographics, as well as a category on theorising gender
- The majority of the research fell within the Gender and Employment category (34%), followed by Gender and Health (20%), while a very small proportion of the gender projects focused on people at risk (5%), or rights and status (8%).

The study then looked at the subset of gender projects that had an SET focus:

- Nearly a quarter (251 out of 1115) of gender projects were identified as having an SET focus
- The three SET focus areas identified included research into women's or men's participation in SET, research that would lead to technology development or innovation and research that has the potential to lead to technology development or innovation. The research focus categories of Gender & Sport (68%) and Gender & Health (58%) made up the largest proportion of gender projects with an SET focus.

MAIN CONCLUSIONS AND RECOMMENDATIONS

Women in South Africa have made great strides over the past decade in terms of their participation as postgraduate students and professionals working in SET. Although still clearly disadvantaged in relation to their White counterparts, African, Asian and Coloured women in this country are also beginning to make their presence felt on the SET stage.

Despite these positive trends, the fact remains that women in SET tend to be younger and less qualified than men; to receive a significantly smaller slice of the rewards and recognition on offer; and, to be clustered in certain scientific domains – disciplinary areas which for too long have been considered women's domains.

In this concluding section, the study highlights a number of issues relating to women and SET in South Africa, which should be used in the development of policy and interventions to rectify the gender imbalances in the public science system. To a large extent, the recommendations revolve around areas for further, in-depth research in order to understand the causes and dynamics underlying the issues identified by this investigation. Nowadays there is a substantial body of literature relating to women in SET that offers empirical evidence and theoretical insights that would be useful to explore.

Accurate, reliable and comparable sex-disaggregated statistics on public sector SET need to be collected as a matter of priority. This applies specifically to every survey conducted by DST and all other major studies undertaken by government.

The fact that women are not adequately "integrated" into the science system requires further research. There is a need more qualitative studies to investigate what kinds of barriers women in SA face in relation to progression within the SET system.

Reliable statistics: The study strongly recommends that the National Department of Science and Technology takes measures to ensure that the gender dimension of R&D in South Africa is incorporated into every aspect of future R&D Surveys. The study also recommends that these surveys find a way to develop uniform categories for the description of various ranks within the science councils and other government SETIs, as well as the ways in which scientific domains or disciplinary areas are defined, in order to enable comparative analyses of the sex differences in these areas.

The vertical and horizontal segregation of women in SET in South Africa. Horizontal segregation refers to the clustering of women in particular scientific domains, while vertical segregation refers to the under-representation of women in senior ranks (European Communities 2000:22). As the study has indicated in the main report, both of these trends pertain to the South African context: the study has shown that as one progresses up the rungs in the higher education sector – from undergraduate to upper postgraduate levels of study, and from Junior Lecturer to Professor – one sees fewer women participating in SET. The study has also shown that women in South Africa are less likely than men to study, work or publish in the Natural Sciences & Engineering disciplines.

Given the lack of reliable information about publication patterns in SA, the study recommend that further research be undertaken to explore specifically the kinds of challenges women scientists face in scientific publishing.

The study recommend that programmes be designed to assist aspiring female scientists in improving their publication output.

More detailed studies need to be undertaken about the distribution of funding grants and scholarships to female scientists in SA.

Given the lack of adequate record-keeping with HE institutions, the study recommend that such institutions be encouraged to develop appropriate and reliable information systems on the funding allocations to their academic staff.

More comprehensive studies on the gender perspective of public science need to be conducted. This requires that more comprehensive project information be gathered.

The study recommend that further research be undertaken to investigate the kinds of opportunities, limitations and barriers that women in South Africa face in relation to their advanced studies in higher education and in terms of their seniority in the SET workforce. Furthermore, there is a need to investigate why there are so few women in the Natural Sciences & Engineering and to formulate strategies and incentives to improve the participation of women (and girls) in these fields.

The low publication output of women in SET That women tend to publish considerably less than men is a global phenomenon. In South Africa, although the gender gap in the SET workforce was almost closing at the start of the new millennium, female scientists were still only producing one fifth (23%) of all peer-reviewed journal articles in the country.

Further research needs to be undertaken which explores the kinds of challenges that women face in terms of producing scientific articles, as well as research which explores the workings of the peer-review system in order to assess the extent to which an “old boys’ club” might be operating. It is also suggested that the DST considers some form of intervention – in the form of support and/or incentives – which will assist female scientists and researchers in improving their publication output.

Fairness and equality in the distribution of resources. While the majority of the recipients of the Medical Research Council’s self-initiated research grants and local Masters and Doctoral scholarships are women, women are seriously under-represented amongst the recipients of National Research Foundation grants and scholarships. In addition, female recipients of grants and scholarships from both funding agencies typically receive less funding than they do actual grants. Besides the obviously inherent inequities of this situation, there are also implications for women’s participation in SET: less funding means fewer opportunities to participate in research and related scholarly activities, and especially in research that is on a large scale.

However, we know much less about the availability and distribution of funding within higher education institutions and from other sources. Therefore, it is recommend that these institutions introduce significant improvements in their current record-keeping systems, in terms of the collection of sex-disaggregated figures on funding allocations. There is a need for further research into women’s experiences of applying for funding. Finally, given that not one institution in the sample was able to provide us with the criteria used by selection committees when reviewing or evaluating funding proposals, the DST could investigate the possibility of encouraging institutions to make these criteria, and the associated process, more explicit and transparent.

Public funding agencies should include incentives for scientists who include an explicit gender perspective in their research where appropriate. Other interventions – such as national conferences and workshops – to increase the awareness of gender and science issues in the national system of innovation, should also be considered.

Promoting 'gender sensitive' research in South Africa A very small proportion (less than 10%) of research conducted in the public sector has a gender dimension. In addition, of those research projects which do draw gender into focus, very few address issues concerning women and men at risk, or their rights and status. Given that these results are based on the analysis of a limited set of research projects a fuller investigation is required.

A more immediate possibility that the SARG could consider is incentivising researchers in the public sector – via funding mechanisms or other forms of support – to include a gender perspective in their research, where appropriate. This, of course, fits with the notion of 'gender mainstreaming', which is the approach that the South African government has adopted in relation to bringing about gender equality, and that the DST has taken up in addressing the issue of women in SET.
