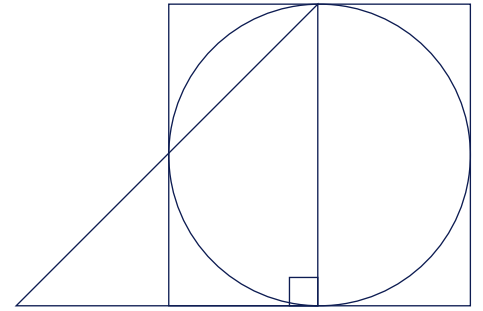


Report

05/06



Faculty of Natural and Agricultural Sciences



Faculty of Natural and Agricultural Sciences

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From the Dean's office



Prof. Herman van Schalkwyk.

The Faculty of Natural and Agricultural Sciences at the University of the Free State (UFS) leads the way in the practising of natural and agricultural sciences in South Africa and the highest levels of quality and credibility are reflected.

Our commitment, however, reaches far beyond just this. It reaches beyond the borders of the country and across continents; its multi-disciplinary and practical approach is vested in all the disciplines presented by the faculty.

In 2005/06 the Faculty experienced significant growth in measurable outputs. A contributing factor was the comprehensive apparatus strategy and plan which was implemented in 2005. With this strategy, university funds were used to leverage other funds in order to obtain huge discounts from suppliers of apparatus. In this way the faculty managed to obtain almost R50 million worth of apparatus in 2005.

The strategy was continued in 2006 when an agreement to the value of R7 542 531 was reached with Shimadzu, according to which apparatus was supplied to the faculty at discount prices. The agreement, which is valid for three years, entails the free replacement of apparatus which is purchased during this period with upgraded versions.

The new apparatus forms part of the UFS vision to compete internationally with quality research outputs in certain niche areas, to provide leadership in advanced training to students from the African continent and to establish the university as a leader among South African universities.

Two researchers with a B rating from the National Research Foundation (NRF) were also appointed. Both of these initiatives bore fruit and in 2006 the faculty increased its total research outputs by

about 13%. As an example, the Department of Chemistry's outputs increased by 100%.

The faculty has been bursting at the seams over the past couple of years. Student figures rose from 3 935 undergraduate, postgraduate and occasional students in 2005, to 4 224 in 2006. There is also strong representivity of students from other African countries and in 2005/06 almost 600 students studied at the faculty.

An extended B.Sc. programme has been presented to students since 2005. The programme aims at providing students who do not comply with all the requirements for the B.Sc. programme with the necessary sub-structure to complete the B.Sc. degree successfully. A preliminary evaluation of the results indicates that the programme is delivering the desired results.

The alignment of the Qwaqwa Campus, which was incorporated into the UFS in January 2003, remains a challenge. Regular discussions are held with staff on the campus in order to make the faculty's programmes more sustainable and to align it with the broader strategic plan of the UFS.

On a national level, the faculty is in the process of making its mark in terms of teaching and community service. In 2005 the faculty again actively began utilising its

experimental farms. A three-way agreement between the UFS, the National Farmers Union (NAFU) and the Mangaung Local Municipality led to the establishment of the Lengau Agricultural Development Centre on the Sydenham Experimental Farm. The centre provides training and mentorship to small-scale upcoming farmers.

To be dynamic and progressive requires innovative thinking. It requires commitment and a desire to deliver excellent teaching and learning opportunities to students. It requires a willingness to form partnerships, and a multi-disciplinary and practical approach to the tertiary education environment in South Africa.

This report covers the faculty's activities in 2005/06. It is a reflection of two years' commitment on the part of a team of skilled and motivated academics and support staff.



Prof. Herman van Schalkwyk

Dean: Faculty of Natural and Agricultural Sciences
University of the Free State

Groundwater Studies



“We strive to identify market needs, research these and provide a service.”

Prof. Frank Hodgson.

Overview

The Institute for Groundwater Studies (IGS) conducts research on a wide variety of water related topics. To date, more than 350 postgraduate students from South Africa and 14 other African countries have qualified in Geohydrology. Many of them are currently working in the United States of America (USA), Europe and Australia.

During 2005 Prof. Frank Hodgson, Director of the institute, was on long leave and Prof. Gerrit van Tonder acted on his behalf.

The IGS boasted 12 Ph.D., 19 M.Sc., and six honours students in 2005. The following highlights were achieved during the year:

- Staff members were involved in the groundwater pollution project of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the United Nations Environment Programme (UNEP) in Africa.
- A 10-day visit to Sri Lanka was undertaken to assist their geohydrologists to assess the impact of the tsunami on the freshwater aquifers along the coast.
- Eight workshops on the South African Groundwater Decision Tool were presented throughout the country.
- A R2,5 million project was undertaken with the Department of Water Affairs and Forestry to develop groundwater-related software.
- Contracts were signed for research projects with the Water Research Commission (WRC), Sasol, Eskom, and BHP Billiton, amongst others.
- Eight papers were presented at the biannual South African Groundwater Conference. One Ph.D. student, Ms Adrie van Wyk, received the award for best student paper.
- Two papers were presented in Skellefteå, Sweden during the Securing the Future conference.
- Two papers were presented in England during the second conference on Processing and Disposal of Industrial and Mining Waste in Falmouth, Cornwall.
- Three researchers undertook a study trip to the University of Texas in Austin, USA. Intensive training in the model of the University of Texas Chemical Compositional Simulator (UTCHEM)



Mr Danie Vermeulen, Dr Ingrid Dennis and Prof. Gerrit van Tonder at the welcoming function with the governor (dressed in white) in Kandy, Sri Lanka.



Drilling of additional core boreholes for the dense non-aqueous phase liquids in fractured rock research.

for multiphase flow modelling was received.

- Projects for Sasol Mining and Sasol Synfuels were successfully completed.
- Discussions on research co-operation with the University of Perindiya in Kandy, Sri Lanka regarding seawater intrusion took place, and two Ph.D. students from the university were enrolled at the IGS.
- Prof. Dave Kramer from the University of Nevada in the USA visited the IGS for three weeks. He is renowned for his work on various topics, including dense non-aqueous phase liquids and isotope studies. During this time, Prof. Kramer presented lectures to IGS students, provided expert input into the current research, and gave a public lecture. Bilateral collaborations for the future were established.
- The contract with BloemWater for chemical analyses of water samples was renewed. The laboratory has also expanded its services by including bacteriology tests on water samples. Ms Henriette Human joined the laboratory.

In June 2005, Dr Brent Usher was invited to act as external evaluator for the final evaluation of a UNEP/UNESCO project entitled: *Assessment of Pollution Status and Vulnerability of Water Supply Aquifers of African Cities*. This project was a follow-up to the project: *The Urban Pollution of Surficial and Groundwater Aquifers in Africa*, which initiated efforts to promote inter-nation research into the topic. This involved 11 countries from across Africa. Dr Usher was involved in the mid-term training and review of the project in Mombasa, Kenya during May 2004 and was invited to act as external reviewer of the project upon its completion.

The evaluation included interviews in Cape Town during July 2005, with representatives from the 11 national institutions involved in the project. The participating countries were from among others West Africa, East Africa and Southern Africa. Field visits were also undertaken to Lusaka, Zambia and Addis Ababa, Ethiopia to interview staff from participating institutions, government officials and decision-makers, non-governmental organisations, and members of the public. The final evaluation report was written with Ms Catrina Perch from the UNEP Evaluation and Oversight Unit in Nairobi, Kenya. The report will be published soon in the form of a booklet distributed by UNEP, and on the UNEP website.

The Asian Tsunami of 26 December 2004 had a devastating impact across the Indian Ocean, causing unprecedented economic, human and environmental damage to the

countries in its path. The South African government is providing assistance to two of the countries affected by the tsunami, namely the Republic of the Maldives and Sri Lanka. Dr Ingrid Dennis was approached in 2005 to assist the South African government in this regard.

The IGS assessed the impact of the tsunami with regard to the groundwater training of local officials and initiated discussions for further co-operation with the UFS.

Prof. Van Tonder and Mr Danie Vermeulen visited Sri Lanka for ten days in December 2005 to assess the situation and thereafter presented the SA Water Support Group with an action plan. The plan consists of three phases:

- **Short term:** Assistance with training Sri Lankan geohydrologists in geophysical apparatus (2005).
- **Medium term:** Training all Water Board personnel in field procedures and computer-related issues (2006).
- **Long term:** Research co-operation between the IGS and the University of Perindiya in Kandy regarding seawater intrusion, with the involvement of two Ph.D. students. These students will enrol at the UFS in 2007.

During the trip, coastal aquifers on the west as well as the east coast were visited and fieldwork performed. Most of the work was done in the district of Ampara, in the eastern part of the country.

In 2006 Prof. Hodgson resumed his duties. During this year 15 Ph.D., 19 M.Sc. and five honours students were enrolled. The following highlights were achieved:

- A follow-up visit to Sri Lanka by Prof. Van Tonder, Dr Dennis and Mr Vermuelen to provide training to the country's geohydrologists at the Centre for Post-graduate Science in Kandy, to assess the impact of the tsunami on the aquifers and to facilitate longer term sustainable management of groundwater in Sri Lanka.
- The extension in scope of the current Geohydrological Software Development for Decision Support project with the Department of Water Affairs and Forestry to develop groundwater-related software and to provide training.
- The publication of several papers in international journals.
- The receiving of a research grant from Sasol to establish the IGS as a Centre of Excellence in South Africa.
- This grant resulted in collaboration with the United States Geologic Survey, as a result of which Dr Allen Shapiro, a pre-eminent expert on fractured rock

aquifers, visited the IGS and presented a series of workshops in Bloemfontein and Pretoria with Dr Usher and Ms Jennifer Pretorius from the institute.

- A short course on Fundamentals of Groundwater Chemistry was presented in Cape Town by Drs Usher and Walt Kelly, from the Illinois State Water Survey in the USA.
- The initiation of a Sasol/Eskom project to conduct collaborative research on sustainable salt sinks with the Universities of the Western Cape (UWC) and KwaZulu-Natal.
- Projects related to coal mine water volumes with all major mining companies were expanded. A result of this was the launching of a major water treatment works to convert mine water to drinking water in the Witbank area. The volumes and expected qualities were largely based on work undertaken in this field by Prof. Hodgson over a number of years.
- The signing of contracts and completion of projects for Sasol Research and Development, Fraser Alexander, Letseng Diamonds, Chemwes, Ingwe, Eskom, Sasol Synfuels and Gold Fields, amongst others.
- The IGS obtained a long-term appointment as external advisor to Sasol Mining to evaluate all groundwater and mine water-related aspects.
- The completion of the South African Groundwater Decision Tool, the Aquifer Management System, the Groundwater Dictionary and the Groundwater Resource Directed Measures software packages for the Department of Water Affairs and Forestry.
- The demonstration of the Aquifer Management System to national parliament in May 2006.
- The presentation of eight South African Groundwater Decision Tool workshops throughout South Africa by Dr Dennis and Mr Rainier Dennis in collaboration with the Department of Water Affairs and Forestry in August and September 2006.
- Involvement with the International Association of Hydrogeologists (IAH) to develop a World Bank/UNEP project proposal on global groundwater governance.
- Dr Usher was invited to present lessons and impacts from the UNEP/UNESCO Groundwater Pollution Project in Africa, at a special African Groundwater Session at the 4th World Water Forum in Mexico in March 2006.
- The Institute organised a five-day course on Reactive Transport Modelling using MT3DMS, PHREEQC and PHT3D with the Council for Scientific and Industrial Research (CSIR) and the Groundwater





Group of the UWC. The course was presented by three international experts in this field.

- The laboratory's contract with Bloem-Water for chemical analyses of water samples was extended.
- The publication of a book, *Groundwater Pollution in Africa*, which is a collection of peer-reviewed papers on this topic. It was co-edited by Dr Usher.
- The purchase of an electromagnetic borehole flow meter from the USA.
- The upgrading of the laboratory and installation of a Shimadzu ICP-MS analyser, and an HPLC system to extend the analytical capabilities of the laboratory.

In March 2006 Dr Usher was invited to present some of the lessons learned from the UNEP/UNESCO project Assessment of Pollution Status and Vulnerability of Water Supply Aquifers of African Cities in Mexico City at the 4th World Water Forum. One of the outcomes from this project was the publication of a peer-reviewed book on Groundwater Pollution in Africa. This book was peer-reviewed by Dr Usher. He was also invited by the International Association of Hydrogeologists to assist in the formulation of a project proposal for global groundwater governance and to attend meetings on this in Gland, Switzerland, in June 2006.

In December 2006 Prof. Van Tonder, Dr Dennis and Mr Vermeulen presented a workshop on the evaluation and management of groundwater resources to geohydrologists at

the University of Perindiya in Sri Lanka. The South African Disaster Management Fund carried the costs of the UFS staff.

Academic staff

Professor/Director: Prof. Frank Hodgson

Professor: Gerrit van Tonder

Senior Lecturer: Dr Brent Usher

Researchers: Dr Ingrid Dennis, Mr Danie Vermeulen

Affiliated Researchers: Prof. Jopie Botha, Messrs Rainier Dennis, Michael du Preez, Robel Gebrekristos, Sechaba Lenong, Mehari Menghistu, Niel Scholtz, Mss Michelle Pienaar, Jennifer Pretorius, Adrie van Wyk

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Research outputs

Publications

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groundwater surface water interaction. Paper presented at the IASTED International Conference, Gaborone, Botswana.

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Statistical data of the faculty



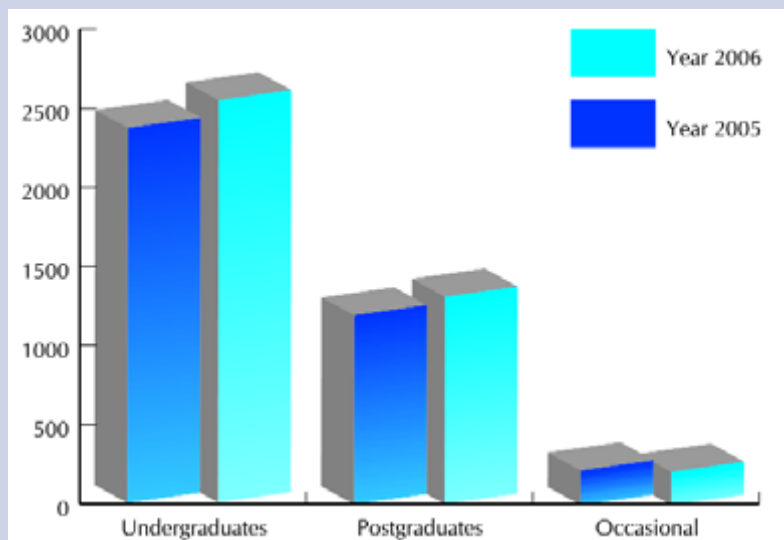
Student figures

Faculty of Natural and Agricultural Sciences, 2005/06

Male					
2005					
Description	African	Coloured	Indian	White	Total
Undergraduate	676	31	26	724	1457
Postgraduate	351	22	15	400	788
Occasional	84	3	4	17	108
Total 2005	1111	56	45	1141	2353
2006					
Description	African	Coloured	Indian	White	Total
Undergraduate	729	28	21	768	1546
Postgraduate	385	21	16	431	853
Occasional	68	2	2	23	95
Total 2006	1182	51	39	1222	2494

Female					
2005					
Description	African	Coloured	Indian	White	Total
Undergraduate	563	41	11	394	1009
Postgraduate	206	16	11	221	454
Occasional	101	5	2	11	119
Total 2005	870	62	24	626	1582
2006					
Description	African	Coloured	Indian	White	Total
Undergraduate	641	39	17	401	1098
Postgraduate	243	15	17	234	509
Occasional	103	2	2	16	123
Total 2006	987	56	36	651	1730

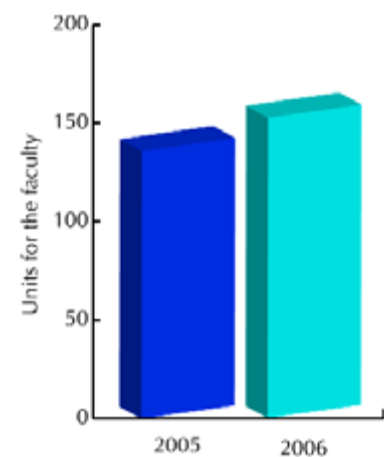
Total					
2005					
Description	African	Coloured	Indian	White	Total
Undergraduate	1239	72	37	1118	2466
Postgraduate	557	38	26	621	1242
Occasional	185	8	6	28	227
Total 2005	1981	118	69	1767	3935
2006					
Description	African	Coloured	Indian	White	Total
Undergraduate	1370	67	38	1169	2644
Postgraduate	628	36	33	665	1362
Occasional	171	4	4	39	218
Total 2006	2169	107	75	1873	4224



Student figures

Student nationality		
Nationality	2005	2006
Angola	1	
Asian countries	21	18
Botswana	20	20
European countries	6	6
Lesotho	142	142
Malawi	2	1
Mauritius		2
Mozambique	8	7
Namibia	40	42
No information	1	
North America	4	4
Other Africa	45	48
South Africa	3610	3893
South America		1
Swaziland	13	13
Zambia	4	6
Zimbabwe	18	21
Total	3935	4224

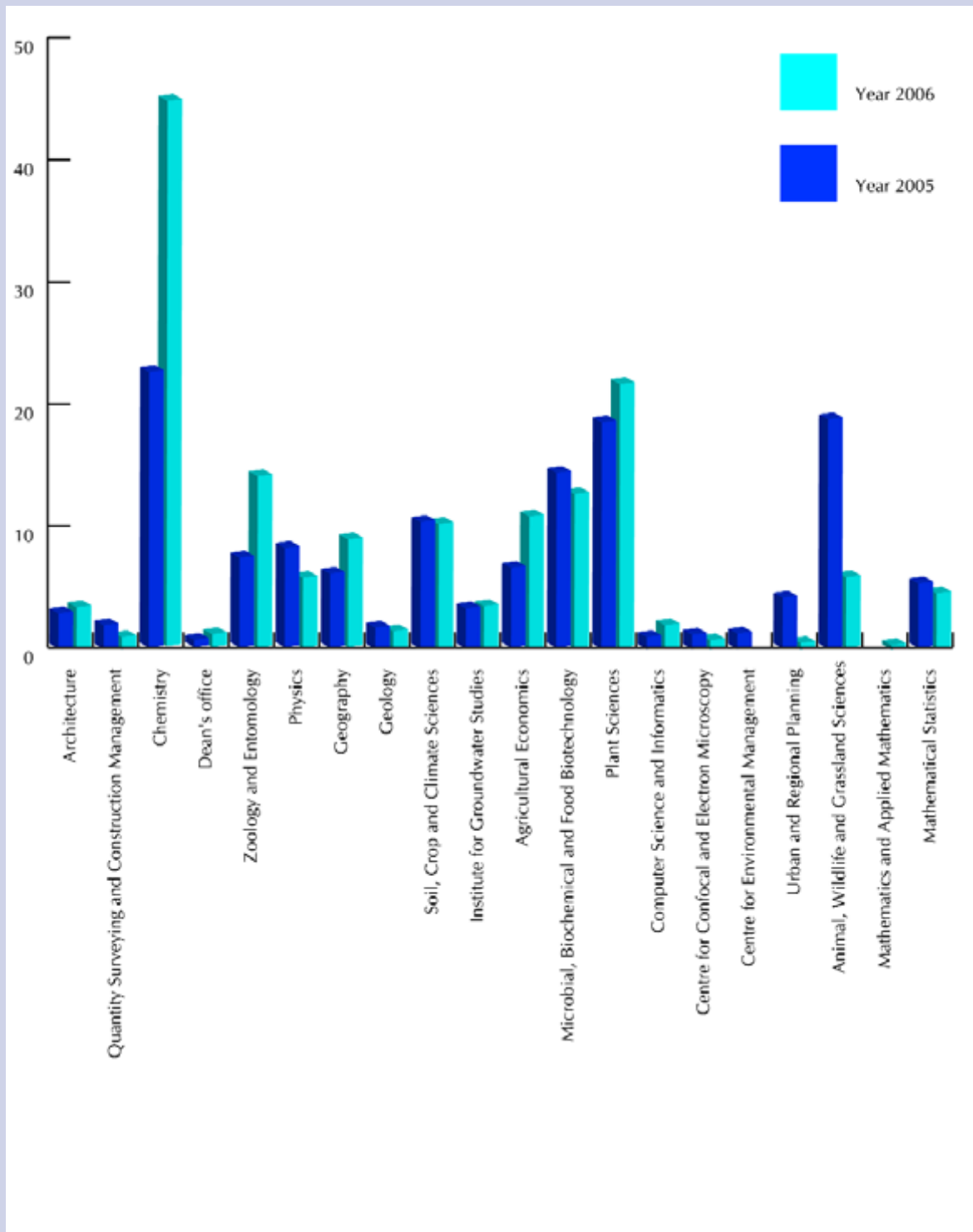
Research outputs for the Faculty of Natural and Agricultural Sciences



Articles published in accredited approved research journals.

Departmental research outputs

Articles published in accredited approved research journals, 2005/06



Glossary



Glossary

A

ACIAR	Australian Centre for International Agricultural Research
AEASA	Agricultural Economics Association of South Africa
ALPRU	African Large Predator Research Unit
ARC	Agricultural Research Council
ARMSCOR	Armaments Corporation of South Africa
ARS	Agri Risk Specialists
ASAQS	Association of South African Quantity Surveyors
ASSA	Anatomical Society of South Africa
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AVS	American Vacuum Society

C

CANSA	Cancer Association of South Africa
CATSA	Catalysis Society of South Africa
CBD	Convention of Biological Diversity
CCEM	Centre for Confocal and Electron Microscopy
CePHMa	Centre for Plant Health Management
CfPB	Centre for People and Buildings
CIAT	International Centre for Tropical Agriculture
CIDB	Construction Industry Development Board
CIMMYT	International Maize and Wheat Improvement Centre
CIOB	Chartered Institute of Building
CIOB-SA	Chartered Institute of Building - South Africa
CSACEE	Central South African Council on Economic Education
CSIC-INTA	Centro de Astrobiología
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation

D

DEAT	Department of Environmental Affairs and Tourism
DiMTEC	Disaster Management Training and Education Centre for Africa
DMISA	Disaster Management Institute of South Africa
DST	Department of Science and Technology

E

EAAP	European Association for Animal Production
EASA	Education Association of South Africa
ECA	European Crystallographic Association
EIGG	Environmental Inorganic Geochemistry Group
EPWP	Expanded Public Works Programme
ESBES	European Symposium on Biochemical Engineering Science
ESREL	European Safety and Reliability
ESRP	Economic and Social Rehabilitation Programme

F

FAO	Food and Agriculture Organisation
FEMS	Federation of European Microbiological Societies
FMP	Facilities Management Programme
FOTIM	Foundation of Tertiary Institutions of the Northern Metropolis

FSRPO	Free State Red Meat Producers Organisation
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G

GIS	Geographical Information Systems
Glen ADI	Glen Agricultural Development Institute
GM	Genetically Modified
GMBA	Gauteng Master Builders' Association
GMO	Genetically Modified Organisms
GWK	Griekwaland-Wes Koöperasie

H

HIV	Human Immunodeficiency Virus
HPCSA	Health Professions Council of South Africa
HPLC	High Performance Liquid Chromatography
HSPCM	Health and Safety Programme for Construction Managers

I

IAGOD	International Association on the Genesis of Ore Deposits
IAH	International Association of Hydrogeologists
ICCC	International Conference on Coordination Chemistry
ICEC	International Cost Engineering Council
ICID	International Commission on Irrigation and Drainage
ICP	Inductively Coupled Plasma
ICRBM	International Conference on Rodent Biology and Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDC	Industrial Development Corporation
IGS	Institute for Groundwater Studies
IITA	International Institute of Tropical Agriculture
INCRoP	Insects on New Crops Programme
INTSORMIL	International Sorghum and Millet Research Support Programme

IPMA

IPMA	International Project Management Association
IPMP	Intensive Project Management Programme
IRDP	Institutional Research and Development Programme
IRWH	In-field Rainwater Harvesting
IUCr	International Union of Crystallography
IUMS	International Union of Microbial Societies
IUPAP	International Union of Pure and Applied Physics

J

JFM	Journal of Facilities Management
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L

LExEn	Life in Extreme Environments
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M

MIRCHEN	Microbiological Resources Centre
MIT	Massachusetts Institute of Technology
MRM	Mineral Resource Management
MSA	Master's Degree in Sustainable Agriculture
MSSA	Microscopy Society of Southern Africa
MUCPP	Mangaung University Community Partnership Programme
MURP	Master's Degree in Urban and Regional Planning

N

NaCOF	National Climate Outlook Forum
NAFU	National African Farmers Union
NAMC	National Agricultural Marketing Council
NASA	National Aeronautics and Space Administration
NASSP	National Astrophysics and Space Science Programme
NCEE	National Council for Economic Education
NDA	National Department of Agriculture
NECSA	National Energy Commission of South Africa
NELSAM	Natural Earthquake Laboratory in South African Mines
NERPO	National Emergent Red Meat Producers' Organisation
NGO	Non-Governmental Organisation
NML	National Metrological Laboratory
NMMU	Nelson Mandela Metropolitan University
NMR	Nuclear Magnetic Resonance
NRF	National Research Foundation
NUFU	Norwegian Council of Universities Committee for Development, Research and Education
NWGA	National Wool Growers' Association

O

OABS	Optimal Agricultural Business Solutions
OECD	Organisation for Economic Co-operation and Development

P

PARSA	Parasitological Association of Southern Africa
PDMIW	Processing and Disposal of Mineral Industry Wastes
POT	Peaks over Threshold
PPP	Public Private Partnership
PRT	Protein Research Trust

R

RICS	Royal Institute of Chartered Surveyors
RIEP	Research Institute of Education Planning
RNA	Research Niche Area
RPO	Red Meat Producers' Organisation

S

SA	South Africa
SAACE	South African Association of Consulting Engineers
SAB	The South African Breweries Limited
SACI	South African Chemical Institute
SACPCMP	South African Council for the Project and Construction Management Profession
SACPVP	South African Council for the Property Valuation Profession
SACQSP	South African Council for the Quantity Surveying Profession
SADC	Southern African Development Community
SAFMA	South African Facilities Management Association
SAFOI	South African Fryer Oil Initiative
SAIP	South African Institute of Physics
SAISC	Southern African Institute of Steel Construction
SAMSI	Statistical and Applied Mathematical Sciences Institute

SANCIAHS	South African National Committee for the International Association of Hydrological Sciences	SEDA	Small Enterprise Development Agency	UNEP	United Nations Environment Programme
SANCU	South African National Consumer Union	SMME	Small, Medium and Micro Enterprises	UNESCO	United Nations Educational, Scientific and Cultural Organisation
SANPAD	South Africa-Netherlands Research Programme on Alternatives in Development	SRC	Student Representative Council	USA	United States of America
SAPOA	South African Property Owners' Association	SRL	Sustainable Rural Livelihood	USAID	United States Agency for International Development
SAPS	South African Police Services	SSAG	Society of South African Geographers	UTCHEM	University of Texas Chemical Compositional Simulator
SAQA	South African Qualifications Authority	T		UWC	University of the Western Cape
SASAS	South African Society for Animal Science	THRIP	South African National Research Foundation Thrust for Industry-Related Projects	W	
SASQUA	Southern African Society for Quaternary Research	TUE	Technical University Eindhoven	WARFSA	Water Research Fund of Southern Africa
SAVAH	South African Association of Visual Arts Historians	U		WATOC	World Association of Theoretically Orientated Chemists
SBE	Sustainable Built Environments	UCT	University of Cape Town	WFP	World Food Programme
		UFS	University of the Free State	WITS	University of the Witwatersrand
		UJ	University of Johannesburg	WRC	Water Research Commission
		UK	United Kingdom	WUA	Water Users' Association
		UN	United Nations		