Capacity Development for Modernizing African Food Systems (MAFS) Working Paper

Technical and Institutional Capacities of AET Institutions in Southern Africa: Are there Lessons for the Rest of Africa?

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The Modernizing African Food Systems (MAFS) Consortium

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Objective: The MAFS Consortium aims to help African agricultural education and training (AET) institutions develop the technical skills and institutional capacity required to modernize African food systems.

MAFS Consortium Members:

- Makerere University
- Michigan State University
- Stellenbosch University
- University of Pretoria

Activities and Outputs: The MAFS Consortium has assembled a technical team from four major agricultural universities to produce a series of empirical background studies that will provide evidence necessary for informing capacity development efforts in African AET institutions. Substantively, the activities center around the following four thematic areas.

Theme 1. Food System Dynamics in Africa and Consequent Skill Requirements in the Private and Public Sectors

Theme 2. Models of AET Engagement with Private and Public Sector Employers

Theme 3. Existing Capacity of African AET: Case studies of African universities with regional footprints

Theme 4. Impact of past AET institution-building efforts in Africa

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ABSTRACT

This paper takes an inventory of technical and institutional capacities of some selected tertiary agricultural education and training institutions (AET) in southern Africa. Data were gathered on key selected areas such as student enrolment, physical infrastructure, teaching staff, curricula, level of research and outreach, and relationship between these institutions and the communities and private sector. The objective was to learn about best practices in the management of the AET institutions which can then potentially be applied to other AET institutions. South Africa demonstrated the greatest degree of diversity in their AET institutions. What is even more remarkable is that South Africa arguably has the most market driven, demand oriented AET-sensitive curricula in southern Africa. Different institutions target different segments in the job market. This is a great lesson for many African countries who are vying to increase job opportunities for their graduates.

A region-wide quality control approach is picking up substantially in the southern African AET institutions. However, it remains to be seen how seriously these standards are being domesticated in the various institutions. Linkages with the private sector and communities are areas where the AET istitutions are continuing to improve. Challenges remain in some of the institutions which are experiencing dwindling of resources and decreasing enrolments.

CONTENTS

1. Background

The term "Southern Africa" in this paper refers to a regional political economic grouping of 15 countries that cover the entire southern horn of Africa (Figure 1). Together they form the Southern Africa Development Community (SADC). It is one of the five regional economic blocs of Africa –the others being ECOWAS, COMESA, EAC, IGAD.

Figure 1. The Southern Africa Development Community Countries

These countries form a very interesting diversity in terms of their history, politics, governance, economic and physical resource endowment, surface area and human population. It is hypothesized that these factors have together shaped the technical and institutional capacities of the agricultural education and training institutions (AET) that we see today in the region. There is a wide range of human development index (HDI) rankings across the SADC region from the highest Mauritius (65th) to lowest Mozambique (172nd) (UNDP, 2007) (Table1). Agriculture still remains one of the key economic sectors across the region. This calls for significant human capital development through agricultural education and training. However, AET is but one of the various sub-sectors that governments are targeting for economic growth. It will always be prudent to analyse the AET sectors in view of the bigger system(s) that they exist in. For instance, higher and tertiary AET will always depend on quality of the basic (primary) and secondary education the students will have received.

In general higher education in the region, and in the whole of sub-Saharan Africa, was shaped by a history of colonialism, independence movements, post-independence development efforts and, conflicts, followed by reconstruction efforts. The establishment of higher and tertiary education institutions was a key part of post-colonial development. However, most of

these institutions were modelled on those of colonising countries or previous regimes. For example, as it will be shown later, to date, 20 years after the majority rule in South Africa, some AET institutions are still in terms of their student numbers all Back or predominantly White institutions (PWI). One over-arching theme is the greater realization that agriculture is an engine for economic growth for regional agrarian economies and a revitalized agricultural sector has immense potential in rural employment opportunities and reducing rural poverty. This engine will however require higher agricultural productivity given that increased yields are critical to the raising of incomes in rural areas (World Bank 2002). This whole endeavour requires investments in technology and knowledge.

Table 1: Socio-economic overview of SADC member countries, 2012

Country	**Population millions (2012)**	**Per capita GDP (US $)**	**HDI (2012)**	**HDI Global Rank**	**Key economic sectors**	**Gross tertiary enrolment (%)**
Angola	19.4	5,209	0.508	148	Oil and gas, trade and commerce, services, agriculture, forestry, fishing	1
Botswana	2.04	12,939	0.638	119	Mining, manufacturing, agriculture, tourism	4
DRC	67.3	262	0.304	142	Agriculture and forestry, services, mining, manufacturing	1
Lesotho	2.4	668	0.461	158	Clothing and textiles, agriculture, manufacturing, tourism	4
Madagascar	21.2	853	0.483	151	Mining, agriculture, industry and tourism	3
Malawi	16.2	268	0.418	170	Agriculture	1
Mauritius	3.3	8120	0.737	80	Agriculture, tourism, manufacturing, financial services	17
Mozambique	27.1	861	0.327	185	Mining, agriculture, industry, tourism	Not available
Namibia	2.2	5786	0.608	128	Mining and agriculture, industry and tourism	6
South Africa	50.3	9678	0.629	121	Services and tourism, mining, manufacturing, agriculture, forestry and fishing, utilities	15

Swaziland	1.1	5349	0.536	141	Manufacturing, Tourism	4
Tanzania	45.3	1334	0.476	152	Mining, agriculture, manufacturing, tourism	1
Zambia	15.4	1423	0.448	163	Mining, agriculture, manufacturing, tourism	2
Zimbabwe	13.2	N>A.	0.397	172	Agriculture, mining, tourism	4

Source: World Bank Report 2013

Table 2 outlines the main factors influencing higher education potential in the region and these from a range of enabling initiatives to constraints such as, low resource allocations, increased enrolment levels, etc. There are a number of regional initiatives that have been put in place to help develop the higher education sector. The 1997 Southern African Development Community (SADC) Protocol on Education and Training committed SADC countries to improving the standard of higher education and research by promoting co-operation and creating regional synergies (SADC, 1997). This was followed by the establishment of Southern African Regional Universities' Association (SARUA) to foster regional integration of higher education. At the continental level the Association of African Universities (AAU) decided to work with regional economic communities, e.g. COMESA. In AET, there has been renewed emphasis on agriculture as a key economic sector for most SADC member states. This has fostered the renewed effort in agriculture higher education through the CAADP initiative. The argument is based on the fact that AET has a direct impact on agricultural productivity and on the performance of ancillary businesses and trade, stimulates implementation of knowledge-driven economic growth strategies and poverty reduction (FARA/NEPAD 2006).

Table 2: An overview of factors influencing higher education potential in the SADC region

Factors influencing higher education potential in the SADC region	**Enabling features**	**Constraining features**
Regional policy framework	• SADC Protocol on Education and Training • Regional Indicative Strategic Development Plan (ISDP) and • SADC Quality Assurance (QA) Framework.	-
National level policy frameworks	• National higher education policy frameworks	• Variation across the region in detail and complexity of national policy

Enrolment patterns	• A general increase in the number of institutions and their enrolment in agriculture • Guided by scarce skills needs assessment for national and regional development e.g ZIMDEF, SADC collaboration Masters programmes	• Increasing enrolment versus institutional capacity and quality. • Numbers still inadequate to meet regional needs • Relative to need, very few postgraduate students enrolled • Gender disparities
Staff capacity	• General lack of human resources (and finances) • Staff development programmes • Staff capacity enhanced by regional collaboration and exchanges..	• High mobility and brain-drain of trained • Disparity in resources among institutions, well-resourced institutions attract well-qualified and experienced staff • Negative effect of the HIV and AIDS pandemic.
Research output	• Relatively low research output but increasing in recent years (especially in well-resourced institutions)	• Low postgraduate enrolment.
Funding initiatives	• Increased governments funding • Increased donor funding. • Strategic African capacity development initiatives plan e.g ACDF.	• Funding still inadequate • Public higher learning institutions still depend on government grants.
Quality assurance	• All countries have quality assurance frameworks in place at a national level • SADC Qualifications Framework • AAU Quality Assurance Project • Internal institutional quality assurance	• Superficial compliance with national quality assurance framework.

2. OVERVIEW OF TERTIARY EDUCATION IN SOUTHERN AFRICA

In terms of the number of institutions, the private higher education sector outnumbers the public sector. In Malawi and Zimbabwe public higher education institutions outnumber private ones. The Higher Education sector is largely based on contact provision: 72% of all students enrolled in public higher education are contact students, 28% are studying via distance education. In many countries there is an emphasis on increasing higher education access as well as addressing gender disparities. In general the focus is on teaching and learning, with some research and community service activities. There is a current shift towards research intensiveness and outputs.

To help regulate and guide the sector there is a range of tertiary education statutory bodies in some countries and in some only a few. This has helped to bring some coherence in the manner business is conducted in the sector. As in any economic sub-sector there is need for systematic data collection to help in planning and analysis of any developments. In the area of tertiary and university education, much of the data collection is done by the universities themselves, with limited collaboration between institutions within the same country. Data at this level may not be readily available (Umlilo weMfundo, 2007). In general there are no central databases for this (Hahn, 2005:7).

In this study it was very difficult to define comparable units of analysis/data categories e.g. Faculty of Agriculture at the University of Zimbabwe, Faculty of Natural and Agricultural Sciences at University of Pretoria, Faculty of Agricultural Sciences at Stellenbosch University, School of Agriculture and Natural Resource Management at Copperbelt University, Department of Agriculture in the Faculty of Science at the University of Zululand. While it is accepted that there is always a history (and relevance) to a particular structure and name, this severely impedes analysis at a higher scale, e.g. national and/or regional. At the moment it is difficult to harmonize reference points and/or indicators. There have been discussions for harmonized statistics and an integrated database of key statistics in the region, a feature which is a priority area for the Regional Indicator Strategic Development Plan (RISDP 2015). It is hoped this will improve SADC member country statistical capacity indicator, statistical practice, and data collection and indicator availability.

3. QUALITY CONTROL: STATUTORY BODIES IN THE TERTIARY EDUCATION SECTOR

Quality assurance is one the key issues that affect the performance of AET institutions. The SADC Protocol on Education and Training has been working towards harmonization, equivalence, and eventual standardization of university entrance and grading systems. As a consequence, this has led to the development of SADC Qualifications Framework (SADCQF). Of the 14 SADC countries only 4 (Angola, Botswana, Malawi, Namibia and Swaziland) do not have national assurance systems in place. Progress has been made to get these in place. The majority (78%) of regional HEI have internal quality assurance systems in place (with a budget to go with it); about 13% did not have any; for the remainder no data was available.

Ministries which oversee key economic sectors (including agriculture) are represented on the statutory bodies (Table 3). Most countries have statutory bodies in the tertiary education sector that prepare national policy framework, monitor institutional governance and management and interface higher education and national development goals.

Table 3: Overview of important statutory bodies in the higher education sector in SADC

Country	Important statutory bodies in the higher education sector
Botswana	•Tertiary Education Council (TEC) • Botswana Training Authority (BOTA)
DRC	• Ministry of Higher Education
Lesotho	• Ministry of Education and Training (only national body)
Madagascar	• Ministry of National Education and Scientific c research (MENRS) • Directorate General of Post Basic Education and Research (DGEPFR)
Madagascar	• Directorate General of Higher Education and Research (DGESR) • Directorate of Higher Education (DESUP) • Conférence des Présidents ou des Recteurs d'Institutions d'Enseignement Supérieur Publiques et Privées (Conference of Presidents or Rectors of Institutions of Public and Private Higher Education) (COPPRIES)
Malawi	None, but a task force is being set up to establish a Council for Higher Education
Mauritius	• Industrial and Vocational Training Board (IVTB) • Tertiary Education Commission (TEC) • Mauritius Examinassions SyndicaTE (MES) • Mauritius Qualifications Authority (MQA)
Mozambique	• None, only Ministry of Education and Culture
Namibia	• National Council for Higher Education • Advisory Council on Teacher Education and Training (ACTET)
South Africa	• Council on Higher Education (CHE) • Higher Education Quality Committee (HEQC)

	• South African Qualifications Authority (SAQA)
Swaziland	• Education Board • Scholarship Selection Board • University Council • University Senate • University Research Board
Tanzania	• Tanzanian Education Authority (TEA) • Tanzanian Commission for Universities (TCU) • Higher Education Students Loan Board (HESLB) • National Council for Technical Education (NACTE)
Zambia	• The Technical Education and Vocation Training Authority (TEVETA) • The Examination Council of Zambia • University Council
Zimbabwe	• Zimbabwe Council for Higher Education (ZIMCHE) • National Manpower Advisory Council (NAMACO) • Zimbabwe Manpower Development Fund (ZIMDEF) • College Lecturers Association of Zimbabwe (COLAZ) • National Economic Consultative Forum • Zimbabwe Occupational Standards Services (ZOSS)

4. RESEARCH METHODOLOGY

The broad objective was to understand the existing technical and institutional capacity of the southern African agricultural higher education and training (AET) institutions to meet the anticipated demand for specific system skills
The specific objective was to carry out a scoping study addressing:

i. inventory of existing long-term training capacity
ii. identify existing African-led capacity building efforts
iii. summarize existing staffing levels, facilities and enrolment in relevant departments
iv. reflect on the processes of gathering comparative regional agricultural education data where the national contexts differ widely

The study started off with a review of literature to analyse past and present trends. A wide range of sources were used, ranging from published and unpublished literature in the libraries to web based searches. A checklist was used to systematically go through the available body of information. This was then followed by unstructured interviews either face-to-face or through telephone or Skype. The semi-structured interviews were based around a checklist of questions on issues that were being addressed by the assignment.

Some key informant interviews were conducted with individuals believed to have deeper insights into the AET sector, people with first-hand knowledge. A total of 20 key informants were interviewed.. In South Africa these were in Pretoria and Limpopo Province. The key informants were selected from the following organisations and groups: Limpopo Provincial Department of Agriculture; Kuschke Agricultural High School (Polokwane); Ulando Comprehensive School (Bela Bela); Dumazi High School (Giyani); Community-based AET providers; Department of Basic Education (DBE); Department of Higher Education and Training (DHET); AgriSeta; 1xCollege of Agriculture (Mandivhandila); and Higher education institutions that offer agricultural programmes; In Zimbabwe key informant interview were conducted with the Ministry of Higher education, Ministry of Agriculture, ZimCHe, and 3xinstitutions of higher learning with AET programmes. There were also 2 interviews with Mozambicans and one Botswana-base AET professionals.

The results of the study are presented in the following sections.

5. TERTIARY EDUCATION ENROLMENTS IN THE SADC REGION

5.1 Foreign Students in Southern African Institutions

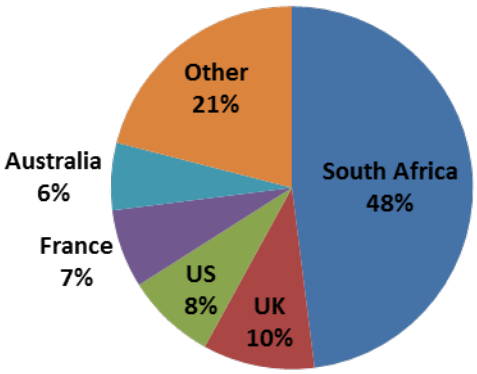
Tertiary level enrolment ratios in the region are generally low and range between 2 and 4% to a high of 17% for Mauritius (Table1 and 4). Other than South Africa, most higher education institutions rely on enrolment of national citizens. South Africa has considerable number of students from SADC countries as well as non-SADC countries. The 2009 enrolments figures across the region are presented in Table 4.

Table 4: Student enrolment in tertiary education across the region, 2013

Country	National citizens	SADC citizens	Other international students
Angola	47 353	0	20
Botswana	14 942	136	632
DRC	60 546	10	112
Madagascar	14 428	537	175
Malawi	7 824	31	10
Mauritius	9 655	4	61
Mozambique	46 790	3	72
Namibia	7 469	700	209
South Africa	697 774	35 745	14 536
Swaziland	5 660	108	17
Tanzania	30 967	38	203
Zambia	14 315	21	59
Zimbabwe	52 289	120	44
Total (all countries)	992 012 (94.9%)	37 453 (3.6 %)	16 150 (1.5 %)
Total (SA excluded)	312 238 (99.0 %)	1 708 (0.5 %)	1 614 (0.5 %)

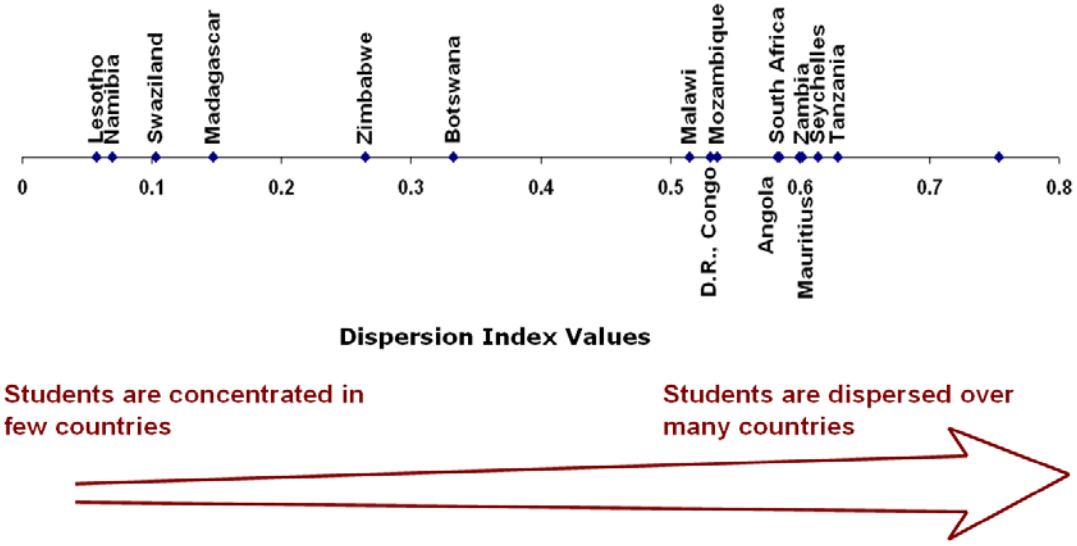
SADC students are among the most mobile students worldwide. In 2009, some 89,000 SADC students studied outside their home countries. Most of the SADC mobile students stay within the region and mainly in South Africa (Figure 1).

Figure 1: Percentage distribution of SADC mobile students by destination, 2009



This is further illustrated by the Dispersion Index (DI) of the regional countries (Figure 2). Botswana, Lesotho, Namibia, Swaziland and Zimbabwe have relatively smaller DI because most of their mobile students go to South Africa.

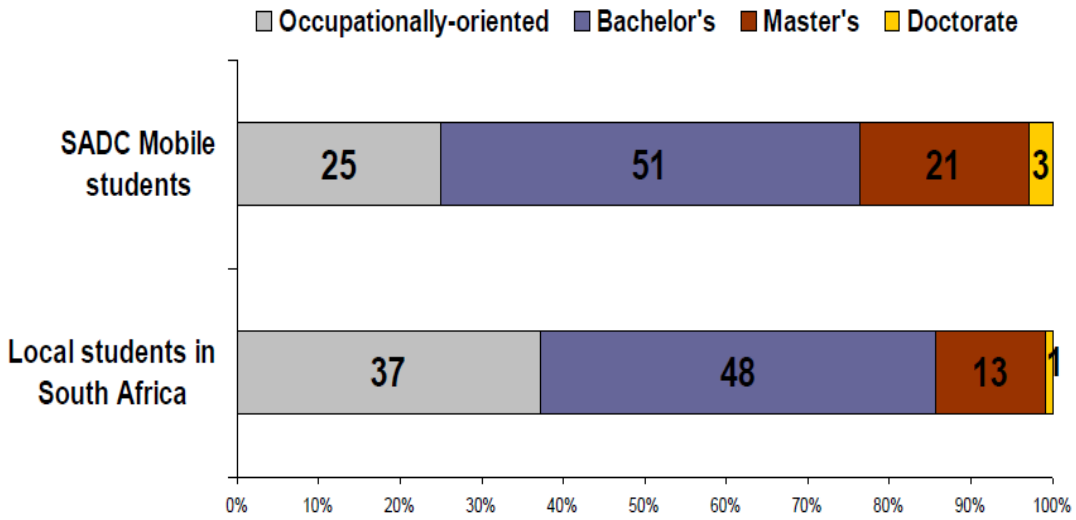
Fig 2: Dispersion index values by country, 2009



Source: UIS Information Bulletin 7, 2012.

Most of these students enroll for first degree South African programmes (Figure 3).This highlights the importance of South African HE programmes, including agriculture, towards regional human resource development. Incidentally South Africa is the leading host country in Africa (11th in the world) putting the country at a very strategic position in human capacity development (SARUA, 2011).

Fig 3: Percentage distribution of tertiary education students studying in South Africa by programme type and origin of students, 2009



Note: First-degree programmes include occupationally-oriented and bachelor's degree programmes.

5.2 Enrolment in AET institutions/faculties

Table 5 summarizes enrolment figures from some of the regional faculties of agriculture. These statistics are generally difficult to compile and are not always readily available. In a number of cases institutions collected data which nobody in the 'system' was particularly interested in or even remembered who or where it was kept.

Table 5: Institutional enrolment at select AET Institutions in Southern Africa

Institution*	2005			2006			2007			2008			2009	2010			2011	2012		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	Total	M	F	Total	Total	M	F	Total
University of Zimbabwe	244	94	338	270	114	384	251	114	365	0	0	8		113	60	173	87	64	21	**85**
Bindura University of Science Education	115	46	161	55	29	84	27	12	39	47	25	72								
Women's University in Africa	48	24	72	40	33	73														
Lupane State University	12	2	14	7	8	15	5	4	9	9	1	10								
National Univ of Science and Technology	9	8	17	11	6	17	26	26	52	34	15	49								
Africa University	22	14	36	17	13	30	23	9	32											
Solusi University	105	49	154	161	68	229	141	126	267	136	131	267								
Chinhoyi University of Technology	54	36	90	50	36	86	49	32	81			57	48							
University of Swaziland	538	375	913	530	419	949	460	396	856			**872**	**1007**							
Copperbelt University										210	55	265								
University of Zambia	182	50	232	191	68	259	205	79	284											
University of Free State			3935			4224			4727			4810	5147							
University of Pretoria	2449	2658	5107	2504	2802	5306	2499	2804	5303	2536	3021	5557	5620			6163	6265	2949	3446	**6395**
Botswana College of Agriculture														625	385	1010				

**Note: difficult to establish comparable statistics across institutions*

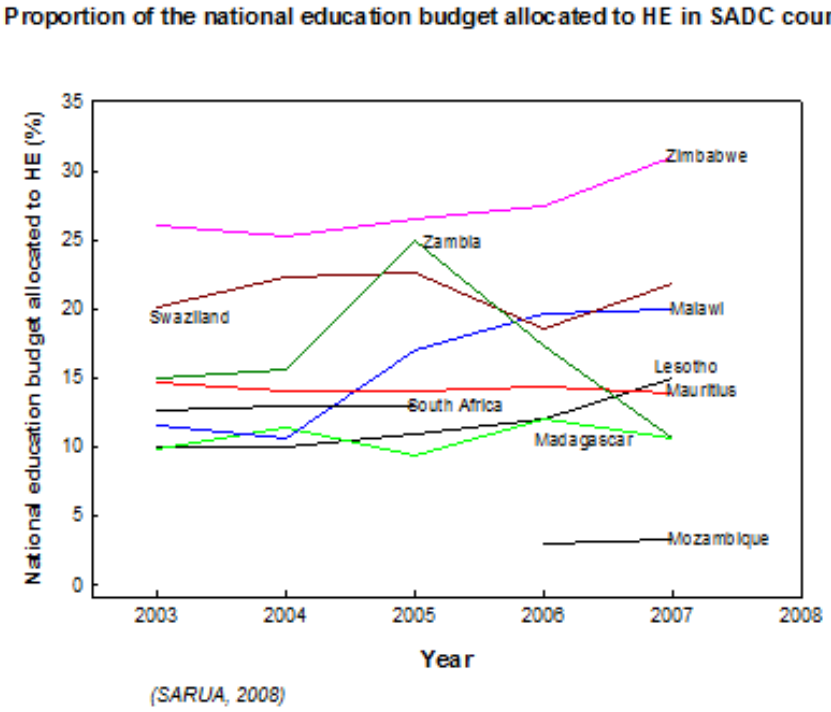
Table 6: Number of teaching/technical staff in some regional Faculties of Agriculture

Institution	Grade	2012
University of Zimbabwe	Lecturers	52
	Teaching Assistants	16
	Technicians	11
	Field Staff	
Bindura University of Science Education	Lecturers	15
	Teaching Assistants	7
	Support Staff	6
Lupane State University	Lecturers	12
	Teaching Assistants	1
	Support Staff	1
National University of Science and Technology	Teaching Staff	9
Africa University	Teaching Staff	10
Chinhoyi University of Technology	Lecturers	42
	Teaching Assistants	5
University of Namibia	Lecturers	54
	Teaching Assistants	8
	Technicians	7
University of Mauritius	Lecturers	18
Mulungushi University	Lecturers	8
Copperbelt Univeristy	Lecturers/Professors	24
University of Zambia	Diploma	5
	BSc	8
	MSc	24
	PhD	19
Nelson Mandela Metropolitan	BSc	2
	MSc	7
	PhD	2
University of Pretoria (NAS & VET)	PhD	277
	Masters	106
	Honours	28
	UG/Diploma	21
University of Free State	Teaching Staff	101
University of Kwazulu Natal	Teaching Staff	42
University of Limpopo	Teaching Staff	32
Botswana College of Agriculture	Lecturers	67
	Technicians	15

6. FUNDING OF AET INSTITUTIONS

Tertiary education is largely funded by government and different countries have different funding allocation modalities. The general funding levels (using available data) is presented in Figure 4. Funding is generally inadequate for effective operation especially the public funded institutions. Generally, priority is given to basic education (primary and secondary). As shown in Figure 4, Swaziland and Zambia have demonstrated severe run down of budgetary allocation to tertiary training institutions. On the other hand, South Africa, Mauritius and Mozambique have remained almost flat over the years but of course with South Africa and Mauritius being quite some distance from the neighbouring Mozambique.

Figure 4. Funding trends in southern African tertiary institutions



(SARUA, 2008)

In terms of revenue, the largest chunks are mostly from government subventions and student fees. The following have been the main trends over the last decade:

- There has been a general shift towards cost sharing in the form of fees; in some cases e.g.. Zimbabwe and Zambia a dual system where a fee-paying system co-exists with a free, government funded for some students *(has led to corrupt tendencies and inequalities in some cases).* Mozambique provides scholarships for students from the rural areas In Namibia and South Africa everyone pays tuition fees
- General expansion of the private education sector (conflict with for-profit mode of operation)
- Sectoral competition even within the education sector itself
- Generally no systematic funding mechanism/formula; mostly via incremental budgeting processes e.g. adjusted for inflation. South Africa has a systematic approach supported by an appropriate staff compliment

    - Loan schemes are available across the region; in some countries there is no recovery of the loans (i.e. translates to free) although in a number of countries this is being corrected e.g. Zimbabwe and Tanzania.
    - Inequalities in access to the loans with the most affluent recurring them in most cases.
- Significant external donor involvement in HE e.g. British Council, USAID; World Bank; Korean/Chinese Scholarship programmes, bilateral initiatives etc. But there need to assess the long term implications; to fund private church universities across the region e.g. Catholic Universities; Seventh Day Adventist Church; Methodist/Dutch Reformed Church. African initiatives include:
    - African Capacity Development Fund which has funded infrastructure at HEI across Africa.
    - Linkages with the regional economic communities

There are also African initiatives by individual governments or continental bodies Examples are:

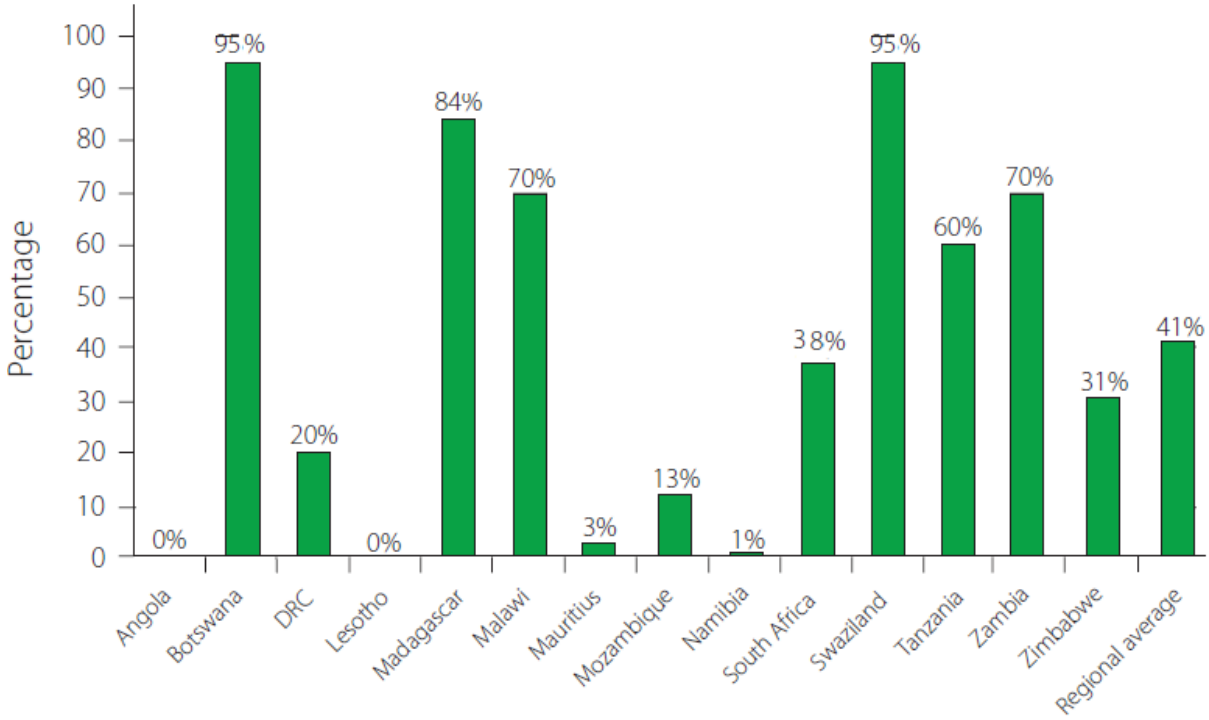
- Private-public partnerships: the state funds most of the capital expenditure and private sector funds the operational costs e.g. Mulungushi University in Zambia (similar in Botswana and Women's University in Africa in Marondera Zimbabwe). Except in SA there is little evidence of private sector support or 'third stream' income in the region.
- Differentiated government funding model: more government funding for those tertiary institutions or programmes with higher social returns like teacher education (relative to private returns) as in Mauritius. In SA there is an added national equity drive to improve the conditions at 'formerly disadvantaged' institutions.

  Other equity models include:

- Zimbabwe Presidential Scholarships for study in South Africa (at least 100 students per year) and is meant for the orphans and the poor;
- Provincial scholarships in Mozambique
- Deliberate loan schemes to address issues of access e.g. in South Africa for members of the 'formerly disadvantaged' communities and gender

There is also a great diversity across countries in financially supporting the needy to get tertiary education. Table 5 depicts that zero support for students in Angola, Lesotho and even Namibia which is only 1%. These figures beg the question—how will the academically gifted but financially poor individuals get their education which is so crucial in human, economic and social development?. It would appear that countries like Botswana and Swaziland with 95% support have made a deliberate decision to raise the necessary skills needed in industry, government and private sector as soon as possible.

Fig 5: Percentage of higher education students receiving government financial support



Source: SARUA, 2008

Funding at institutional levels takes several forms: block funds which are made up of research funds, teaching funds and developmental funds. Others are targeted funds that are released to meet particular purposes. Tuition fees and levies are other sources as well.

Table 8 Total number of annual research publications reported by SADC institutions

Institution	Type of Publication	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
University of Zimbabwe	Journal	29	22	12	29	27	25	36	28	16	12	12		248
	Books	4	3		1	7	3	3		5	1			27
	Other													0
University of Namibia	Journal	4	1	5	3	5	4	6	4	7	8			47
	Books					1	1		1					3
	Other				1	1				7	9	2		20
University of Mauritius	Journal	2	4	3	4	1	3	2	3	18	11	5		56
	Books													0
	Other		1		3				1	12	6			23
University of Stellenbosch	Journals	97	96	125	149	149	173	171	154	197	145	263		1719
	Books	27	8	3	10	6	15	15	16	27	3	29		159
	Others	178	118	276	218	8	63	61	61	36	46	78		1143
University of Free State	Journals	35	27	15	17	21	90	85	100	77	74			541
	Books/Chapters	0	1	0	0	13	1	1	8	3	5			32
	Other	55	63	54	90	52	232	223	133	149	122			1173
University of KwaZulu Natal	Journals				137	325		350	367	464	530			2173
	Books/Chapters				15	27		34	18	17	7			118
University of Limpopo	Journals											72	107	179
	Books/Chapters												2	2

7. AGRICULTURAL EDUCATION AND TRAINING IN SOUTH AFRICA

7.1 BACKGROUND

Historically, the Agricultural Education and Training (AET) in South Africa lacked coherence and co-ordination and followed no deliberate strategic direction. This was true for both the formal and non-formal sub-sections as well as vertical integration within the formal education and training sector. Resource support for AET was skewed in favour of the white demographic. By and large, the former White institutions are still better resourced than their historically Black counterparts. The offered programmes were characterised by marked differences in quality, standards, outcomes and curriculum. This restricted mobility of students across institutions and, if anything, created barriers to higher levels of training. There were poor linkages between AET and the agriculture industry. The formal AET sub-sector had some quality control in place but the same could not be said of the non-formal sector. The application of quality control varied and was not effective in the provision of reliable products to the industry. For the previously disadvantaged communities admission requirements and affordability were major barriers to access AET. This was further compounded by the fact that agriculture had a negative career image among the youths, with the typical situation being that there *were large numbers of unemployed agriculture graduates* on one hand, while on the other there was *a shortage of critical skills in agriculture*.

This background led to the development of the AET Strategy (2002-2005) whose objectives were among others, to i) guide the development and provision of a nationally coordinated, effective, responsive and quality assured AET accessible to all South Africans, ii) address the historical emphasis on primary production and widen the spectrum of disciplines included in AET to incorporate current and future trends and opportunities, for example, agro-tourism and game farming and iii) facilitate the adoption of appropriate legislative and regulatory framework necessary to protect the education and training rights and interests of agricultural and rural role players

7.2 THE NEW AET OPTIONS IN SOUTH AFRICA

Following the AET Strategy the sector has a more defined structure which covers both the formal and non-formal sub-sectors. The strategy takes into consideration the fact that education and training provision should be for all, i.e. those who have completed school, those who did not complete their schooling, and those who never attended school.
Formal agricultural training is available at **five** different levels, viz. at primary schools, secondary schools, colleges of agriculture, technikons and universities. The primary and secondary schools are under the puview of the Department of Basic Education (DBE) while the rest fall under the Department of Higher Education and Training (DHET). Typically, given the devolution of power in the SA government system, primary and secondary schools are managed by the education departments of the provinces while colleges of agriculture are controlled by the provincial departments of agriculture. The DHET is responsible for the following institutions:

- 23 public universities (with two more being established in 2014);
- 50 public technical and vocational education and training (TVET) colleges (formerly known as further education and training [FET] colleges);

- public adult learning centres (soon to be absorbed into the new community colleges);
- private post-school institutions (registered private FET colleges and private higher education institutions, also to be renamed TVET colleges);
- the Sector Education and Training Authority (SETAs; e.g. AgriSETA for agriculture) and the National Skills Fund (NSF);
- regulatory bodies responsible for qualifications and quality assurance in the post-school system – the South African Qualifications Authority (SAQA) and the Quality Councils. The DHET – through the Quality Councils – is responsible for assuring the quality of provision in these colleges and for ensuring that the qualifications that they offer are registered.

Although the universities fall under the DHET agricultural faculties are the responsibility of the respective universities concerned. Training of agricultural extension officers and researchers are provided at the faculties of agriculture of the universities or at technikons offering agricultural subjects. Veterinary surgeons are trained at the University of Pretoria's Faculty of Veterinary Sciences at Onderstepoort. State veterinarians are assisted countrywide by animal health technicians who obtained a National Diploma in Health at certain technikons and various other colleges of agriculture.

On a less formal level the ARC (Agricultural Research Council) regularly presents various specialised training courses and information days which are attended by farmers and delegates from South Africa and neighbouring countries. Specialized exhibitions, training courses and open days (with practical demonstrations) are used to reach the small-scale farmer.

7.3 PRIMARY AND SECONDARY SCHOOLS

For the Foundation Phase (Grades R, 1 and 2) the core subjects are Language(s); Mathematics and Life Skills. At the Intermediate Phase (Grades 4-8) the subjects are mainly Language(s), Mathematics, Natural Science & Technology, Social Sciences and Life Skills. At both the Foundation and Intermediate Phases there is little or no elaborate coverage of agricultural concepts in a direct manner. At the Senior Phase (Grades 9 and 10-12) the national curriculum requires learners to take seven subjects: 2 languages; Mathematics; Life Orientation, plus three (3) choice subjects. In the field of Agricultural Sciences one can choose from one of three subjects that are offered: Agricultural Sciences, Agricultural Management Practices, and Agricultural Technology. The time allocation for each of these subjects in the curriculum is 4 hours per week; 160 hours per year and 40 weeks per year. In detail:

Agricultural Sciences covers the relationship between soils, plants and animals and the production and processing of food, fibre, fuel and any other agricultural commodities that have an economic, aesthetic and cultural value. The knowledge, skills and values acquired in this subject enable learners to understand the application of appropriate technology in commodity production (animal and plant) and processing in a manner that will ensure sustainable agriculture. Agricultural Sciences consists of soil science (components, forming, characteristics, organic matter, chemical and colloidal characteristics, classification and soil microbiology), plant science (nutrition, reproduction and propagation, breeding, protection and classification), animal science (nutrition,

reproduction and propagation, breeding, protection and classification), agricultural economics, basic chemistry, basic biological concepts, sustainable natural resource utilisation and management of the environment. *(Content Framework annexed).*
Relative to the other two agricultural courses this is, by far the most popular agricultural subject based on the numbers of learners who sit for this subject every year.

Agricultural Technology focuses on technological processes used in agriculture, *viz.*an understanding of how processes, equipment and structures are used with people, soil, plants, animals and their products. The environment, the sustenance and maintenance of the quality of life and increasing economic, aesthetic and sound cultural values are important considerations in Agricultural Technology. The subject is of a practical nature and is designed to help learners to solve problems in an innovative and creative way. By applying the technological process, technology becomes knowledge in action. Agricultural Technology draws on the following knowledge fields: technology, engineering, mathematics, physical and life sciences, geography and the agricultural field. This subject may only be offered in agricultural schools or schools with land and the required equipment.

Agricultural Management Practices is the study and application of production, economic and management principles that are used in the cultivation, transformation and marketing of food and other agricultural products. These principles are used to produce and add value to high-quality agricultural products so that these products have economic, aesthetic, social and cultural value. Agricultural management Practices draws knowledge and skills from disciplines such as crop sciences; animal sciences; economics and management sciences; engineering; and information and communication technology. The subject is designed to provide learners with a sound practice-orientated base that integrates theoretical and practical competencies. the main topics in the Agricultural management Practices curriculum are: Crop Production and Crop management; Soil and Water management; Product harvesting and Quality Control; Animal Production and Animal management Aspects; Farm management and Evaluation; Value Adding, Processing and Producer Organisations; Agri-tourism, Business Planning and Entrepreneurship *(Content Framework annexed).*

Not all secondary schools in the RSA offer agriculture as a formal subject. Among those that offer agriculture there are 43 special agricultural high schools in the provinces where learners are required to take one or more agricultural subjects (Table 9 a). These schools usually have a farming unit to cater for agronomic and livestock demonstrations and material for training purposes.

The NSC results for the three agricultural courses for the period 2008 to 2013 are presented in the Table 9 b below.

Table 9 a Schools offering agricultural science as a subject in Grade 10, 11 and 12

Province	Agricultural Schools	Academic Schools
Western Cape	3	34
Eastern Cape	3	581
Northern Cape	2	13
Free State	7	66
Limpopo	7	1040
Mpumalanga	9	227
Kwazulu Natal	4	368
Gauteng	1	28
North West	7	170
	43	2527

Records show that the filtering at secondary school is quite strong because those scoring over 50% are extremely few as shown in the figures below. Apparently though, at higher college levels, the pass rate is quite impressive (Table 9 b).

In 2010 a total of 85 523 Grade 12 learners from the above mentioned schools wrote the final matric end exam in agricultural Science. The results are the following:

- 30 837 (36%) failed the exam (< 30%)
- 27 184 (31%) pass the subject (30 – 39%)
- 16 789 (19%) pass the subject (40 – 49 %)
- 7 572 (9%) pass the subject (50 – 59%)
- 2 450 (3%) pass the subject (60 – 69%)
- 674 (0.7%) pass the subject (70 – 79%)
- 117 (0.1%) pass the subject (80% +)

In 2011 77719 students wrote the examinations and the results in agricultural science were as follows:

- 21432 (27.6%) failed (< 30%)
- 25515 (32.8%) pass (30 – 39%)
- 17991(23.1%) pass (40 – 49%)
- 8808 (11.3%) pass (50 – 59%)
- 3043 (4%) pass (60 – 69%)
- 804 (1%) pass (70 – 79%)
- 118 (0. 2%) pass (80 – 100%)

Most likely then, those that will be entering tertiary AET institutions should preferably have come from the pool of the 43 agriculture secondary schools. One would therefore expect them to be conversant with agriculture not only in theoretical terms but also practical-wise.

Table 9 b Agricultural results at National Senior Certificate 2008- 2013

	2008		2009		2010		2011		2012		2013	
Subject	Wrote	% Achieved	Wrote	% Achieved	Wrote	% Achieved	Wrote	% Achieved	Wrote	% Achieved	Wrote	% Achieved
Agricultural Management Practices					1128	100	1 100	99	1 223	100.0	1 417	100
Agricultural Sciences	85 668	52.1	90 136	52	85 523	63	77 719	71	78 148	73.7	83 437	81
Agricultural Technology					534	99	590	100	675	99.3	688	100
Total	**85668**		**90136**		**87 185**		**79 409**		**80 046**		**85 542**	

The proportion of students achieving a pass at NSC has increased significantly over the years for the widely taken Agricultural Sciences. The other two subjects have always recorded high pass rates. However, at the NSC Agricultural Science is a stand-alone subject, and can be studied without taking Mathematics or Science, the critical gateway subjects for would-be entrants to higher education. The implication is that even with passes Agricultural Science a student will have limited choice of study options in higher education without Mathematics or Science. Chances and options at higher education level are further restricted by the fact that most of the passes in Agricultural Science are at Standard Grade syllabus (relative to Higher Grade). The more subjects a student elects to take on the Standard Grade, the lower her/his chances are of qualifying to enter higher education. Maths and Science are still necessary for students to be admitted to science-based agriculture programmes (e.g.: BSc Agriculture).

Posts NSC there are several colleges and universities for further formal training. There are also a number of less formal avenues for further training (as indicated earlier).

Technical and Vocational Education and Training (TVET) Colleges [*formerly Further Education and Training (FET) Colleges]*

At the moment there are 10 (out of 50) Technical and Vocational Education And Training (TVET) Colleges that offer agricultural programmes. The curriculum of these TVETs is explicitly vocational and they contribute immensely to the intermediate and high-level skills needs of the agriculture sector. The system offers flexibility such that learners can enrol a whole qualification at one time or come on an intermittent basis as instructional offerings are needed or as finance becomes available or to meet the particular need they may have for specific skills. This gives both regular and irregular enrolments over a period of time. Ultimately, it is difficult to make direct links between enrolments and graduates in the TVET College sector. These colleges are structured to be responsive to the students and also to the labour market needs of the local economy. In agriculture the focus of the TVET is on courses related to farming as a form of business practice; courses dealing with farming mechanics; courses focused on crop and animal production. The curriculum offered in the TVET Colleges is nationally specified and the same programme can therefore be found in all TVET Colleges.

More recently there has been a deliberate effort to strengthen partnerships between colleges and employers, both at the system level and that of individual colleges. It is envisaged these partnerships will assist the colleges to locate opportunities for work-integrated learning, to place students when they complete their studies, and to obtain regular workplace exposure for staff so as to keep them abreast of developments in industry. Employers have been afforded the space to advise the college system and individual colleges around issues of curriculum, and experts from industry could teach at colleges on a part-time or occasional basis. The Sector Education and Training Authority (SETA), appropriately called AgriSETA, has been pivotal in promoting this partnership ans well as skills development for the agricultural sector.

However, the national vocational training systems, across the region, are generally small and ineffective and are more focused on industrial and service occupations.

7.4 AET AT COLLEGES OF AGRICULTURE

Prospective farmers, extension officers, animal health and engineering technicians are trained at the colleges of agriculture of the provincial departments of Agriculture and the National Department of Agriculture. Practical training takes up about half the student's time. The balance is devoted to lectures and demonstrations. The colleges also offer training in farm economics and management. In addition to the diploma course, special and short courses are available. Training at all colleges of agriculture is accorded the same status and formal recognition as training at technikons.

There are *twelve* public Colleges of Agriculture in South Africa offering qualifications at NQF Level 1 to NQF Level 6. These are Cedara in KwaZulu- Natal, Elsenburg in the Western Cape, Fort Cox in the Eastern Cape, Glen in Free State, Grootfontein in Free State, Lowveld in Mpumalanga, Madzivhandla in Limpopo, Owen Sithole in Kwazulu-Natal, Potchefstroom and Taung in North- West, Tompi Seleka in Limpopo and Tsolo in the Eastern Cape. The colleges are managed under the auspices of Provincial Departments of Agriculture and the National Department of Agriculture. A Senior Certificate or equivalent is the minimum requirement for admission for the main programmes.

The common qualifications are the Higher Education Certificate (HEC) in Agriculture (NQF Level 5) which takes two years, and the Diploma in Agriculture (NQF Level 6), which is pursued for a further one year on completion of the Higher Certificate in Agriculture. HEC and the Diploma programmes are accredited by the HEQC of the Council for Higher Education (CHE), while the programmes in NQF Level 1 to 4 are accredited by Umalusi and AgriSETA.

Table 10 shows the broad curriculum offered by the Colleges. The actual programmes/programme contents at the Colleges of Agriculture are not highly standardized. Instead flexibility is enshrined to allow individual colleges to orient their courses towards supporting the main agricultural activities of their respective province/ region. For example the Lowveld College in Mpumalanga focuses on sugar cane, tobacco and horticulture; Elsenberg has set itself the aim of specializing in agribusiness, horticulture and cellar technology (wine making); Grootfontein College of Agriculture focuses on the provision of technically-trained manpower for the small-stock farming sector and related industries.

Table 10: The Broad Curriculum in Colleges of Agriculture in South Africa

General Courses	Courses covering specific sub-fields	More specialized courses within sub-fields	Specific product courses include:
Plant Production	Agronomy (Grain crops)	Crop protection	Eg: Vegetable, fruit production, viticulture, sugar cane etc. Also: green house management, Forestry
	Crop production	Pasture	

		Management	
	Horticulture		
	Soil science		
Animal production	Animal breeding	Artificial insemination	Eg: Beef cattle, dairy cattle, fish, mutton, pig, poultry, wool etc
	Animal nutrition	Animal husbandry	
		Feedlot management	
	Animal production	Small stock production	
		Large stock production	
	Animal health		
Agricultural Engineering	Hydraulics/Hydraulic systems	Irrigation and drainage systems	
	Agricultural implements		
	Mechanisation planning		
	Electrical apparatus/ motors		
	Surveying		
Agricultural Management	Marketing		
	Farm management	Office admin	
		Land use planning	
	Community development		
	Financial management	Farm accounting	
	Economics	Production factors	
		IT applications	
		Entrepreneurial	

		skills	
Environmental management	Game ranching Veld management	Problem animal control	
Other		Farm safety	

Agricultural Colleges offer courses to a more advanced level than in the FET Colleges, for example in crop production more advanced courses like 'Greenhouse Management' are available; "Farm Mechanics" of the FET curriculum is taken at an advanced level as "Agricultural Engineering" at the Agricultural Colleges. There is deliberate emphasis on the balance of theoretical to practical in the College programmes, with on average, 55-60% theoretical component the rest being for practicals.

Table 11 below gives changes in the number of students graduated at the colleges over years. The Colleges also offer various non-formal courses in collaboration with industry partners, e.g. welding, performance testing, wool classing, etc. Elsenburg College of Agriculture and Potchefstroom College of Agriculture also offer BTech degrees in conjunction with Cape Technikon and Tshwane University of Technology, respectively. A diploma (or in some cases a degree in agriculture) is required for admission to the B.Tech course.

Table 11: Graduate Output of Agricultural Colleges 1999 to 2012

Year	Qualification	Enrolment	Graduate output
2011/12	Higher Cert	220	158
	Diploma	1203	318
	Degree	90	58
	Total	**1428**	**534**
2010/11	Higher Cert	196	201
	Diploma	710	328
	Degree	128	54
	Total	**1034**	**583**
2009	Higher Cert	675	344
	Diploma	55	299
	Degree	90	101
	Total	**820**	**744**
2008	Higher Cert	720	344
	Diploma	787	299
	Degree(Elsenburg)	109	101
	Total	**1616**	**744**
2007	Higher Cert	867	268
	Diploma	591	308
	Degree(Elsenburg)	67	68
	Total	**1525**	**644**
2006	Certificate	52	0
	Higher Cert	508	280

	Diploma	557	327
	Total	**1117**	**607**
2005	Certificate	131	1
	Higher Cert	667	322
	Diploma	716	315
	Degree	225	-
	Total	**1739**	**638**
2004	Certificate	26	18
	Higher Cert	860	348
	Diploma	564	286
	Degree	11	11
	Total	**1461**	**663**
2003	Certificate		361
	Higher Cert		284
	Diploma		200
	Total		**845**
2002	Certificate		327
	Higher Cert		268
	Diploma		282
	Total		**877**
2001	Certificate		317
	Higher Cert		209
	Diploma		258
	Total		**784**
2000	Certificate		209
	Higher Cert		253
	Diploma		462
	Total		**924**
1999	Certificate		274
	Higher Cert		264
	Diploma		357
	Total		**895**

7.5 AGRICULTURAL EDUCATION AND TRAINING AT UNIVERSITIES OF TECHNOLOGY

There are five Universities of Technology in South Africa offering AET. These are Cape Peninsula University of Technology (CPUT), Central University of Technology Free State (CUT), Mangosuthu Technikon (Mantec), Durban University of Technology (DUT), and Tshwane University of Technology (TUT). The Agricultural qualifications offered by these institutions include certificates, diplomas, B.Tech, M.Tech and D.Tech degrees at some technikons. A matriculation certificate (or equivalent) is required for entry to these courses. Selection applies for all fields of study. The three year national diplomas usually consist of two years formal training at the technikon followed by one year of structured

experiential training at an approved employer. On completion of the National Diploma in Agriculture or Agricultural Management students can enrol for the BTech in Agriculture and the following MTech degrees.

Most of the AET students are enrolled at TUT which has a very broad curricula compared to the other institutions. It offers a wide range of agricultural programmes in four main streams, namely Horticulture, Crop Sciences, Nature Conservation, and Animal Sciences. The total enrolments and throughputs for the technikons (and universities) are presented in Table 12 below. Enrolments for the technikons peaked in 2003 after which they have been declining. The throughput has shown an increase in recent years.

Table 12: Throughput rates for AET programmes for SA Universities and Technikons 1994-2010

Year	Universities			Technikons		
	Enrolment	Graduates	Throughput	Enrolment	Graduates	Throughput*
2011/12	13189	2149	16	2744	1299	47
2010/11	12397	2318	17	4907	1297	26
2009	4477	2039	46	1520	816	54
2008	4348	1879	43	3894	816	21
2007	14503	1991	14	3745	1307	35
2006	7914	1406	18	3599	959	27
2005	8302	1328	16	3035	685	23
2004	5404	905	17	2342	783	33
2003	4558	904	20	6638	862	13
2002	4223	802	19	6125	811	13
2001	4242	745	18	6346	703	11
2000	3411	907	27	5258	627	12
1999	3013	762	25	4683	624	13
1998	2963	778	26	4778	679	14
1997	2914	669	23	4775	598	13
1996	2746	582	21	4281	630	15
1995	2686	556	21	4535	584	13
1994	2581	612	24	3946	355	9

**crudely measured as the number graduating divided by the enrolment*

Enrolment at the Universities of Technology peaked in 2003 (Table 12) and has somewhat stabilized at just under 4000 students enrolled a year. Black students dominate in these institutions, followed by Whites. In general there are few or no Coloured and/or Asian students. The gender composition is generally tilted in favour of males although this varies from one institution to the other; for example females dominate the enrolment numbers at DUT. The annual graduation 'output' from AET programmes increased by a factor of at least x2 from the early 2000s. TUT has consistently trained more than 50% of the graduates every year. This might simply be a reflection of the size of TUT relative to the other Technikons on one hand or suggestive of factors that might be contributing to the low enrolments in the other institutions.

Table 13: AET enrolment per University of Technology in SA

University	Enrolment year							
	2004	2005	2006	2007	2008	2009	2010/11	2011/12
CPUT	112	130	85	372	521	293	2145	1089
CUT	95	213	187	272	98	106	133	132
MANTEC	449	407	581	725	831	242	633	285
DUT	139	148	892	793	816	295	328	278
TUT	1727	2137	1854	1583	1628	584	1708	960
TOTAL	2522	3035	3599	3745	3894	1520	4907	2744

There was a general increase in enrolment from 2004 to 2008 and a sudden drop in 2009 for all Universities of Technology (Table 13). Tswane University of Technology tops in enrolment whilst Central University of Technology has the lowest for the 2004 to 2012 period.

Table 14: Breakdown of enrolments by gender and race per university of technology

Cape Peninsula University of Technology (CPUT)												
Year	**African**			**Coloured**			**White**			**Indian**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
(CPUT)												
2004	5	3	8	5	2	7	87	10	97			
2005	1	3	4	8	2	10	111	5	116			
2006	6	3	9	12	1	13	57	6	63			
2007	21	4	25	21	8	29	290	28	318			
2008	72	120	192	47	51	98	165	62	227			
2009	66	91	157	24	17	41	72	23	95			
2010/11	540	816	1356	141	213	354	255	130	385	7	3	10
2011/12	299	399	698	74	114	188	124	73	197	4	2	6
Central University of Technology (CUT)												
Year	**African**			**Coloured**			**White**			**Indian**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
(CUT)												
2004	52	16	68	3	0	3	22	2	24			
2005	85	56	141	--	--	-	69	3	72			
2006	67	46	113	3	0	3	61	10	71			
2007	123	85	208	1	1	2	59	3	62			
2008	35	28	63	2	0	2	30	3	33			
2009	45	31	76	3	2	5	22	2	24			
2010/11	75	31	106	2	0	2	21	4	25			
2011/12	69	28	97	2	0	2	32	1	33			
Durban University of Technology (DUT)												
Year	**African**			**Coloured**			**White**			**Indian**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
(DUT)												
2004	81	41	122	3	1	4	13	0	13			
2005	87	47	134	2	1	3	11	0	11			
2006	177	355	532	5	11	16	18	27	45	69	230	299
2007	156	332	723	-	-	-	1	1	2			
2008	154	365	519	6	9	15	49	193	242	18	22	40
2009	102	134	236	1	1	2	3	2	5	10	42	52
2010/11	111	154	265	1	3	4	5	3	8	17	34	51
2011/12	108	105	213	1	1	2	3	4	7	24	32	56

Mangosuthu University of Technology												
Year	***African***			***Coloured***			***White***			***Indian***		
	Male	***Female***	***Total***	***Male***	***Female***	***Total***	***Male***	***Female***	***Total***	***Male***	***Female***	***Total***
(MUT)												
2004	265	184	449									
2005	236	171	407									
2006	321	258	579				1	1	2			
2007	351	372	488	2	7	9	18	20	38	56	202	258
2008	384	440	824				6	1	7			
2009	106	134	134	2	0	2						
2010/11	306	323	629	0	1	1	2	1	3			
2011/12	144	141	285									
Tshwane University of Science and Technology												
Year	***African***			***Coloured***			***White***			***Indian***		
	Male	***Female***	***Total***	***Male***	***Female***	***Total***	***Male***	***Female***	***Total***	***Male***	***Female***	***Total***
(TUT)												
2004	695	398	1093	4	3	7	388	233	621	4	2	6
2005	603	900	1503	3	4	7	224	402	626	1	0	1
2006	775	547	1322	6	5	11	302	216	518	1	2	3
2007	642	576	1218	7	0	7	177	178	355	2	1	3
2008	645	531	1176	4	3	7	248	197	445	0	0	0
2009	225	230	485	0	1	1	51	42	93	2	3	5
2010/11	671	689	1360	4	1	5	180	154	334	5	4	9
2011/12	387	403	790	0	1	1	121	46	167	1	1	2

At Cape Peninsula University of Technology White students dominated in enrolment, followed by coloured students from 2004 to 2008. Black Africans had the highest proportion of enrolment in 2009. Male students are more than female students across all races with an exceptional case of female black Africans who outnumbered their male counterparts between 2008 and 2009.

For Central University of Technology, black Africans highly out-numbered white and coloured students from 2004 to 2009. There was no change in enrolment of coloured students for the entire period. In addition, male students lead in enrolment compared to female students for all the three races for the 2004 to 2009 period.

The highest enrolment at Durban University of Technology was from black Africans followed by Indians, Whites and Coloureds, in that order from 2004 to 2009. Female black African students were more than male students between 2006 and 2009, whilst there were more female than male Indian students in the study period. The male and female enrolment was the same in coloured and white students from 2004 to 2009, though there were exceptionally more white female than male students in 2006 and 2008.

Black African students account for more than 90 % of the enrolment at Mangosuthu Technikon, with white, Indian and coloured races occupying the remaining proportion. Whilst the information about gender enrolment for the white, Indian and coloured races was not readily available, there were more male than female black Africans between 2004 and 2006. A notable increase in female to male black students enrolment occurred from 2007 to 2009.

At Tswane University of Technology, black African and white students contribute to 60 and 30 % of enrolment, with coloured and Indian races forming the remaining 10%. There are generally more male than female African, white and coloured students. There is an equal proportion of male to female Indian students.

The breakdown of the enrolments by subject matter at the universities of technology is presented in Table 15.

Table 15: AET Enrolments at Universities of Technology by Category of Education Subject Matter (CESM) in 2012

CESM*	Diploma	BTech	MTech	DTech	Total	%
Agricultural Business & Management	766	145	11	1	923	**34**
Agricultural Productions Operations	447	66	0	0	513	**19**
Applied Horticulture & Hort Business Services	138	11	0	0	149	**5**
Food Technology	170	11	9	0	190	**7**
Plant Sciences	195	27	7	0	229	**8**
Agriculture, Agric Operations & Related Sciences & Other	188	33	15	1	237	**9**
Family and Consumer Services	120	1	1	0	122	**4**
Chemistry	139	13	4	1	157	**6**
Veterinary Biomedical Science	8	7	0	0	15	**1**
Public Health	63	11	9	8	91	**3**
Biotechnology	65	0	0	0	65	**2**
Ecology, Evolution, Systematics and Population Biology	53	0	0	0	53	**2**
Total	**2352**	**325**	**56**	**11**	**2744**	**100**
Percentage	**86**	**12**	**2**	**0**	**100**	

AET enrolments at the universities of technology were dominated by Agricultural Business & Management (34%) and Agricultural Productions Operations (19%). The majority of the enrolments are at the diploma level (86%) with the BTech (12%) enrolments a distant second.

In line with enrolments figures Diploma graduates dominated the numbers of graduates from universities of technology, 73% of the graduates (Table16). In terms of CESM Agricultural Business & Management (24%) and Agricultural Productions Operations (20%) dominated the graduate numbers followed by Public Health (13%) and Agriculture, Agric Operations & Related Sciences (10%).

Table 16: AET graduates from universities of technology by Category of Education Subject Matter (CESM) during 2012 academic year

CESM*	Diploma	BTech	MTech	DTech	Total	%
Agricultural Business & Management	199	107	1	0	307	**24**
Agricultural Productions Operations	215	43	0	0	258	**20**
Applied Horticulture & Hort Business Services	33	13	0	0	46	**4**
Food Technology	51	10	1	0	62	**5**
Plant Sciences	74	12	2	0	88	**7**
Agriculture, Agric Operations & Related Sciences & Other	105	20	0	0	125	**10**
Family and Consumer Services	63	15	5	0	83	**6**
Chemistry	78	6	5	0	89	**7**
Veterinary Biomedical Science	19	5	0	0	24	**2**
Public Health	89	79	2	0	170	**13**
Biotechnology	21	13	4	4	42	**3**
Ecology, Evolution, Systematics and Population Biology	5	0	0	0	05	**0**
Total	**952**	**323**	**20**	**4**	**1299**	**100**
Percentage	**73**	**25**	**2**	**0**	**100**	

7.5 Faculties or Departments of Agriculture at Universities in South Africa

There are 11 traditional universities that offer theoretically oriented university degrees faculties, departments or schools of agriculture, *viz*. University of Fort Hare, University of KwaZuluNatal, North-West University, University of the Free State, University of Pretoria, Stellenbosch University, Rhodes University, University of Cape Town, University of Limpopo, University of Western Cape and University of Witwatersrand. There are also six (6) comprehensive universities that offer a combination of academic and vocational diplomas and degress, viz. University of Johannesburg, Nelson Mandela Metropolitan University, University of South Africa, University of Venda, University of Zululand, and Walter Sisulu University. All the universities offer various agricultural programmes, with some institutions offering a wide variety in the Agriculture curricula. Enrolment peaked at 14503 in 2007 (Table 12) but has since shown a declining trend.

The individual university enrolment patterns are presented in Table 17. Stellenbosh, UNISA and Pretoria together account for more than 55% of the total enrolment. The popular programmes at the Universities are A gricultural Management, Agricultural Sciences, and Animal Sciences offered as three or four year programmes.

Table 17: AET enrolment per University in South Africa

University	Year of enrolment							
	2004	2005	2006	2007	2008	2009	2010/11	2011/12
Fort Hare	362	415	583	581	159	222	268	268
North West	856	786	757	606	217	179	619	681
NMMU	--		104	479	412	396	814	256
Free State	823	729	879	890	263	344	288	357
KZN	474	621	466	2109	--	230	306	263
Limpopo	544	681	455	804	328	347	1114	-
UP	803	1220	1592	2987	1220	1423	386	200
UNISA		1597	1526	2917	1309	840	5427	6893
Stellenbosch	1153	1742	966	1965	356	335	902	1793
Venda	389	404	362	575	66	133	85	435
Zululand		107	121	124	---	5	226	--
Western Cape			103	390	18	23	476	461

The **University of Fort Hare** offers three bachelor degrees in agriculture: Bachelor of Agriculture (B.Agric.), Bachelor of Pedagogics - Agriculture option (B.Ped.Agric.); and Bachelor of Science in Agriculture (B.Sc.Agric.). The B.Agric. and B.Ped. (Agric.) degrees can be taken by students without matriculation mathematics. The B.Agric. is a three-year degree programme. The B.Ped.(Agric.) is a four year programme offered by the Faculty of Education and it contains virtually all the courses prescribed for the B.Agric. degree which are presented in the Faculty of Agriculture with additional courses in education. The B.Sc.Agric. degree (a four-year course) is offered by the Faculty of Agriculture, a pass in mathematics at matriculation level is required. For this degree more specialised options such as Agricultural Economics, Animal Science, Crop Science, Soil Science and Land and Water Use Development, are offered. Postgraduate qualifications up to doctoral level may be obtained in all disciplines by students interested in research.

At Fort Hare Black students account for more than 95% of the enrolment (Table 18a) and the number of male students is generally higher than for females. The number of graduating students (Table 18b) has increased steadily up to 2009 after which the figures leaped from 64 to 113 in 2011 and 122 in 2012.

Table 18a: Breakdown of enrolments by gender and race University of Fort Hare

Year	African			Coloured			White			Indian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	221	139	**360**				2	0	**2**			
2005	259	156	**415**									
2006	376	201	**577**				2	0	**2**	4	0	**4**
2007	367	213	**580**				1	0	**1**			
2008	91	68	**159**									
2009	134	87	**221**					1	**1**			
2010/11	162	106	**268**									
2011/12	162	106	**268**									

Table 18b: Breakdown of graduates by gender and race University of Fort Hare

Year	African		
	Male	Female	Total
2004	27	17	**44**
2005	47	32	**79**
2006	32	27	**59**
2007	39	25	**64**
2008	36	25	**61**
2009	39	25	**64**
2010/11	81	32	**113**
2011/12	90	32	**122**

The **University of the Free State** offers a B.Agric.degree, B.Sc.Agric. degree, a two-year Diploma in Agriculture and a two-year masters degree in Sustainable Agriculture (MSA). The university has almost equal proportions of White and Black students and together they account for above 90% of the enrolments (Table 19a). The Black student numbers have increased over the years to catch up with their White counterparts. For both groups male students outnumber the females.

Table 19a: Breakdown of enrolments by gender and race University of the Free State

Year	**African**			**Coloured**			**White**			**Indian**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	230	82	**312**	6	3	**9**	392	105	**497**	3	2	**5**
2005	178	90	**268**	8	6	**14**	363	83	**446**	1	0	**1**
2006	127	222	**323**	2	3	**5**	73	105	**178**	7	53	**60**
2007	148	214	**362**	3	8	**11**	79	434	**513**	1	3	**4**
2008	83	55	**138**	1	0	**1**	105	17	**122**	1	1	**2**
2009	95	67	**162**	2	3	**5**	157	18	**175**	1	1	**2**
2010/11	55	82	**137**				128	20	**148**	3	0	**3**
2011/12	68	98	**166**	2	2	**4**	1	1	**2**	34	151	**185**

Table 19b: Breakdown of graduates by gender and race at the University of the Free State

Year	**African**			**Coloured**			**White**			**Indian**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	38	9	**47**	1	0	**1**	68	23	**91**	1	1	**2**
2005	44	16	**60**	2	0	**2**	17	20	**94**	1	0	**1**
2006	18	49	**67**	1	1	**2**	28	72	**100**	1	-	**1**
2007	30	26	**56**	0	1	**1**	86	27	**113**	1	0	**1**
2008	30	60	**90**	3	1	**4**	19	93	**112**	1	0	**1**
2009	30	60	**90**	3	1	**4**	19	93	**112**	1	0	**1**
2010/11	61	41	**102**				80	22	**102**	1	0	**1**
2011/12	35	37	**72**	1	1	**2**	15	98	**113**			

The graduation patterns at Free State are dominated by the White but does not show clear gender differentiation across all racial groups (Table 19b).

The **University of Stellenbosch** offers three courses, viz. a three-year degree course in Agricultural Management (B.Agric.Admin.), four-year degree courses in food sciences (B.Sc.Food Science) and agricultural sciences (B.Sc.Agric.). Enrolment in AET programmes peaked during the period 2005-2007 but is showing a steady decline in recent

years. White student numbers remain higher than any of the other racial groups (although there are indications that access has been improving for the other groups). These differences are also reflected in the graduation numbers (Table 20b). There seems to be gender balance in the student numbers.

Table 20a: Breakdown of enrolments by gender and race University of Stellenbosch

Year	African			Coloured			White			Indian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	74	46	**120**	31	29	**60**	567	402	**969**	4	0	**4**
2005	91	69	**160**	48	48	**96**	883	597	**1480**	5	1	**6**
2006	70	32	**102**	29	28	**57**	335	270	**605**	1	1	**2**
2007	145	70	**215**	48	62	**110**	943	689	**1632**	5	3	**8**
2008	39	20	**59**	16	20	**36**	159	102	**261**			
2009	26	15	**41**	17	9	**26**	156	108	**264**	1	3	**4**
2010/11	94	51	**145**	52	38	**90**	471	189	**660**	5	2	**7**
2011/12	117	96	**213**	85	69	**154**	845	565	**1410**	10	6	**16**

Table 20b: Breakdown of graduates by gender and race University of Stellenbosch

Year	African			Coloured			White			Indian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	17	10	**27**	3	1	**4**	99	79	**178**	2	0	2
2005	16	15	**31**	3	6	**9**	141	94	**235**	0	0	0
2006	13	7	**20**	9	3	**12**	115	52	**167**			
2007	19	19	**38**	2	10	**12**	200	112	**312**			
2008	29	12	**41**	8	6	**14**	152	122	**274**			
2009??	29	12	**41**	8	6	**14**	152	122	**274**			
2010/11	19	6	**25**	8	9	**17**	154	93	**247**	1	0	1
2011/12	34	14	**48**	12	15	**27**	118	92	**210**			

The **University of KwaZulu-Natal** offers four-year programmes on agricultural, economic, management and science disciplines. In addition to the BSc Agric in the production disciplines, Commercial and Community Forestry have been added. The Faculty of Science and Agriculture also offers a three-year BAgric in Rural Resource Management; Sports Turf Management; BSc Dietetics; BSc Human Nutrition and a post-graduate programme in Food Security. It also offers a degree in Agricultural Engineering.

Table 21a: Breakdown of enrolments by gender and race University of KwaZulu-Natal

Year	African			Coloured			White			Indian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	192	74	**266**	6	2	**8**	98	71	**169**	16	15	**31**
2005	208	119	**327**	6	4	**10**	99	129	**228**	19	37	**56**
2006	114	109	**223**	2	3	**5**	73	105	**178**	7	53	**60**
2007	461	496	**957**	18	11	**29**	249	235	**424**	451	188	**639**
2008	-	-	**-**	-	-	**-**	-	-	**-**	-	-	**-**
2009	52	82	**134**	1	1	**2**	19	46	**65**	4	25	**29**
2010/11	111	119	**230**	1	2	**3**	13	42	**55**	2	16	**18**
2011/12	136	102	**238**				14	7	**21**	2	2	**4**

Table 21b: Breakdown of graduates by gender and race University of KwaZulu-Natal

Year	African			Coloured			White			Indian		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2004	9	22	**31**	--	--	--	17	11	**28**	1	0	**1**
2005	22	22	**44**	0	2	**2**	15	38	**53**	0	6	**6**
2006	20	28	**48**	0	1	**1**	21	30	**51**	0	9	**9**
2007	81	70	**151**	0	1	**1**	80	26	**106**	1	3	**4**
2008	--	--	--	--	--	--	--	--	--	--	--	--
2009	26	34	**60**	1	1	**2**	16	49	**65**	4	9	**13**
2010/11	38	57	**95**	0	1	**1**	13	43	**56**	3	19	**22**
2011/12	33	28	**61**				13	6	**19**	2	0	**2**

The Faculty of Agriculture, Science and Technology of the **University of the North West** offers a four-year B.Sc. (Crop Science, Animal Science or Animal Health). A three-year diploma in Animal Health is also offered and there is provision for a three-year course in Agriculture (Animal Science or Crop Science). Other programmes are the Advanced Diploma in Animal Health, Postgraduate Diploma in Agricultural Economics and Management and the Postgraduate Diploma in Agricultural Extension. B.Sc. Honours in Animal Science, Crop Science, Parasitology, Agricultural Economics, Agricultural Extension are also offered by the Faculty of Agriculture. Provision is made for postgraduate studies at both masters and doctorate levels.
This university caters for one of the former disadvantaged Black communities. Female students outnumber the males.

Table 22a: Breakdown of enrolments by gender and race University of the North West

Year	African			Coloured			White			Indian		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2004	388	408	**856**									
2005	353	433	**786**									
2006	323	417	**740**									
2007	303	303	**606**									
2008	113	104	**217**									
2009	99	80	**179**									
2010/11	320	299	**619**									
2011/12	348	323	**671**				5	2	**7**	2	1	**3**

Table 22b: Breakdown of graduates by gender and race University of the North West

Year	African			Coloured		
	Male	Female	Total	Male	Female	Total
2004	76	113	**189**			
2005	81	104	**185**			
2006	66	99	**165**	0	3	**3**
2007	64	70	**136**			
2008	46	54	**100**			
2009	46	54	**100**			
2010/11	58	69	**127**			
2011/12	73	76	**149**			

The faculty of agriculture, **University of Limpopo,** offers undergraduate and postgraduate training in Agricultural Economics, Animal Production and Soil Science. Agricultural

Extension is only offered at postgraduate level. Degree programmes include a three-year Bachelor of Agricultural Management and a four-year Bachelor of Science in Agriculture. Both programmes lead to honours, masters and Ph.D. The faculty is in the process of establishing a centre for rural community empowerment which will act as the outreach arm of the faculty. A four-year Bachelor of Agriculture in Education is offered by the Faculty of Education.

Table 23a. Breakdown of enrolments by gender and race University of Limpopo

Year	African			Coloured			White		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Female**	**Male**	**Total**
2004	325	216	**541**	1	0	**1**	1	2	**3**
2005	408	273	**681**						
2006	271	184	**455**						
2007	442	362	**804**						
2008	162	165	**327**						
2009	168	178	**346**						
2010/11	540	574	**1114**						
2011/12	--	--	--						

Table 23b: Breakdown of graduates by gender and race University of Limpopo

Year	African		
	Male	**Female**	Total
2004	38	28	**66**
2005	36	40	**76**
2006	137	122	**259**
2007	100	65	**165**
2008	72	46	**118**
2009	72	44	**116**
2010/11	--	--	**--**
2011/12	--	--	**--**

The School of Agriculture, Rural Development and Forestry of the **University of Venda** for Science and Technology offers three-year and four-year BSc. Agric. degrees programmes with majors in Agricultural Economics, Animal Science, Crop Science, Horticultural Sciences and Soil Science. In addition, there is a three-year Bachelor's degree in Family Ecology and Consumer Sciences; a four-year degree programme in Food Science and Technology, postgraduate diploma in Agricultural and Rural Engineering, as well as a host of postgraduate programmes in the above disciplines and Rural Development. The latter is available at the Centre for Rural Development, which also serves as the community outreach of the University. The School, as indeed the entire university, operates on a project-based modularisation curriculum.

Table 24a: Breakdown of enrolments by gender and race University of Venda

Year	African		
	Male	**Female**	**Total**
2004	217	172	**389**
2005	247	157	**404**
2006	208	154	**362**
2007	323	252	**575**
2008	37	29	**66**
2009	70	63	**133**
2010/11	47	38	**85**
2011/12	221	214	**435**

Table 24b: Breakdown of graduates by gender and race University of Venda

Year	African		
	Male	Female	Total
2004	**8**	**26**	**34**
2005	**27**	**22**	**49**
2006	**21**	**20**	**41**
2007	**28**	**24**	**52**
2008	**32**	**35**	**67**
2009	**32**	**35**	**67**
2010/11	**62**	**71**	**133**
2011/12	**43**	**40**	**83**

The Department of Agriculture, Faculty of Science and Agriculture at the **University of Zululand** was established in 1989. It is one of the fastest growing departments in the Faculty of Science and Agriculture. The department has three critical areas (units) in its four-year B.Sc. Agriculture programme: Agricultural Extension/Economic and Rural Development, Animal Science and Plant Production. The department also offers certificates and diplomas in the three sub-units. These three sections function as a system. The Department focuses on a system approach to sustainable agriculture and rural development. The vision of the department is excellence in teaching, research and community outreach.

Table 25a: Breakdown of enrolments by gender and race University of Zululand

Year	African			Asian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
2004						
2005	59	48	**107**			
2006	59	154	**362**			
2007	68	56	**124**			
2008	--	--	**--**			
2009	1	1	**5**			
2010/11	95	129	**224**	0	2	**2**

Table 25b: Breakdown of graduates by gender and race University of Zululand

Year	African		
	Male	**Female**	**Total**
2005			
2006	7	3	**10**
2007	5	7	**12**
2008	--	--	--
2009	10	10	**20**
2010/11	34	38	**72**

The **University of South Africa (UNISA)** has introduced two nationally accredited distance education training programmes in Agricultural Management to cater for changing training needs of professional farmers and agriculturists who cannot attend residential educational institutions. These programmes were developed in collaboration with industry partners.

Table 26a: Breakdown of enrolments by gender and race University of South Africa

Year	African			Coloured			White			Asian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004	262	158	**420**	5	5	**10**	198	161	**359**	7	7	**14**
2005	196	167	**363**	3	6	**9**	584	247	**831**	7	10	**17**
2006	667	468	**1135**	18	8	**26**	160	174	**334**	18	13	**31**
2007	1125	1065	**2190**	34	32	**66**	286	316	**602**	32	27	**59**
2008	514	565	**1079**	17	17	**34**	82	93	**175**	7	14	**21**
2009	302	366	**668**	11	6	**17**	52	88	**140**	2	13	**15**
2010/11	2042	2207	**4249**	68	61	**129**	383	535	**918**	51	80	**131**
2011/12	2876	2642	**5518**	81	75	**156**	623	432	**1055**	109	55	**164**

Table 26b: Breakdown of graduates by gender and race University of South Africa

Year	African			Coloured			White			Asian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2004												
2005	45	42	**87**	2	0	**2**	21	23	**44**	5	3	**8**
2006	21	9	**30**	1	0	**1**	5	10	**15**	1	0	**1**
2007	42	34	**76**	1	0	**1**	18	16	**34**	1	1	**2**
2008	33	26	**59**	--	--	**--**	5	6	**11**	1	4	**5**
2009??	33	26	**59**	--	--	**--**	5	6	**11**	1	4	**5**
2010/11	62	41	**103**	1	0	**1**	10	8	**18**	1	1	**2**
2011/12	75	82	**157**	4	1	**5**	18	19	**37**			

Table 27a: Breakdown of enrolments by gender and race University of Nelson Mandela

Metropolitan University

Year	African			Coloured			White			Asian		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2006	57	29	**86**	2	0	**2**	14	2	**16**			
2007	140	69	**209**	16	4	**20**	189	59	**248**	1	1	**2**
2008	138	84	**222**	6	4	**10**	138	42	**180**			
2009	139	82	**221**	11	4	**15**	122	37	**159**	0	1	**1**
2010/11	297	274	**571**	19	12	**31**	169	41	**210**	1	1	**2**
2011/12	66	47	**113**	7	4	**11**	90	38	**128**	3	1	**4**

Table 27b: Breakdown of graduates by gender and race University of Nelson Mandela Metropolitan University

Year	African			Coloured			White			Asian		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2006	9	4	**13**	1	2	**3**	0	3	**3**			
2007	20	15	**35**	3	0	**3**	50	14	**64**	1	0	**1**
2008	50	21	**71**	3	0	**3**	86	29	**115**	1	0	**1**
2009	50	21	**71**	3	0	**3**	86	29	**115**	1	0	**1**
2010/11	63	49	**112**	6	3	**9**	68	21	**89**			
2011/12	43	51	**94**	5	2	**7**	69	29	**98**			

Table 28a: Breakdown of enrolments by gender and race University of Western Cape

Year	African			Coloured			White			Asian		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2006	3	18	**21**	25	46	**71**	4	3	**7**	1	3	**4**
2007	49	86	**135**	81	127	**208**	10	9	**19**	13	15	**28**
2008	7	4	**11**	3	2	**5**	1	1	**2**			
2009	8	7	**15**	3	3	**6**	1	1	**2**			
2010/11	130	66	**196**	97	143	**240**	8	11	**19**	9	12	**21**
2011/12	101	127	**228**	103	92	**195**	7	11	**18**	10	10	**20**

Table 28b: Breakdown of graduates by gender and race University of University of Western Cape

Year	African			Coloured			White			Asian		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2006	4	1	**5**	9	7	**16**	1	1	**2**			
2007	1	3	**4**	3	16	**19**	1	0	**1**	0	1	**1**
2008	--	--	**--**	--	--	**--**	--	--	**--**	--	--	**--**
2009	--	--	**--**	--	--	**--**	--	--	**--**	--	--	**--**
2010/11	15	23	**38**	25	39	**64**	3	1	**4**	3	3	**6**
2011/12	13	26	**39**	18	8	**26**	3	4	**7**	0	1	**1**

The enrolment patterns by discipline are summarised in Table 29.

Table 29: AET Enrolments in universities by Category of Education Subject Matter (CESM)
during 2012 academic year (year 2011 in annexure)

CESM*	UG	PG Dip	Hons	MS/MA	PhD	Total
Agricultural Business & Management	4203	5	249	201	33	**4691**
Agricultural Mechanisation	15	0	6	5	0	**26**
Agricultural Productions Operations	203	0	11	38	14	**266**
Applied Horticulture & Hort Business Services	10	0	0	0	0	**10**
Animal Sciences	1050	0	22	24	18	**1114**
Plant Sciences	1005	0	18	53	10	**1086**
Soil Sciences	106	0	8	25	1	**140**
Forestry and Wood Sciences	269	0	11	36	20	**336**
Agriculture, Agric Operations & Related Sciences & Other	967	0	790	320	106	**2183**
Dietetics and Clinical Nutrition Services	64	24	0	0	0	**88**
Family and Consumer Services	689	0	23	41	0	**753**
Food science & Technology	52	25	0	21	0	**98**
Foods, Nutrition & Related Services	45	0	0	2	0	**47**
Botany/Plant Biology	204	0	30	26	28	**288**

Biochemistry. Biophysics and Molecular Biochemistry	205	0	11	10	10	**13**
Microbiological Sciences and Immunology	184	0	8	6	0	**198**
Zoology/Animal Biology	175	0	41	55	80	**351**
Genetics	243	0	0	0	0	**243**
Biotechnology	263	0	26	76	9	**374**
Ecology, Evolution, Systematics and Population Biology	501	0	69	0	91	**661**
Total	**10453**	**54**	**1323**	**939**	**420**	**13189**
Percentage	**79**	**0**	**10**	**7**	**3**	**100**

Undergraduate level AET enrolments dominated overall enrolments in universities, Honours being a distant second; then Masters and PhD. This has been the trend over the years (e.g. for 2011 annexed). Over the years enrolments for PG Diplomas has been on the decline and in 2012 there were no enrolments for this level of training. Most universities are phasing out this level of training. At the undergraduate level Agricultural Business & Management had the most enrolments with 40% of total undergraduate, and Animal Sciences (10%) and Plant Sciences (10%) in second place. At postgraduate level the Agriculture, Agricultural Operations and Related Sciences dominated enrolments; with 60% of the enrolment at Honours; 34% at Masters, and 25% at PhD. The respective enrolments for Agricultural Business & Management category, which was second, were 19%, 21% and 8%.
The figures for the 2012 graduating class for these categories are presented in Table 30.

Table 30: AET graduates from universities by Category of Education Subject Matter (CESM)
during 2012 academic year

CESM*	**UG**	**PG Dip**	**Hons**	**MS/MA**	**PhD**	**Total**
Agricultural Business & Management	350	4	72	41	21	**488**
Agricultural Mechanisation	5	0	0	0	0	**5**
Agricultural Productions Operations	38	0	11	5	2	**56**
Applied Horticulture & Hort Business Services	12	0	0	0	0	**12**
Animal Sciences	161	0	32	23	12	**228**
Plant Sciences	32	0	27	6	5	**70**
Soil Sciences	0	0	5	3	2	**10**
Forestry and Wood Sciences	89	0	1	6	0	**96**
Agriculture, Agric Operations & Related Sciences & Other	250	0	44	171	29	**494**
Dietetics and Clinical Nutrition Services	32	33	0	0	0	**65**
Family and Consumer Services	105	0	0	4	0	**109**
Food science & Technology	21	7	0	2	0	**30**
Foods, Nutrition & Related Services	8	0	3	1	0	**9**
Biochemistry. Biophysics and Molecular Biochemistry	39	0	9	11	7	**66**
Botany/Plant Biology	29	0	25	16	2	**72**
Microbiological Sciences and Immunology	50	0	3	2	3	**58**

Zoology/Animal Biology	38	0	30	24	20	**112**
Genetics	27	0	0	0	0	**27**
Biotechnology	0	0	0	0	0	**0**
Ecology, Evolution, Systematics and Population Biology	143	0	9	33	2	**187**
Agricultural Business & Management (Inst. Agrar Stream)	0	0	5	2	0	**7**
Agricultural Productions Operations (Inst. Agrar Stream)	0	0	0	0	0	**0**
Agriculture, Agric Operations & Related Sciences & Other (Inst. Agrar Stream)	0	0	0	0	2	**2**
Plant Sciences (Inst. Agrar Stream)	0	0	0	0	0	**2**
Total	**1429**	**44**	**276**	**350**	**109**	**2208**
Percentage	**65**	**2**	**13**	**16**	**5**	**100**

The top ranking CESM for the 2012 graduates were Agriculture, Agric Operations & Related Sciences 22%; Agricultural Business & Management 22%, and Animal Sciences 10%. The rest of the CESM had each less than 10% of the graduates.

8. UNIVERSITY OF PRETORIA

Background

At the University of Pretoria AET is offered largely by two faculties: The Faculty of Natural and Agricultural Sciences (NAS), and the Faculty of Veterinary Sciences (VET). Table 31 shows the range of programmes presented by NAS. The Faculty also offers 'Four-year Programmes' for a wide range of programmes. These programmes have lower entrance requirements and are designed for students who are not academically prepared, but who are willing to work hard to succeed and obtain their degree. Basically, the programmes include an additional year of study which will enhance students' basic knowledge and skills before progressing onto more specialist studies in the later years of the programmes. This has been very successful with the students and in improving access to university education. The Faculty also offers an additional degree course, namely the BInstAgrar, which is a four-year development orientated degree course. This course can be pursued at post-graduate level at the Post Graduate School for Agriculture and Rural Development.

Table 31: The range of undergraduate programmes presented by NAS at UP

BScAgric (Agricultural Economics/Agribusiness Management)	BSc (Biochemistry)	BSc (Chemistry)
BScAgric (Animal Science/Pasture Science)	BSc (Biological Sciences)	BSc (Environmental and Engineering Geology)
BScAgric (Animal Science)	BSc (Biotechnology	BSc (Environmental Sciences)
BScAgric (Applied Plant and Soil Sciences)	BSc (Ecology)	BSc (Geoinformatics)
BScAgric (Food Science and Technology);	BSc (Entomology)	BSc (Geography)
BScAgric (Plant Pathology)	BSc (Genetics)	BSc (Geology)
BSc (Food Management)	BSc (Medical Sciences)	BSc (Physics)
BSc (Food Science	BSc (Microbiology)	BSc (Meteorology)
BSc (Nutrition)	BSc (Human Physiology, Genetics and Psychology)	
	BSc (Plant Science)	
BSc (Actuarial and Financial Mathematics)	BSc (Zoology)	
BSc (Applied Mathematics)		
BSc (Mathematical Statistics)		
BSc (Mathematics)		
BConsumer Science (Clothing: Retail Management)		

The NAS Faculty offers more than 150 postgraduate degrees at honours, masters and doctoral levels.

The UP Faculty of Veterinary Science is the only veterinary faculty in the country and it offers a Diploma in Veterinary Nursing and BVSc programmes. The following postgraduate programmes are offered by the Faculty include: BVSc Hons; MMedVet; MSc (Veterinary Tropical Diseases); MSc in Animal / Human / Ecosystem Health; MSc (Research-based), and PhD and DVSc.

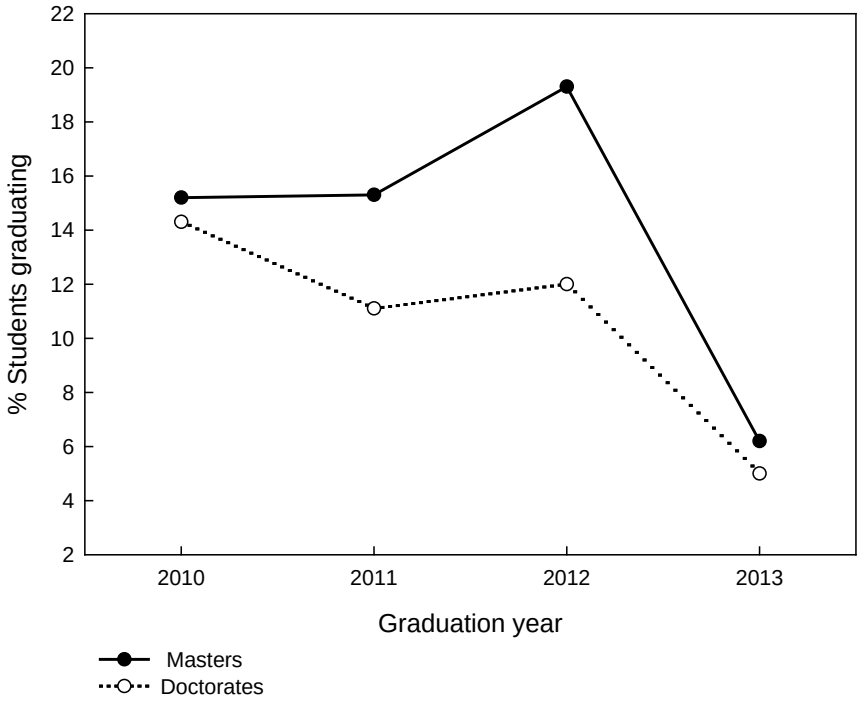
8.1 University of Pretoria Enrolments

In recent years UP has been graduating the largest number relatives to the other institutions that offer AET programmes. White students still dominate enrolment in the AET programmes at UP and female students outnumber the males.

Table 32: NAS Student growth and demographics 2004-2013 at the University of Pretoria

Year	UG	PG	Male	Female	Total	% Female
2004	3298	1530	2344	2484	4828	51
2005	3533	1574	2449	2658	5107	52
2006	3654	1652	2504	2802	5306	53
2007	3664	1639	2499	2804	5303	53
2008	3784	1773	2536	3021	5557	54
2009	3785	1835	2517	3103	5620	55
2010	*	*	*	*	6163	
2011	4539	1906	2800	3465	6265	55
2012	4359	2036	2949	3446	6395	54
2013	5194	1669	3270	3893	7163	54

Fig 6: The number of graduating Masters and Doctorate graduates as a percentage of enrolment-NAS, University of Pretoria



Note: It is highly likely that the 2013 graduation data has not yet been fully captured. Otherwise it is difficult to think of any other reason for this sudden decline).

In line with the long-term vision of becoming a leading research-intensive university in Africa UP has in recent years invested in research and postgraduate education. Table 33 presents the recent trends for the various postgraduate programmes offered by NAS and VET. This complemented by an increased effort in continuing education by both NAS and VET. There has been a deliberate effort in the development of quality short courses with the specific aim of enriching and empowering the communities and government officials with knowledge and skills to deal with the challenges faced in the workplace as well as within our communities and rural areas. These short courses are not only within South Africa but also span across the sub-region and the African continent.

Table 33: Postgraduate student enrolment in the NAS and VET faculties at UP (2010-2014)

Level of PG study	Faculty	Year of enrolment				
		2010	**2011**	**2012**	**2013**	**2014***
Honours	NAS	445	453	456	438	375
	VET	43	46	43	33	34
	Total	***488***	***499***	***499***	***471***	***409***
Masters	NAS	851	878	916	880	490
	VET	157	164	172	164	113
	Total	***1008***	***1042***	***1088***	***1044***	***603***
Doctorate	NAS	391	431	491	518	288
	VET	75	74	78	79	42
	Total	***466***	***505***	***569***	***597***	***330***
Grand Total		***1962***	***2046***	***2156***	***2112***	***1342***

**as of February, 2014*

The strategic focus for UP is to increase numbers at the MSc and PhD levels.

Table 35: International postgraduate student enrolment in the NAS and VET faculties at UP (2010-2014)

Level of PG study	Faculty	Year of enrolment				
		2010	**2011**	**2012**	**2013**	**2014***
Honours	NAS	40	44	42	55	47
	VET	3	2	2	2	--
	Total	***43***	***46***	***44***	***57***	***47***
Masters	NAS	149	161	173	166	85
	VET	50	53	56	47	32
	Total	***199***	***204***	***229***	***213***	***117***
Doctorate	NAS	159	170	197	227	127
	VET	29	30	29	26	12
	Total	***188***	***200***	***226***	***253***	***139***
Grand Total PG		***430***	***450***	***499***	***523***	***303***

**as of February, 2014*

The University's long-term vision also calls for the strengthening of the University's profile and diversity. These are both reflected in the figures presented in Tables 36 and 37. From 2011-2013 the international student enrolment at NAS stabilised at about 15% of total student enrolled. However, when split into undergraduate and postgraduate (Table 36), international postgraduate students in NAS accounted for an average of 28% of the faculty at postgraduate level during the three years.

Table 36: Student numbers and percent domestic against international: NAS-UP

	DOMESTIC			INTERNATIONAL			YEAR TOTAL	Percent Internatl		TOTAL % Of INTERNL
	UG	*PG*	*TOTAL*	*UG*	*PG*	*TOTAL*		*%UG*	*%PG*	INTERNL
2011	3871	1383	**5254**	416	491	**907**	6161	9.7	26.2	14.7
2012	3871	1468	**5339**	426	544	**970**	6309	9.9	27	15.4
2013	4446	1375	**5821**	487	570	**1057**	6878	9.9	29.3	15.4

Approximately 65% of the undergraduate international students were African, with SADC region dominating with 60% of the students (5% from other African countries; Table 37). The remaining 35% for undergraduate students was from the rest of the world. At postgraduate level the international were 47, 35 and 16% from SADC, other African countries and the rest of the world, respectively.

Table 37: International students registered with NAS: UP

	UNDERGRADUATE				POSTGRADUATE			
	SADC	*Other African*	*OTHER*	*TOTAL*	*SADC*	*Other African*	*OTHER*	*TOTAL*
2010	176	25	100	**301**	215	149	88	**452**
2011	246	24	146	**516**	238	174	79	**491**
2012	256	21	149	**426**	267	194	83	**544**
2013	297	27	163	**487**	255	214	101	**570**

Efforts are continuously being made to increase international student representation through formal international linkages and exchange programmes.

Table 38: Current academic staffing levels for NAS and VET at UP (2014)

Faculty	Gender			Total
	Female	Male	Other	
NAS	132	186	--	**318**
VET	41	77	1	**119**
Total	**173**	**263**	**1**	**437**
(UP Total	***1017***	***1053***	***1***	***2071)***

The Faculty employs not only excellent academics, but world-class researchers who enjoy national as well as international acclaim, in their fields of expertise. There are still challenges in balancing the gender.

Research excellence is recognised by the significant number of competitive grants that the Faculty receives from various funding bodies, both local and international. the. In addition, the Faculty receives significant contract funding through existing partnerships and collaborations with Science Councils and Government Organisations including the CSIR (SERA), the ARC, the Water Research Commission, the South African Weather Services and the Chamber of Mines to name a few. In relation to industries and companies the Faculty has extensive collaborative agreements with some of South Africa's major

contributors including the PBMR, SASOL, ESKOM, Sappi, Mondi, Potato SA, SAFCOL, SANLAM, HSBC, ABSA, Benfield and Kumba Iron Ore and Exxaro.

Some of the research indicators are presented in Table 40. For 2012 the two faculties contributed about 31% of the research output and about 57% of all NRF-rated academics of the University of Pretoria.

Table 39: Research indicators of the NAS and Vet Faculties at UP

	Reporting year			
Indicator	**2009**	**2010**	**2011**	**2012**
No. of accredited publication journal units	364.89	379.54	396.88	390.25
No. of accredited journal publication units in ISI journals	341.37	361.58	370.85	375.26
No. of accredited ISI publications in SA journals	14.25	14.42	23.87	61.66
No. of accredited ISI publications in non SA journals	327.12	347.34	346.04	313.60
% accredited ISI publication units to total publication journal units	93.55	95.31	93.22	96.16
% of accredited ISI publications in non SA journals	95.83	95.99	93.31	83.57

The Faculties of NAS and VET have exceptionally strong research ethos with increased focus on producing quality research publications. In 2012, almost 96% of the articles from these faculties were published in ISI accredited journals; 84% of them in non-South African journals. In relation to postgraduate research, the Faculties see their role as offering high-quality training to both local and international post-graduate students.

9. **CHALLENGES IN THE AET SECTOR**

This section is largely based on the various discussions/interviews conducted and are corroborated by more structured studies in the sector.

i) Lack of quality staff/personnel:-right across the board there was a 'cry' for lack of skilled personnel; At the school level it is staff equipped to teach agricultural science, management and technology. Where you find formally trained teachers they are usually lacking in one aspect or other. One set might be good in practical aspects but poor in content and in imparting theoretical knowledge and the related assessments. Certain skills like genetics and/or business management skills are not always taught to the general agricultural teacher. The South African Agricultural Teachers' Association (SAATA) has put in place an initiative that offers in-service training for agricultural teachers, equipping them with subject knowledge and know-how.

ii) Academic alignment issues:- these ranged from how agriculture is covered in the curriculum to the subject combinations from NSC for entry into tertiary institutions. In the South African context the admission requirements for mathematics and science is a bottle neck for most high school learners who would want to study agriculture. Some learners have a 'fear factor' for these subjects and end up taking agriculture as a replacement. However this does not work out well subject package that has agricultural sciences excludes mathematics and science. Put crudely, you do not get credit from agriculture as a science subject. Another scenario was that Agricultural Management (as a high school subject) covers a lot of business management is considered in combination with the traditional business management subjects. If learners took agricultural management and passed they still cannot be enrolled in an agricultural programme at higher levels.

iii) The curriculum at Universities and colleges of agriculture needs to include practical application of theoretical knowledge. At the moment the curriculum seems to be focused narrowly on production aspects. The quality of training at this level has a direct bearing on the quality of extension service delivery.

iv) Lack of coherence and strategic alignment right from the schools through to universities. Most countries in the region have now developed AET strategies but there is no visible effort to operationalize these strategies. Using the South African example, the programmes offered at the school level are not directly linked to post school training or employment. They do not influence or themselves influenced by what happens at taking place at the tertiary institutions. The whole AET does not seem to have from the users of its output, the private sector and even government itself. Ultimately the sector ends up having weak articulation and analysis of the demand patterns. The institutions are producing large numbers of unemployable students. This also helps create the impression that 'there is no employment in agriculture'.

    Colleges need to be more closely linked to agriculture, industries and universities.

v) Inadequate funding/support:- the AET institutions are under resourced, especially the agricultural high schools and colleges.

vi) Socio-economic issues:-

    a. Level of education of the parents who on one side if they have low levels of education they cannot advise their children on what careers to follow, let alone agriculture. On the other hand some learners ended up taking agriculture because their parents (because of relatively higher level of

education) wanted them to follow a career in agriculture. Some parents were encouraging their children to take agriculture to take advantage of the land reform in both Zimbabwe and South Africa.
It was put to us that low levels of education, for the parents, severely limits career advice to their children. More often the parents would end up simply supporting what the child's decision.

b. Poverty limits access to formal AET. This is very expensive and the poor do not have the financial resources to study further. This is quite an issue in the formerly disadvantaged communities in South Africa.
c. Waning lack of interest in agriculture, especially among the youth. People look down upon agriculture as typically the 'fork-hoe-dagga' profession, either only for the rich white people or the low social class. The young would rather seek careers associated with urban lifestyles and a wider range of chances for work.
d. Lack of access to information on agriculture, especially to people of colour in South Africa.

10. CONCLUSIONS

10.1. The Architecture of Education in Southern Africa

Data from secondary school to tertiary level was only comprehensively obtained in South Africa. For the rest of the countries, it was quite scanty and could not lead itself to any meaningful analysis. The architectural design of education in South Africa from the secondary to the tertiary level is quite strategic in the sense that there are specific schools earmarked for agriculture and these become potential suppliers of students to AET institutions. The 43 agricultural secondary schools nation-wide form a very important pool for the nation's future agriculturalists. It would be very beneficial for the rest of the countries to emulate this model.

10.2 Agricultural Colleges and Universities of Technology and Faculties of Agriculture

These are tailored to meet different skill requirements in the agricultural sector. Agricultural colleges are much diversified in the curricula. It is clear that the graduates target very different destinations abased on their specialization. The notion of "releasing on the streets" which is common in many African countries seems to be less of a problem in South Africa. Many countries have also found themselves producing excessive number of graduates who cannot find employment. To the contrary, the industrial sector complains of not getting people to employ. The problem here is that of graduates not having the skills required by the industry. The "technikons" or more commonly known as Institutes of Technology have very high reputation in the country. In fact some of them, especially depending on the program, require someone to have a degree from the "theoretical universities". This demonstrates the seriousness accorded to practical/hands on training in the technikons. From the colleges of agriculture up to the Faculties of Agriculture, the most popular programs are those that have agricultural business and management followed closely by agricultural produce operations. All this reflects forces in the market indicating that this is where the jobs are.

10.3 Predominantly White (PWI) and Predominantly Black (PBI) AET Institutions

There is a very clear pattern of PWI and PBI. It is a bit of a puzzling arrangement given that it is today 20 years after the majority rule in South Africa and the several government initiatives that have been in force to date. It would seem that the issue is not about being Black or White but rather the willingness to pay for the good schools. And perhaps it happens that the good schools are more expensive and they can only be afforded by a few who by and large are White.

10.4 Declining Enrolment in AET Institutions

As per data shown in the various tables, enrolment in AET in most AET institutions is going down. These include Fort Hare, North West, Free State,

KZN and University of Pretoria. It is only in the UNISA and University of Stellenbosch that we find numbers somewhat increasing. This may partly reflect market forces—perhaps in recent years graduates may have found it increasingly difficult to get jobs.

10.5 Graduation Rates in Colleges and Faculty of Agriculture

It was observed that in recent years, on average only about a third graduate from the AETs. The reason could principally be financial difficulties because all students have to pay fees –if not partial but wholly—and this may create difficulties for some. Because of this difficulty, some may therefore be leaving to go and look for work.

10.6 Enrolment of Foreign Students

Universities in South Africa and especially the University of Pretoria are leading in the continent in terms of having international students and mainly from the SADC region. For example quarter of the post graduate students at the University of Pretoria are foreigners.

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ANNEXURE 1: CONTENT FRAMEWORK FOR AGRICULTURAL SCIENCES

The following tables provide an indication of the content that should be addressed in each of Grades 10, 11 and 12.

Grade 10

KNOWLEDGE AREA	CONTENT

Agro-ecology	• Ecological regions of the world: outline of various regions.
	• Ecological regions in South Africa: geographical distribution and veld types.
	• Adaptations to ecosystems:
	  • adaptations of animals to specific regions;
	  • effect of weather phenomena (e.g. El Niño).
	• Veld management:
	  • foundation of the livestock industry;
	  • principles of utilisation.

Agri-industry	• Key importance: provider of food, raw materials, jobs, economic stability.
	  • Demand for foodstuffs: determined by natural resources.
	  • Overview of agricultural development:
	  o population growth and shift;
	  o land redistribution and development;
	  o land ownership;
	  o industries;
	  o indigenous knowledge.
	• Organisations in the farming industry: roles and examples.

Soil science	• Basic and components:
	  • components;
	  • rock minerals (primary and secondary).
	• Soil forming factors and process:
	  • geographical factors;
	  • climate;
	  • biological factors;
	  • weathering of rocks.

Animal sciences	• General classification, importance and economic value of animals:
	  • beef;
	  • dairy;
	  • sheep;
	  • pigs;
	  • goats;
	  • horses;

Plant sciences	• General classification, importance and economic value of plants:
	  • field crops;
	  • horticultural crops;
	  • fodder crops;
	  • forests (wood production).

Optimum resource utilisation	• Agricultural resources: • soil and water control and conservation; • water quality; • agricultural pollution; • soil degradation
Biological concepts	• An overview of the cell and its components and properties. • The cell division process and why it is necessary.

KNOWLEDGE AREA	CONTENT

Basic chemistry	• Compounds:
	  • overview of the general atomic structures of the compounds most important to agriculture;
	  • formation of simple and organic compounds.

Soil science	• Profile and characteristics:
	  • physical and morphological characteristics (e.g. texture, structure, colour, air, temperature, moisture, soil pores);
	• Chemical and colloidal properties:
	  • inorganic and organic;
	  • adsorption and exchange;
	  • acidity, alkalinity and salinity (danger and reclamation);
	  • organic matter and its importance.
	• Soil microbiology: importance and role in agriculture.

Plant science	• Plant nutrition:
	  • role of photosynthesis;
	  • absorption and storage of water and nutrients.
	• Mineral nutrition:
	  • fertilisation practices;
	  • availability of nutrients and essential minerals;
	  • organic and inorganic fertilisers;
	  • nutritional elements and analysis.
	• Reproduction:
	  • plant improvement;
	  • methods of asexual and sexual reproduction;
	  • pollination.
	• Protection:
	  • weed control;
	  • plant pests and diseases and their control (inter-pest management control, IPM);

Optimum resource utilisation	• Soil surveying and planning: aims and principles, leading to precision farming.
	• Water use:
	  • irrigation;
	  • scheduling of irrigation;
	  • drainage.
	• Soil cultivation: aims and methods (e.g. mulching, bare soil).
	• Crop rotation: the concept.
	• Controlled agricultural production:
	  • greenhouse;
	  • hydroponics;
	  • tunnels;
	  • aquaculture;

ANNEXURE 2: CONTENT FRAMEWORK FOR AGRICULTURAL TECHNOLOGY

The following tables provide an indication of the content that should be addressed per Assessment Standard in Learning Outcome 3 in each of Grades 10, 11 and 12. The skills highlighted in Learning Outcomes 1, 2 and 4 should be presented in combination with the content suggested for Learning Outcome 3.

Grade 10		
Assessment Standards		**LO 3: Content**

10.3.1	Demonstrate awareness and knowledge of working safely in the agricultural environment according to the OHS Act.	**Safety**
		• OHS Act: Reference to relevant workshop practices.
		• General Safety Regulations:
		  • Safe handling of tools.
		  • Safe use of static or stationary farm equipment.
		  • Fire fighting equipment for the prevention and control of electrical fires.
		  • Electrical safety: Electrocution & fire hazard.
		  • Safe use and storage of hazardous substances.

10.3.2	Know and understand the principles, concepts and properties of different materials and their uses in making types of agricultural structures.	**Materials and Structures:**
		• Materials to be considered**:**
		  • Metals:
		  • Ferrous: high carbon steel, mild steel, cast iron (grey & white).
		  • Non-ferrous: aluminium, copper, zinc, lead and tin.
		  • Alloys: brass, soldering and stainless steel.
		  • Timber:
		  • Softwood (treated poles and planks).
		  • Building and construction:
		  • Cement, sand and aggregate.
		  • Stone, bricks and damp proof course.
		  • Pre-cast items (beams, walls, poles, etc.).
		  • Roof covering.
		  • Fencing:
		  • Types of wire.
		  • Types of supports: (posts, struts, standards and droppers).
		• Structure**:**
		  • Building structures: Floors, walls and roof
		  • Building mixtures: (Concrete, mortar and screed).
		  • Basic foundations: (Compaction, vibration and reinforcing techniques).
		  • Support: (Walls, beams, struts, columns and stands).
		  • Roof: (Trusses (metal & wood) and roof covers).
		  • Fencing: [Regulations regarding fencing and knowledge

10.3.3	Know and understand the application of the different basic skills and construction processes in the agricultural environment.	**Skills and Construction Processes:**
		• Skills used in handling of related basic tools:
		  • Measurements (different units).
		  • Cutting, joining and bending.
		  • Assembling.
		  • Use of templates.
		
		• Basic construction processes:
		  • Basic carpentry:
		  • Usage of timber in agriculture.
		  • Metal work:
		  • Basic Arc-welding: (simple joints and their symbols)
		  • Types of rods and their uses.
		  • Setting of welding current.
		  • Different types of welding machines.
		  • Basic Gas-welding: (simple joints and their symbols)
		  • Types of welding wire.
		  • Setting of gas bottles.
		  • Setting of different flames.
		  • Soft soldering:

10.3.4	Show an understanding of basic principles and economic use of electrical energy in agriculture.	**Electrical Energy**
		• Basic principles of electrical energy:
		  • Standard symbols and units as applicable to electricity and electrical appliances: AC, DC, watt, volt, ampère and ohm.
		  • Electrical current, electrical potential and load.
		• Economic use of electricity:
		  • Elements of circuitry: lights, wiring and cables.
		  • Heaters and refrigerators.
		  • Motors (identification of single and three phase)

10.3.5	Identify the purpose and use of different basic tools, equipment and implements and knowledge of components of mechanised agricultural equipment and systems.	**Tools, Equipment, Implements and Mechanised systems**
		• Basic tools, implements and equipment:
		  • Hand tools used in workshop: electric and manual.
		  • Horticulture cultivation tools and equipment:
		  • Garden tools and equipment (spade, rake, hand spray, etc.).
		  • Implements (rotavator, mower, etc.).
		• Animal drawn and mechanized implements:
		  • Basic cultivation: primary and secondary tillage implements.
		  • Transportation.
		• Mechanised systems: components
		  • Engine systems:
		  • 2-stroke, 4-stroke and diesel (ignition, cooling, lubrication, pulleys and belts.).
		  • Driving systems:
		  • PTO, steering and wheels.
		  • Lift system:
		  • 3-point coupling.
		  • Braking systems:

10.3.6	Know and identify the types and applications of different irrigation	**Irrigation**
		• Micro irrigation systems:
		  • Hydroponics, micro sprayers and drip.
		• Macro irrigation systems:
		  • Flood and different types of sprinklers.
		  • Pumps:
		  - Stroke, centrifugal, submersible and rotor.

10.3.7	Know and identify the use and purpose of different sources of information and communication systems on a farm.	**Communication**
		• Information sources:
		  • Printed media (magazines/brochures).
		  • Electronic media (TV/radio/internet).
		  • Organised agricultural societies.
		  • Farmer days and Agricultural shows.
		• Different types of communication systems:
		  • Two way radios, telephones and Internet.

10.3.8	Know and understand basic freehand sketching and drawings related to agriculture.	**Drawings**
		• Interpret and use:
		  • Basic freehand sketches and drawings:
		  • Lines (hidden, dash and dotted).
		  • Views and symbols.

10.3.9	Know and understand the concepts and principles of measurements and calculations used for maintenance expenditure and the calibration of tools and equipment as applied in the agricultural environment.	**Measurements, Calculations and Calibrations** • Different measurements and related units. • Basic expenditure calculations in projects. • Calibration of tools and equipment used.

Grade 11		
Assessment Standards		**LO 3: Content**

11.3.1	Demonstrate awareness and knowledge of working safely in the agricultural environment according to the OHS Act.	**Safety**
		• OHS Act: Application to relevant workshop practices.
		• General safety regulations:
		  • Safe handling of advanced tools.
		  • Safety regarding electricity.
		  • Safe use of mechanized farm equipment.
		  • Fire fighting equipment for the prevention and control of veld fires.
		  • Safe use and storage of hazardous substances.
		• Knowledge of the code of practice for livestock, poultry and pigs

11.3.2	Know and understand the principles, advanced concepts, properties of different materials and their uses in making agricultural structures.	**Materials and Structures:**
		• Materials to be considered**:**
		  • Metals:
		  • Ferrous: high carbon steel, mild steel, cast iron (grey & white).
		  • Non-ferrous: aluminium, copper, zinc, lead and tin.
		  • Alloys: brass, soldering and stainless steel.
		  • Timber:
		  • Softwood (treated poles and planks).
		  • Polymers:
		  • Fibreglass & resins; PVC and adhesives.
		  • Plumbing:
		  • Water pipes: galvanised, copper and polymers.
		  • Other accessories.
		  • Fencing:
		  • Types of wire.
		  • Supports: posts, struts, standards and droppers.
		• Structures
		  • Buildings:
		  • Plan and maintain structures for animal production (handling facilities and/or housing) considering:
		  Design and construction concepts. Elements of nature and soil factors.
		  Waste management (drainage and solid waste). Basic plumbing (water pipes, gutters, drain pipes and accessories).
		  • Fencing:
		  • Related regulations

11.3.3	Know and understand the application of the different advanced skills and construction processes in the agricultural environment.	**Skills and Construction Processes:**
		• Skills used in handling of related advanced tools:
		  • Measurements (venier).
		  • Cutting, joining and bending.
		  • Assembling.
		  • Use of templates.
		
		• Construction processes:
		  • Carpentry:
		  • Timber in agricultural environment.
		  • Metal work:
		  • Basic sheet metal work.
		  • Heat treatment: tempering, annealing and case hardening.
		  • Arc-welding:
		  Complex joints (pipes, etc.) and their

		Setting of welding current. Different types of welding machines. • Gas-welding: complex joints (pipes, etc.) and their symbols Complex joints (pipes, etc.) and their symbols. Types of welding wire. Setting of gas bottles. Setting of different flames. • Hard soldering:
11.3.4	Know and understand equipment generating and distributing electrical energy in agriculture.	**Electrical Energy** • Utility equipment generating electrical energy: • Symbols/units as applicable (AC, DC, kW, etc.) • Generator and alternator • Utility equipment distributing electrical energy: • Transformer. • Elements of circuitry: • Distribution boards. • Lights, plugs and switches. • Wires and cables. • Overall protection: trip switches, earthing
11.3.5	Know and understand the purpose and effective use of advanced tools, equipment, implements and components of mechanised agricultural equipment and systems.	**Tools, equipment, mechanised implements and systems** • Advanced tools and equipment: workshop and outdoor. • Animal handling. • Scales and weighing equipment. • Mechanical crop cultivating implements and equipment: • Ploughs, planters, tillers, etc. • Spraying equipment. • Electric motor: star and delta motors (single and three phase) • Types of electric motors and their different components. • Mechanised systems: • Engine systems: • 2-stroke, 4-stroke and diesel (ignition, cooling, lubrication, and hydraulic). • Driving systems: • PTO, steering and wheels (bearings). • Lift system: • 3-point coupling.

11.3.6	Describe and demonstrate an understanding of technical principles of the systems in irrigation, wastewater, water supply and the different drainage systems in an agricultural environment.	**Irrigation and Water Management**
		• Irrigation systems.
		• Pumps.
		• Water supply systems:
		  • Tanks, dams and reservoirs.
		  • Weirs, canals and sluice gate.
		  • Boreholes and wells.
		• Drainage systems:
		  • Stone, pipes and open drains.
		• Waste water:
		  • Contours and erosion control.

11.3.7	Know and understand the effective use of communication technology in agriculture.	**Communication**
		• Computer technology in agriculture:
		  • Feeding.
		  • Temperature control.

11.3.8	Interpret and produce freehand sketches of orthographic and isometric drawings related to agriculture.	**Drawings related to agriculture**
		• Drawings used in agriculture:
		  • Different views:
		  - Front, side and top.

11.3.9	Interpret the concepts and principles of measurement and calculation used for maintenance expenditure and the calibration of tools and equipment in the agricultural environment	**Measurements, Calculations and Calibrations**
		• Measurement and calibration as applicable in tools, implements and equipment used in:
		  • Cultivation.
		  • Delivery pressure, flow and temperature.
		  • Symbols.
		• Calculation of fabrication and maintenance expenditure:
		  • Production, running and machinery cost.

Grade 12		
Assessment Standards		**LO 3: Content**

12.3.1	Demonstrate awareness and knowledge of working safely in the agricultural environment according to the OHS Act.	**Safety**
		• OHS Act: Reference to relevant workshop practices.
		• General safety regulations:
		  • Safe handling of more advanced tools (hydraulic and pneumatic).
		  • Safety regarding electricity.
		  • Road safety and roadworthiness.
		  • Safe use of motorized farm equipment.
		  • Fire fighting equipment for the prevention and control of fires of hazardous substances.
		  • Safe use and storage of hazardous substances

12.3.2	Know and understand the principles, more advanced concepts, properties of different materials and their uses in making different types of agricultural structures.	**Materials and Structures**
		• Materials, their protection and maintenance:
		  • Metals:
		  • Galvanise, plating, undercoat and painting.
		  • Elements of nature.
		  • Timber:
		  • Treatment, painting and creosote.
		  • Materials for special use:
		  • Polymers: Polystyrene, PU-foam, Teflon and epoxy.
		  • Ventilation (cooling and heating):
		  • Insulation.
		  • Materials used for electric fencing.
		• Structures:
		  • Building:
		  • Planning and maintaining of structures for plant production (e.g. tunnels), curing and storage facilities:
		Design, construction and production concepts. Elements of nature and soil factors. Ventilation and insulation.
		  • Fencing:

12.3.3	Know and understand the application of more advanced skills and construction processes in the agricultural environment.	**Skills and Construction Processes:** • Skills used in handling of related more advanced tools: • Measurements. • Cutting, joining and bending. • Assembling. • Use of templates. • Finishing off. • Construction processes: • Additional carpentry: Doors, door- and window frames: • Fitting of hinges, locks and glass (glazing). • Metal work: • Sheet metal work. • Arc-welding: more advanced joints and their applications. • Gas-welding: more advanced joints and their applications. • CO_2-welding: Components & setting of welding

12.3.4	Know, understand and explain the use of alternative sources that generate electrical energy in agriculture.	**Electrical Energy**
		• Alternative sources of electrical energy:
		  • Solar systems, wind generator, hydro-electricity, geothermal, bio-energy (methane amongst others).
		  • Batteries.

12.3.5	Know and understand the purpose and effective use of more advanced tools, equipment, implements and components of mechanised agricultural equipment and systems.	**Tools, equipment, mechanised implements and systems**
		• More advanced tools and equipment:
		  • Pneumatic and hydraulic tools.
		  • Specialized cultivation tools and equipment.
		• More advanced implements:
		  • Harvesting implements for plant and animal products:
		  - Harvesters, silage cutter, balers, etc.
		  - Milking, shearing, sorting, etc.
		• Electric motors: fault finding, problem solving, maintenance and care.
		  • Star and delta motor (single and three phase).
		• Mechanised systems: Diagnose faults, problem solving, maintenance and care:
		  • Engine systems: 2-stroke, 4-stroke and diesel
		  - ignition, cooling, lubrication and hydraulic, differentials, gears, chains.
		  • Driving systems:
		  - PTO, steering and wheels (bearings).
		  • Lift system:
		  - 3-point coupling.
		  • Braking systems:

12.3.6	Know and understand the effective use and purpose of the irrigation systems, water supply and drainage systems in an agricultural environment.	**Irrigation and water management**
		• Irrigation systems: fault finding, problem solving, maintenance and care:
		  • Pumps.
		  • Water supply.
		  • Scheduling and operating.
		  • Drainage systems.
		  • Waste water management.

12.3.7	Know and understand the effective use of communication technology in agriculture.	**Communication**
		• Computer technology information:
		  • Irrigation scheduling.
		  • Temperature control.

12.3.8	Interpret and produce freehand sketches of assembly and sectional drawings related to agriculture.	**Drawings**
		• Drawings used in agriculture:
		  • Sectioned views.
		  • 1^{st} and 3^{rd} angle and isometric views.

12.3.9	Apply the concepts and principles of measurement and calculation used for maintenance expenditure and the calibration of tools and equipment in the agricultural environment.	**Measurements, Calculations and Calibrations** • Problem solving in application of data collected from measurements and calculations. • Use data collected from measurements and cost calculations in purpose made fabrications. • Effective use of tools, equipment and implements due to correct measurements, calibrations and adjustments.

KNOWLEDGE AREA	**CONTENT**

Animal sciences	• Nutrition:
	  • alimentary canal and digestion;
	  • components and digestibility of feed;
	  • biological value of feed;
	  • energy value of feed;
	  • types of feed;
	  • supplements;
	  • planning a feeding programme (Pearson square, principles of a fodder flow programme).
	• Production:
	  • increasing production;
	  • shelter;
	  • handling of farm animals;
	  • behaviour of farm animals.
	• Reproduction:
	  • reproductive organs (male and female);
	  • parturition;
	  • artificial insemination (AI);
	  • embryo;
	  • milk production.
	• Protection and control:

Agricultural management	• Marketing:
	  • price determination;
	  • the market;
	  • methods of marketing.
	• Entrepreneurship: business planning.
	• Production factors and management:
	  • soil;
	  • labour;
	  • capital;
	  • the management process.

Basic agricultural genetics	• Heredity, selection, variation and breeding:
	  • mechanisms;
	  • monohybridism and dihybridism;
	  • Mendel's law;
	  • segregation and independent recombination of characteristics.
	• Plants and animals.
	• Growth and genetic manipulation: genetically modified crops and their purpose.

ANNEXURE 3: CONTENT FRAMEWORK FOR AGRICULTURAL MANAGEMENT PRACTICES

topic	Conte	
Crop Production and Crop management	Grade 10	investigate agricultural crops with regard to the following: • production practices and an overview of the economic importance of crop production; • potential role in industry; • main production areas in the RSA; • production systems; • classification of these crops according to agronomic/horticultural
	Grade 11	Investigate at least ONE specific agricultural crop with regard to the following: • the main production areas and potential role in industry; • overview of economic importance of this crop; • classification of this crop with regard to agronomic/horticultural characteristics; • growth curve and critical period during its growth; and
	Grade 12	None
soil and Water management	Grade 10	FOUR agricultural crops • general climatic requirements (temperature, rainfall, humidity, evaporation and radiation); • collection of weather data; • basic soil aspects; • soil cultivation methods and types of implements; • irrigation; drainage (methods and types);
	Grade 11	One specific agricultural crop • method of soil sampling and basic soil profile; • basic soil characteristics and properties; • soil cultivation and tillage practices (methods and aims); • irrigation (methods and types); • basic principles in water scheduling; • climatic requirements (precipitation, temperature, evaporation,
	Grade 12	Physical farm planning

Topic	Content	
Crop Management	Grade 10	Four agricultural crops • *crop establishment practices*: basic soil preparation practices, plant density, depth and methods (factors influencing each);weeds (types and methods of control); • main diseases (methods or types and control); • main pest (methods, types and control). • crop rotation, monoculture and inter-cropping; • keeping records (financial, physical and production records);
	Grade 11	One specific agricultural crop • soil and plant analysis, fertilization according to soil analysis and fertilization methods and programme ; • crop establishment practices; • basic principles and terminology (e.g. plant density, depth, planting time, treatment of seed, methods and factors influencing each); • *weeds*: types, identification, prevention and methods of control; • *diseases*: types, identification, prevention and methods of control; • *pests*: types, identification, prevention and methods of control. • principles of crop rotation, monoculture and inter-cropping; • calibration and setting of different farm implements; • methods of crop protection; • precision farming; • manipulation of plant growth (pruning, trellising, green housing,
	Grade 12	None
	Grade 10	investigate types of farm animals (e.g. cattle, sheep, pigs and chickens) with regard to the following: • production practices and an overview of the economic importance of production; • potential role in industry; • main production areas in SA; • farming systems;

animal Production	Grade 11	Investigate at least one specific farm animal with regard to the following: • the economic importance; • potential role in industry; • main areas of production; • Breed standards (evaluating and judging a breed), including:
	Grade 12	harvesting, grading, storage and distribution of crop (practices and principles).
Topic	**Content**	
animal management aspects	Grade 10	Four types of farm animals (e.g. cattle, sheep, pigs and chickens) • handling of farm animals; • care of farm animals; • behaviour of farm animals. • housing and facilities; • after-care of animals (dehorning, removal of extra teats, castration, etc.); • identification methods (earmarks, tattooing, ear tags, etc.); • basic concepts of feeding (classification and terminology). • diseases (identification, types and methods of control); • *parasites*: internal and external (identification, types and methods of control).

	Grade 11	• One specific farm animal • *Reproduction*: aspects of production unit (oestrus, mating, artificial insemination, embryo transplantation, cloning, gestation period and service register); • *Housing and facilities*: types and functions; • *After-care*: dehorning, castration, identification, etc • *Diseases*: types, identification of symptoms, prevention and methods of control; • Animal handling and facilities; • *Basic veterinary practices*: diagnostic procedure, blood smear, blood sample and tissue sample; • *Immunology*: active and non-active; • *Parasitology*: internal and external types, identification, prevention and methods of control. • Feeding aspects according to physiology status; • Requirements, rations, procedures and methods; • Keeping records (physical, production, financial and animal health programmes); • Production-related legislation; • Farmer health issues; Risk management. • if a ruminant is chosen as the farm animal:
	Grade 12	

Topic	Content	

management principles, Farm planning and recording	Grade 10	• Definition of management;
		• Principles such as:
		  • planning;
		  • control;
		  • co-ordination;
		  • motivation; and
		  • communication.

	Grade 11	• Objectives of veld management
		• Grazing systems:
		  • extensive and intensive principles (selective grazing, non-selective grazing, rotational grazing, etc.);
		  • use (fodder flow planning);
		  • carrying capacity and relevant terminology; and
		  • veld composition and determining carrying capacity.

	Grade 12	• soil; • camps; • contours; • resource use; • precision farming; • mechanisation; • economic planning (budgets, trial balance, cash flow, and income and expenses statement); • labour planning; • planning regarding implements; • recording (aim, advantages and types of records);

Product harvesting and Quality control	Grade 12	• Product harvesting:
		  • regulations and legal aspects;
		  • handling products; and
		  • storing products.
		• Quality control measures
		• Sorting and grading products

Topic	Content	
marketing, Producer organisations, Value adding and Processing	Grade 12	• marketing of products: • marketing methods and channels; • marketing Acts; • marketing functions; and • advertising. • Role of producer organisations: • types of organisations; • advantages and disadvantages of organisations; and • the role of the product organisation in the marketing of products. • Value adding: • value-adding methods; • types of products; and • advantages. • Processing:
Agro-tourism, Business planning and entrepreneurship	Grade 12	*Agro-tourism*: definition and description • types; • advantages and disadvantages; and • requirements. • The farmer's role: • Business planning: • description and explanation of a business plan • a simple business plan; and • methods of setting prices. • Entrepreneurship: • definition; • qualities of an entrepreneur; • managing skills: • different types of business; • business creation in agriculture; • business survival strategies; and

Topic	Content	
Farm valuation and planning	Grade 12	Farm valuation: • inter-reliance of different enterprises; • profitability of enterprises; • viability of enterprises; and • suitability of the farm in terms of the business plan. management: • planning; • organising; • motivation; • control;

Annex 5: Agricultural Schools In South Africa

Augsburg Agricultural Gymnasium, Clanwilliam
Bekker High School , Magaliesburg
Boland Agricultural High School , Windmeul
Morgenson Landbou Akademie, , Morgenzon
Gelukwaarts Agricultural And Hotel School, Van Stadensrus
Harry Oppenheimer Agricultural High School, Limburg
Hendrik Potgieter Agricultural High School, Reddersburg
Itokisetseng Combined School, Wesselsbron
Jacobsdal Agricultural High School, Jacobsdal
Kgotso Agricultural Secondary School , Hoopstad
Kroonstad High School , Kroonstad
Kuschke Agricultural High School, Eerstegoud
Marlow Agricultural High School, Cradock
Martin Oosthuizen High School, Kakamas
Merensky High School, Tzaneen
Middelburg High School, Middelburg
P H Moeketsi Agricultural High School, Taung 8584.
Nampo Agricultural Secondary School , Bothaville 9660.
Niekerksrus Agricultural School, Viljoenskroon 9520.
Northern Cape Agricultural High School, Jan Kempdorp 8550.
Oakdale Agricultural High School, Riversdale 6770.
Phandulwazi Agricultural High School , Alice 5700.
Seotlong Agricultural And Hotel School, Witsieshoek
Settlers Agricultural High School, Settlers
Suikerland Agricultural High School, Malelane
Umzimvelo Agricultural School, Ermelo
Unicom High School, Tweespruit
Weston Agricultural School, Mooi River
Winterberg Agricultural High School, Fort Beaufort

Annex 6: AET Enrolments in universities by Categoery of Education Subject Matter (CESM) during 2011 academic year

CESM*	**UG**	**PG Dip**	**Hons**	**Masters**	**PhD**	**Total**
Agricultural Business & Management	4198	4	257	185	44	**4688**
Agricultural Mechanisation	16	0	1	0	0	**17**
Agricultural Productions Operations	194	0	7	30	10	**241**
Applied Horticulture & Hort Business Services	6	0	0	0	0	**6**
Animal Sciences	1018	0	18	21	11	**1068**
Plant Sciences	952	0	15	48	7	**1022**
Soil Sciences	98	0	3	23	2	**126**
Forestry and Wood Sciences	248	0	6	22	14	**290**
Agriculture, Agric Operations & Related Sciences & Other	886	0	762	306	94	**2048**
Dietetics and Clinical Nutrition Services	42	27	0	0	0	**69**
Family and Consumer Services	652	0	9	17	0	**678**
Food science & Technology	48	7	0	2	0	**57**
Foods, Nutrition & Related Services	31	0	0	1	0	**32**
Botany/Plant Biology	196	0	25	20	21	**262**
Biochemistry. Biophysics and Molecular Biochemistry	197	0	3	5	6	**211**
Microbiological Sciences and Immunology	155	0	6	5	0	**166**
Zoology/Animal Biology	166	0	31	52	78	**327**
Genetics	191	0	0	0	0	**191**
Biotechnology	249	0	32	51	3	**335**
Ecology, Evolution, Systematics and Population Biology	429	0	33	56	45	**563**
Total	**9972**	**38**	**1208**	**844**	**335**	**12397**
Percentage	**80**	**0**	**10**	**7**	**3**	**100**