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A REVIEW OF FORESTRY CURRICULA IN SOUTH AFRICAN TERTIARY INSTITUTIONS

Palesa Mgaga

A research report submitted to the Faculty of Science, University of the Witwatersrand, in partial fulfilment of the requirements for the Master of Science
(Coursework and Research Report in Environmental Sciences)

Supervised by: Professor Mary Scholes

May 2018. South Africa.

Declaration

I declare that the work presented in this research report is, to the best of my knowledge and belief, my own original work, except as acknowledged in the text. This report is being submitted for the degree of Master of Science and it has not been previously submitted for a degree at this or any other university.

The proposed study received human research ethics approval from the University of the Witwatersrand Human Research Ethics Committee for Non-Medical research, Protocol Number H16/06/01.

Palesa Mgaga



Submitted for examination on the 18th day of May 2018 to the University of the Witwatersrand in Johannesburg, South Africa.

Abstract

Modern day foresters assume a variety of roles that constantly challenge them to remain professionally relevant in a dynamic system that requires them to engage with the continuously expanding number of stakeholders that need to be engaged in the forestry sector. This study is important in understanding how a forester's job has shifted from simply managing trees and forests for timber to managing trees and forests to achieve the interests of various stakeholders and biological ecosystems that are influenced by profit generating industries. These socio-economic roles have created new trends in the structure of forestry curricula that are reflected in labour markets and the consistent demand for forestry graduates to acquire a broad array of competencies. The focus of this research is to provide a baseline study that will highlight the range and improve our understanding of forestry education programmes in South African tertiary institutions. Document review, Behavioural Event Interviews (BEIs) and gap analysis were the methods used. The research approach used case studies where students and academic experts from four tertiary institutions and forestry employers were interviewed. The findings from this research highlighted some of the key issues associated with forestry curriculum design which included disciplinary versus interdisciplinary studies e.g. plantation growth and plantation sustainability. Maintaining a programme with low enrolment numbers and declining capacity in, facilities and funding for various degrees is difficult resulting in poorly prepared students from some institutions. The main conclusions drawn from this study are that a higher level of integration of social sciences in forestry curricula is pivotal to resolving some of the challenges facing the forestry sector, and that in light of programmes whose delivery process is severely restricted by budget constraints, solutions developed jointly between industry and tertiary institutions should be on going. Based on these findings this study proposes stronger national collaboration between forestry education programmes and stakeholders in the forestry sector.

Keywords: collaboration, competencies, curriculum design, disciplinarity, forestry education, socio-economic roles

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A project of this nature, geographically dispersed between five South African provinces, is only possible with the support and willingness of many people to play their role during the entire process. This project would not have been possible without the willing participation of all stakeholders involved, these are, students and academic experts from various tertiary institutions as well as employers in the forestry and government sectors. Thank you all for your precious time during the interview process.

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A review of forestry curricula in South African tertiary institutions

1. Introduction - Research problem

Today's forester is constantly challenged to remain professionally relevant in a dynamic environment by being required to apply knowledge and skills that were not imparted during his training. The inclusion of biodiversity from surrounding natural ecosystems in the territory of commercial forests has pressured the forestry profession to evolve into a broader perspective that Temu and Ogweno (2007) believe has triggered changes in forestry education (Arevelo *et al.*, 2010; Daramola, 2010; Orenius and Rekola, 2007; Temu and Ogweno, 2007).

Forests play a crucial role in the livelihoods of citizens regardless of their country being developed or in the process of developing. The growing awareness of environmental issues such as desertification, soil conservation, carbon sequestration, water quality and biodiversity conservation just to name a few has raised the premium on forest resources (Temu and Ogweno, 2007). This growing awareness has encouraged dialogue on highly contested environmental issues such as how to find a balance between the wise usage and conservation of natural resources.

South Africa's commercial plantations are 99.7% made up of exotic species, the three main taxa are *Eucalyptus* spp. (hard woods), *Pinus* spp. (softwoods) and *Acacia mearnsii*. (Wattle) (FSA, 2017). These exotic species are preferred over native species because their seeds are easily accessible and easier to handle, they grow much faster and are also easier to handle silviculturally (Richardson, 1998). However, the intended introduction of alien invasive species by the forestry sector has had unintended consequences on the water resources and biodiversity of surrounding natural ecosystems in events where these species managed to escape cultivation (van Wilgen *et al.*, 2001; Moore 2005). The South African nutrient poor Fynbos biome is a befitting example; the nutrient-cycling regimes of this biome have been negatively impacted by the ability of Australian wattle species to fix atmospheric nitrogen (van Wilgen *et al.*, 2001; Moore 2005).

Richardson (1998) stated that the woody alien species invading 38% of country's area come from commercial plantations while Rouget *et al.* (2002) established that 54% of the alien trees and shrubs invading South Africa are two of the three main taxa grown in commercial

plantations, namely, *Acacia mearnsii* and *Pinus* species. These invasions pose different combinations of economic, environmental and social loss to various stakeholders (Moore, 2005).

The continuously expanding number of stakeholders that need to be engaged in the forestry sector cuts across political, social and economic boundaries; as a result, a forester's job has shifted from simply managing trees and forests for timber to managing trees and forests to achieve the interests of various stakeholders and biological ecosystems that are influenced by the industries that gain profit from them as well as local communities whose livelihoods depend on them.

Globally, the number of students in forestry education training programmes has declined by 30% over the last ten years. This has resulted in many forestry technician schools shutting their doors (Leslie *et al.,* 2006; Nyland, 2008; Temu and Ogweno, 2007). This substantial decline has been evident in Europe and Africa since 1993, despite the fact that enrolment in universities has tripled within the last twenty years. Africa has experienced a drastic decline in graduating technicians from 1995 mainly because of reduced funding that has resulted in the scaling down of forestry programmes, the lack of employment opportunities despite the expanding role of foresters in environmental management as well as other personal factors like higher paying job opportunities (Nair, 2004; Temu and Ogweno, 2007).

Africa and Europe are faced with the challenge of finding ways to attract quality students and resources for their higher education forestry training programmes. This is because very few students regard forestry as a profession; furthermore, the issue of forestry applicants predominantly being students that achieved low passes at school level is a cause for concern especially in Europe (Miller, 2004; Temu and Ogweno, 2007).

The purpose of this study is to provide a national baseline study on curriculum content and any potential fragmentation in South Africa's tertiary level forestry education. The information obtained from this research will be useful for strengthening research on forests and it could also shed insight on ways to attract more South African youth to higher education forestry training programmes.

2. Literature Review

2.1 The history of a global advisory function in forestry education

The recommendations from the Fourth World Forestry Congress held in 1954 led to the formation of a Food and Agriculture Organisation (FAO) panel on forestry education in 1956 which acted as a global advisor on forestry education (Temu and Ogweno, 2007). Its purpose was to inform tertiary level forestry education leading to a bachelor's qualification, ranger schools offering diplomas and certificates, vocational training of workers and the public on forestry related issues. In 1964, the panel was reintroduced as the FAO Advisory Committee on Forestry Education (ACFE). The ACFE established a forestry education branch that coordinated global forestry education activities within the FAO, its deliberations touched on curricula content, lifelong learning, public education and the quality of forestry education issues among others (Temu and Ogweno, 2007). Training for forest industries was the most popular topic on the ACFE's agenda; this highlights the committee's commitment to the important role that forests play from the perspective of industrial development, it was followed by social forestry which highlighted the importance of extension in the field, especially in light of the heterogeneity of the committee's membership as a result of increasing participation from developing countries and the third most popular topic was vocational training which drew special attention to the need for practicing foresters to continuously upgrade their skills as a result of the emerging issues in the forestry sector.

Through the years of its existence, the ACFE recommended expanding forestry curricula to incorporate courses such as engineering, wood utilization and industrial forestry in the 1950s; agriculture, extension, wildlife and watershed management in the 1960s; environmental education, communication skills and public relations in the 1970s; forest policy and law, agroforestry, rural sociology and politics in 1980s; and sustainable development, GIS and information technology in the 1990s (Temu and Ogweno, 2007). The issue of the lack of employment for forestry graduates became apparent after 1990; this was the time when forestry employment opportunities in the public sector were gradually decreasing in many countries. Hence the commitment of the ACFE to expand the curricula to incorporate social sciences, economic and management courses as a strategy for forestry graduates to qualify as candidates for broader employment opportunities (Temu and Ogweno, 2007; Ratnasingam *et al.,* 2011). This strategy introduced the challenge of how to deal with the ever-increasing number of

courses recommended for inclusion within the curricula, after all, a 3-4 year degree programme is limiting in this regard and also bearing in mind that packing the curriculum with too many courses could potentially degrade the professional integrity of forestry qualifications.

The issue of the lack of skilled manpower was ACFE's main concern in its initial stages. However, most developing countries ticked this box by the 1980s because of the committee's strategy of providing the opportunity for students from developing countries to study for their graduate and postgraduate degree abroad in Europe and North America (Temu and Ogweno, 2007). The strategy had a multiplier effect on the capacity of developing countries because the majority of these graduates chose to train other students in training institutions that offered forestry qualifications in their home countries. Thereafter, the committee shifted its attention to curriculum issues, where they focused on the content of undergraduate degrees, technical training e.g. diploma and certificates and how forestry training programmes can impart non-technical competencies such as attitude and ethics (Temu and Ogweno, 2007).

The ACFE ceased to exist in 1996 and since then, there has been a lack of systematic follow up on the models that have been adopted and why. This created a gap among forestry education institutions due to the lack of guidance and support and, they were left stranded on how to understand and integrate emerging global environmental issues such as the Millennium Development Goals (MDGs) and climate change into their curricula. The influence of the ACFE inspired Eastern and Southern Africa to establish their own forestry education advisory committee in 1971 which engaged a variety of stakeholders on matters of human resource needs for the forestry sector and determined the quality and curriculum content of forestry training programmes. Sadly, during the 1980s, this committee also came to an end (Temu and Ogweno, 2007).

2.2 African representation in the Advisory Committee on Forestry Education

During the lifespan of the committee, Africa was mainly represented by Kenya, Nigeria and Cameroon; South Africa was presented with an opportunity to participate in this dialogue only once, along with Gabon, Ivory Coast and Sudan (Temu and Ogweno, 2007). Among all these countries, only South Africa and Kenya were able to develop an industrial wood processing industry, this is why training for the industry is so important to them. There was no representation from Africa in the ACFE's first meeting; South Africa was one of the first countries to be invited to send representatives because we were one of only two countries

providing professional forestry training in the continent. However, due to the hostility towards the country's apartheid legacy, South Africa was unable to participate.

2.3 Sustainable Development Goals (SDGs) and Forestry

The importance of forests is highlighted under the Sustainable Development Goals (SDGs) which are spearheaded by the United Nations (UN Economic and Social Council, 2017). Forests are explicitly addressed in goal 15 under the theme "Life on Land" which aims to sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss. The International Day of Forests which annually takes place on the 21st of March is a global effort supporting SDG 15. The day provides countries with the opportunity to raise awareness of the importance of forests and highlight the ways in which they sustain and protect us by implementing local, national and international activities such as tree planting campaigns. In the Western Cape Province of South Africa, the Stellenbosch municipality has been implementing a local initiative called the Million Trees Project which began in 2013. Nationally, the country annually implements National Arbor Week which takes place from the 1st to the 7th of September. The aim of this event is to promote better knowledge of trees especially indigenous ones, encourage everyone to plant and care for trees and finally highlight their importance in our lives. The leading custodian of South Africa's Arbor Week is the Department of Agriculture, Forestry and Fisheries (DAFF).

2.4 The marginalisation of women in natural resource careers

The unequal distribution of natural resources between men and women has raised awareness of the position which women assume in the scope of natural resources, globally, women are generally under-represented mainly because of their gender in this regard (Karim, 1995; Koech and Kireger, 2007). To address this issue, a number of international conventions have been established to empower women by unlocking their door to education; these include the United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention Against Discrimination in Education of 1962, and the 1981 United Nations (UN) Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (Koech and Kireger, 2007). This highlights the importance for African universities to produce skilful students who are able to actively assume leading positions in the sustainable development of a country, irrespective of their gender. The Millennium Development Goals (MDGs) on Education support reinforced this idea by advocating for gender equality and the empowerment of woman because

they play a crucial role in the management of natural resources (Koech and Kireger, 2007; Sifuna, 2006).

Koech and Kireger (2007) conducted a study in Kenya on the place of women in tertiary level natural resource education for socio-economic development. One of the key results of this study is the asymmetrical distribution of access to education based on gender in Kenya, there are gender inequality issues at every level of the country's education system that need to be addressed. In 2004, the country experienced its greatest gender gap where only 36% of students enrolled in higher education were female students. This shows that fewer woman have access to higher education in Kenya, sadly this observation is also the case in many countries in Sub-Saharan African (SSA) with a few exceptions such as South Africa (SA). That said, over the years, Kenya has been pushing to close the gender gap that has seen a large number of girls and women miss out on opportunities in education.

2.5 The importance of forestry education in the social issues facing Sub-Saharan Africa (SSA)

The prevalence of Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) in Africa poses one of the greatest threats to the continent's stability and development. The pandemic has resulted in a high dependence of rural communities on forest resources, which has negative implications on the environment and natural resource management (Kungu and Otor, 2007). Based on the findings of the Joint United Nations Programme on HIV/AIDS (UNAIDS) (2003), the region of the African continent that suffers the most in this regard is SSA. HIV/AIDS is not only a health concern, but also an environmental and food security concern because of its vast implications that extend beyond health. For example, many studies have shown a directly proportional relationship between high rates of HIV and rural communities that have inadequate access to food (Kungu and Otor, 2007). The majority of the population affected by HIV/AIDS in SSA is rural hence the pandemic is labelled a 'rural problem', affecting the part of the population which is not well prepared to confront its implications (UNDP, 2002).

The link that the HIV/AIDS pandemic has to forestry is not clear to many people. It simply follows that the coping strategy of families affected by HIV/AIDS is to exploit local forest resources for survival and to generate a source of income (Kungu and Otor, 2007). Fuel wood for cooking is the most important Non-Timber Forest Product (NTFP) that contributes to these families' health and nutrition. In this regard, educating the society at large on the significant role

that forestry assumes for families that are trying to mitigate HIV/AIDS is important for creating awareness of this relationship.

2.6 Transformation in forestry education

2.6.1 Oregon State University (OSU), United States of America

The question of whether forestry education can be part of a natural resource management curriculum has been grappled with at the proceedings of the SILVA-IUFRO Symposium held at Wageningen University in 2005. One of the universities that we can learn from in this context is Oregon State University (OSU) in the United States of America (USA). The institution has two decades of experience that might help many struggling schools, departments and faculties of forestry around the world (Jensen, 2006). In 2003, OSU introduced a Natural Resources Degree that is administered between four Colleges of the university, the programme is of an interdisciplinary nature and its most popular specialisation is forest ecosystems. OSU is among the few institutions of the world that have successfully managed to retain the identity of both traditional forestry and natural resources qualifications (Jensen, 2006). In response to the changing professional needs of employers in the USA, such as graduates that are capable of crossing disciplinary boundaries among others, OSU introduced a new interdisciplinary degree in Natural Resources in acknowledgement of the rigidity and lack of adaptability of its current curriculum. The initial purpose of this programme was to complement existing independent degree programmes in traditional disciplines as opposed to competing with them (Jensen, 2006). Having examined the steady enrolment numbers in traditional forestry programmes in light of growing enrolment numbers in the Natural Resources programme, OSU is confident in that the introduction of this new interdisciplinary programme appears to have had minimal impact on the enrolment numbers of traditional disciplines.

Some of the characteristics that distinguish the Natural Resources programme from traditional degree programmes are that it is not centred with a single department, it has no designated faculty, it has no graduate, research or continuing education programmes and its graduates follow unpredictable career paths compared to students graduating from traditional programmes (Jensen, 2006). OSU openly acknowledges that offering such a programme is not without challenges, most of which are student-centred *i.e.* the programme being dispersed between four colleges leads to a lack of group identity for the students and administrative in nature *i.e.* sourcing financial support between multiple deans is challenging. However, the university's

Natural Resources graduates are attractive to many different employers in the job market, this statement is supported by their employment rate of 80-100% (Jensen, 2006). A conclusion that can be drawn from OSU's experience is that an interdisciplinary Natural Resources curriculum can be compatible with traditional forestry qualifications (Jensen, 2006).

2.6.2 Wageningen University, Netherlands

A different conclusion to the same question may be drawn from Wageningen University's experience of an integrated curriculum between forestry and nature conservation. Wageningen's approach was a change over from a pure forestry curriculum to a forest and nature conservation one. The university has undergone three curriculum changes between 1884 and 1981; however, this study will focus on the university's most recent changes in its forestry education. Between 1982 and 1994, Wageningen University moved from five specializations grounded in the discipline of forestry (afforestation, forest policy, forest products, forest management and forest development) to Forest and Nature Conservation (FNC) which offered four specializations (forest and nature policy, management of forests and nature, forest and nature development and nature and tourism) (Jansen and Schmidt, 2006). This period marked profound changes in the discipline of forestry in the Netherlands as public support for the profession drastically diminished and the support for nature conservation started growing. During the same period, employment opportunities for new practicing professionals were low because foresters were competing with biologists and social geographers for the same positions. Only one third of forestry graduates managed to find placements in the field of their training (Jansen and Schmidt, 2006).

Between 1995 and 2004, the five year Forest and Nature Conservation (FNC) curriculum changed from offering four specializations to a new curriculum offering two specializations, namely, Policy and Management and Ecology and Management in a BSc-MSc format. That is, the university offered these two specializations at both levels *i.e.* BSc-FNC (3 years) and MSc-FNC (2 years) (Jansen and Schmidt, 2006). Having examined the different approach adopted by Wageningen University, of which was to introduce an integrated curriculum between forestry and nature conservation, the conclusion that can be drawn from Wageningen's experience is that, on the contrary, it is possible to have a curriculum that focuses on both forestry and nature conservation. Wageningen University considered the change to cohabit Forest and Nature Conservation in one curriculum as their best approach to reflect current changing values of

forests in society and to date; there have not been any negative signs hence the continuation of the programme (Jansen and Schmidt, 2006).

European countries have a system called the Bologna Process which comprises of a series of ministerial meetings to ensure compatibility of the standards and quality of their higher education standards. The requirements of the Bologna Declaration of higher education reform have influenced Europe's current transformation in forestry education. However, the rate and depth of transformation varies greatly across countries leading to a great diversity of curricula (Lewark *et al.,* 2005). The University of Eastern Finland coordinates a specialised International Master's Degree Programmes in cooperation with seven other co-organising universities such as Wageningen University in the Netherlands and University of Freiburg in Germany among others. The university offers an MSc European Forestry which is a two year double-degree Erasmus Mundus programme (Innes, 2010). One of the reasons why this great diversity of curricula is likely to persist in Europe is the importance of local context which seems to have lasting impacts on the type of institutions and content of the curriculum. To respond to this challenge, the Bologna Declaration emphasises mobilising students so that they are able to access the different profiles of forestry curricula offered across European countries, this condition further provides students the opportunity to develop individual qualification profiles (Lewark *et al.*, 2005).

2.6.3 Stephen F. Austin State University (SFASU), United States of America

Another similar experience to Wageningen University can be drawn from Stephen F. Austin State University (SFASU) in the USA. The similarity between the experiences of these universities lies in that both institutions refrained from introducing a new programme as OSU did, they focused on revising and strengthening their existing curricula to best meet the current needs and challenges of society, employers and the environment. The curriculum revision of SFASU's Bachelor of Science in Forestry (BSF) was more focused on the side of ensuring the development of non-technical competencies such as written and oral communication and behaviours associated with professional conduct (Bullard *et al.,* 2014). The reason for this is that the university has a reputation of generally doing well at imparting forestry technical knowledge and skills.

The Bachelor of Science in Forestry curriculum at SFASU had not been revised since 1999 when the most recent 2012 curriculum revision process began. A key aspect emphasised by the 2012 revision process was to deliver a curriculum that provides students with extracurricular

opportunities such as internships before graduating as a means to enhance the development of people and workplace related competencies (Bullard *et al.*, 2014). The restructuring of the Bachelor of Science in Forestry curriculum was centred on "weaving" other current important topics in the curriculum. These topics include changes in water availability and water quality and climate change and its effects among others. Since these issues interact to impact forest resources and society, SFASU acknowledges these knowledge areas as critical to the ability of entry-level forestry professionals and therefore has integrated them in the Bachelor of Science in Forestry by "weaving" them in the programme (Bullard *et al.*, 2014). An important point of note is that the university managed to maintain its strong emphasis on forestry technical skills in the programme while "weaving" knowledge and skills in high-priority areas.

There is no one-size-fits-all solution to the challenges facing forestry education. The impact of local context on the content of forestry curricula from one country to another creates a staggering amount of experiences, from which a lot can be learned through cooperation, comparison and exchange. It is important to acknowledge the need for a curriculum to reflect the current needs of society; however, it is equally as important to recognize that a curriculum is designed within a specific context to meet specific needs. An important point of note is that the case studies presented in this section are a good basis for stimulating ones thinking on ideas of curriculum transformation.

2.7 Forestry education from a South African perspective

South Africa's total land area is 122.3 million ha and of this; approximately 1.3 million ha which is 1% of South Africa's land cover is used for plantation forestry. Woodlands (locally referred to as savannas) which are the dominant vegetation type in South Africa and natural forests cover approximately 39.5 million ha and of this, approximately 500 000 ha which is 0.4% of the land cover is covered by natural forests. The rest of the total land area is designated for grazing (68.6%), arable land (13.9%), conservation (9.6%) and other (6.9%) (Godsmark, 2017). Nearly all the timber used for commercial purposes in South Africa originates from plantations; the principal species planted are hard woods (*Eucalyptus spp*. 44%), softwoods (*Pinus spp.* 44%) and wattle (*Acacia mearnsii.* 12%) (FSA, 2017). The wood processing industry and commercial forestry plantations play an important role in South Africa's economy. In 2016 both contributed R31 billion which is 0.6% towards the country's Gross Domestic Product (G DP) (FSA, 2017). South Africa's forestry sector has also made significant contributions to unemployment by currently employing 158 400 workers (1.3% of South

Africa's workforce) in areas where unemployment generally thrives. The bigger picture follows that 534 000 dependants are supported by these jobs and in total, the livelihoods of 1.35% of the population, approximately 692 000 South Africans depend on the forestry sector (FSA, 2017; Godsmark, 2017).

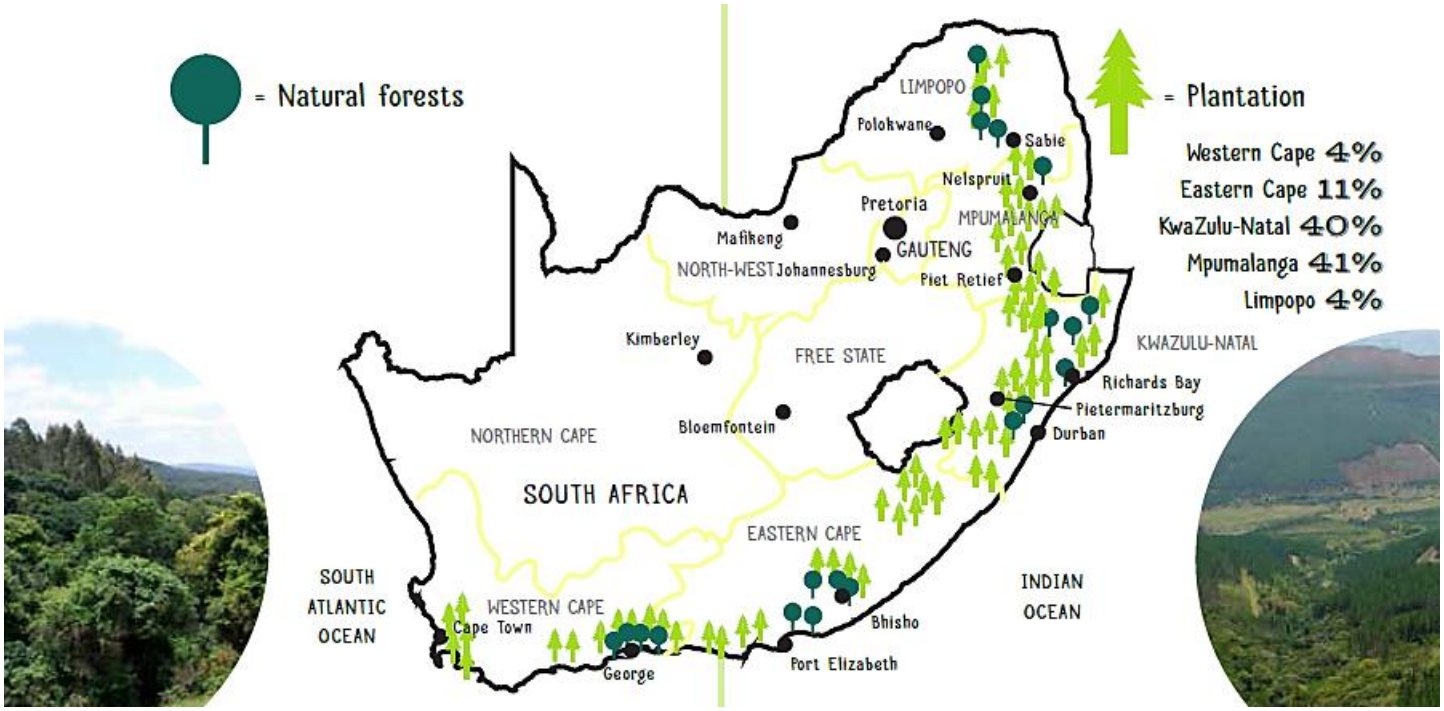


Figure 1: Map of South Africa's forests (FSA, 2017).

The socio-political developments that have taken place over the last 25 years have impacted tertiary level forestry education in one way or another. During this period, South Africa has experienced an overall reduction in total plantation area and afforestation. Conservation pressure is the main contributor to the reduction in plantation area specifically with regard to society's increased awareness of the importance of water conservation. The protection of wetlands and catchment areas has resulted in contested spaces between conservation initiatives and commercial forestry plantations. In accordance with Godsmark (2017) the total new afforestation over a 10 year period starting from 2006 to 2015 is 18 827 ha while between 1980 and 2005, a larger area of 370 978 ha of total new afforestation was achieved. In the political arena, the significant changes that have occurred in the ownership and privatization of government plantations have also negatively impacted tertiary level forestry education by drastically reducing its access to resources (Längin and Ackerman, 2007). Before these changes occurred, the government dominated higher forestry education through financing its institutions, offering financial support for students in the form of bursaries and two-year internships for

forestry graduates which eventually led to permanent employment within government. With an estimated 80% of private plantations currently under land-claims, land ownership will continue to pose a challenge to South Africa's forestry sector (Chamberlain *et al.,* 2005).

Another factor that has had negative impacts on funding for institutions is outsourcing, major companies in the forestry sector have contracted out all their operations. This has resulted in a forestry sector that is saturated with contractors, most of whom are poorly trained and unqualified to conduct such forest operations and sadly, this situation has not improved over the years (Längin *et al.,* 2006; Morkel, 2000). Furthermore, the impacts of outsourcing are evident from the increase in fire damage to plantations in regions that experience summer rainfall and the lack of basic research capacity as a result of the current fragmentation in the country's tertiary level forestry education system. To elaborate, government and higher education forestry institutions conduct only 10% of the forestry sector's research (Längin and Ackerman, 2007). Outsourcing and the rationalisation of technical expertise by companies has drastically reduced employment opportunities for professional foresters. The above mentioned challenges of the privatisation of state owned plantations, major companies outsourcing their operations to contractors, land claims and the sector's water consumption in the midst of serious environmental problems such as water scarcity all have painted a negative image of the forestry sector to society and most importantly an undesirable image of forestry as career for young people (Längin and Ackerman, 2007).

In South Africa, higher education in forestry began in 1905 at the South African College in Tokai, Cape Town. Stellenbosch University (SUN) and the Saasveld School of Forestry, now known as the Nelson Mandela Metropolitan University (NMMU) after a merger in 2005 established their higher education forestry qualifications in 1932. They offer a professional BSc Forestry degree and a technical Diploma in Forestry respectively. At the college level, Fort Cox College for Agriculture and Forestry which was established under the no longer existing Swartkop Forestry School (1946) started their programme in 1970. The University of Venda (UV) and the University of KwaZulu-Natal (UKZN) were the last two institutions to join as providers of professional forestry training in 1999 and 2000 respectively. The University of Venda (UV) offers a BSc Agriculture and Forestry combination while UKZN used to offer a no longer existing BSc Agriculture with Forestry as a major (Längin and Ackerman, 2007; Underwood *et al.,* 2008). It hasn't been easy for UV and UKZN to maintain their qualifications

as a result of low student numbers and inadequate staff capacity hence the termination of the qualification in UKZN.

South Africa's forestry education is no exception to the global trend of a decline in funding compared to the support governments used to provide and as a result, forestry faculties along with their forestry programmes and modules have drastically had to be scaled down. A key characteristic that sets forestry apart from other professions is that it is shaped by the continuously changing local and national perception and attitude towards it (Längin and Ackerman, 2007). Hence, public opinion shapes forest management practices as well as the kind of forestry graduates required to deal with emerging issues and new trends of the 21st century. This means that South African forestry institutions are in a position where they have to achieve more output with less input in the midst of striving to maintain the country's qualifications at international standards.

3. Key Questions and Objectives

Given that there is no local record of a study of this nature, the aim of this research is to provide a baseline study that will highlight the range and improve our understanding of forestry education programmes in South African tertiary institutions.

The objectives of this study are as follows:

1) Review forestry education programmes by analysing secondary documents.
2) Conduct Behavioural Event Interviews (BEIs) to determine the competency of undergraduate students acquiring forestry qualifications.
3) Conduct a Gap Analysis to determine whether the needs of the forestry sector are being met by the forestry education system.

Objective one and objective two will also be carried out for natural resources centred curricula *i.e.* environmental sciences, ecology, natural resource management or any other equivalent BSc course in natural sciences. The analysis of secondary documents will enable a comparative analysis of the education given to forestry and environmental scientists and BEIs will enable a comparative analysis of the differentiating and essential competencies required for successful overall performance between forestry and environmental scientists respectively. This approach will explore the idea of the disciplinarity of forestry as a profession as opposed to more interdisciplinary where in addition to modules that are grounded in the discipline, other types of natural sciences are also be considered in curriculum design.

4. Research Methods

4.1 Introduction

The International Union of Forest Research Organisations (IUFRO) in partnership with the International Forestry Students' Association (IFSA) is currently conducting a global project on tertiary level forestry education that will contribute towards implementing the 2015-2019 IUFRO strategy. The research will be conducted in each continent; South Africa will be one of the countries participating on behalf of Africa. A skeleton framework of the research methods was provided by the bigger global effort, this provided each researcher the opportunity to contextualise these methods on the basis of the setting within their home country's local scale. This study was designed with a purpose to expand and update the strengths and weaknesses of South Africa's tertiary level forestry education and generate a baseline study that could potentially be used as a comparative study for similar future forestry education research. Education plays a critical role in international agreements and processes hence, this project can be regarded as an opportunity for South Africa to contribute toward Africa's participation in this global effort.

4.2 Case study as a Research strategy

The research strategy adopted to complete this empirical research used case studies where a variety of stakeholders concerned were interviewed. One undergraduate forestry and/or natural resources programme was selected from the University of Venda, University of KwaZulu-Natal, Nelson Mandela Metropolitan University and Stellenbosch University. A sample of students and academic experts from these institutions was interviewed and supporting secondary documents from the selected programmes were also assessed. A sample of employees representing employers in industry, consulting and research in the private sector and government departments and non-governmental organizations in the public sector was also interviewed. To obtain a rich output from this detailed and time-consuming undertaking, a variety of data collection methods were used to study South Africa's tertiary level forestry education system. A purposeful sampling technique was implemented in all the data collection methods used in this research. The technique produces a non-probability sample that is selected based on the characteristics of a population that are in tune with the objectives of the research. Purposeful sampling was the chosen technique because only a limited number of primary data sources could contribute to the areas explored by the

objectives of this research. Simply put, the researcher zeroed in on the targeted stakeholder groups and interviewed whomever that was available. Sample size determination posed a considerable challenge for this research because student numbers were very low in the majority of the selected forestry programmes; however they are representative of nearly 100% of the entire population. The researcher's choice of research strategy was generally informed by the practical considerations associated with planning face-to-face interactions with all concerned stakeholders, which are geographically dispersed between five different provinces in the country and are all working on tight deadlines and schedules. Ensuring the perspectives of all stakeholders (students, academic experts and employers) were captured was important for this research because tertiary education is a complex environment. Therefore, the choice to implement case studies as a research strategy was most suitable for achieving the aim and objectives of this research.

4.3 Objective 1

4.3.1 Case study 1: Document analysis

A document is a written or printed paper that contains information about the phenomenon being investigated, it exists independently of the researcher's actions and usually; it is produced for a specific purpose other than that of the research. Corbetta (2003) and Yin (2003) suggest the use of secondary sources as a means to support and expand on the evidence that has been collected from other sources. A key advantage of document analysis identified by Corbetta (2003) is associated with the technique being non-reactive. This means that the information contained in the document is not subject to distortion as a result of the interaction between the researcher and the respondent during an interview.

4.3.2 Research method: Document analysis

A number of documents in the form of course outlines from the participating undergraduate forestry programme from each tertiary institution were critically analysed. These documents were provided to the researcher by a host lecturer who had been suggested by the relevant Head of Department (HoD) from each tertiary institution. The collected course outlines enabled the researcher to examine the study from a different perspective after all the interviews with associated stakeholders *i.e.* academic experts, employers and students were conducted. This research method provided the researcher an opportunity to highlight

any contradictions emerging as a result of the inconsistencies between the data in the documents and the interviews conducted with stakeholders.

4.4 Objective 2

4.4.1 Case study 2: Behavioural Event Interviews (BEIs)

McClelland (1973) suggested that competency assessment should be used as an alternative method to traditional academic intelligence assessments which have historically failed to account for successful performance in high-level positions. Multiple studies conducted by McBer and Company, a consulting firm, have continuously proven that competency assessments done using interviews are better equipped to predict the success of high-level executives compared to scores achieved in academic intelligence tests (McClelland, 1998). This idea is further supported by Hogan *et al.* (1996) in their study which showed that personality features unrelated to intelligence determine occupational success. BEIs originate from Flanagan's (1954) critical-incident interview; they are grounded on that the best predictor of future behaviour is past behaviour and are used to determine the characteristics that distinguish outstanding performers from average performers (McClelland, 1998). The importance of capturing the characteristics that differentiate outstanding performing students from average performing students is so that they can be taught to those whose performance is evidently a result of a lack of competence in those very same characteristics. In this research, McClelland's 1998 BEI method was used to determine the competency of undergraduate students acquiring forestry qualifications in South Africa. The reasons for choosing final year students as the main year-group of focus for this research is that firstly, they are at the highest level of their undergraduate career where they should be adequately prepared for the work environment by the time they graduate and secondly, they are more capable of assisting our understanding of the forestry education system due to their accumulated learning experiences from first to final year.

4.4.2 Sampling strategy

A random sampling strategy would be inappropriate for conducting student BEIs for this study because the purpose is to determine the characteristics that distinguish outstanding students from average students. Therefore, homogeneous purposeful sampling was used to focus this case study on the area investigated by objective 1. Each student was classified, by the host lecturer, into a homogeneous group (outstanding or average) based on their marks.

The shared characteristic among students in the same group was that they were either top performing students or average performing students. McClelland (1998) says the logic behind this nomination stems from that it is generally easier for people to agree on who is outstanding rather than what makes them outstanding.

The study required 6 final-year students per institution. However, due to the fact that students were not compelled to take part in this research, the host lecturer was requested to send a list containing only the names and email addresses of more than the required number of students that met the requirements *i.e*. top and average performers. The researcher invited all the students for an interview and sent back all the names of the students that had agreed via email to participate in an interview. The purpose of this was for the host lecturer to double-check that the names met the required sample size of 3 top performers and 3 average performers. This approach ensured that the researcher remained objective during the interviews as the host lecturer only revealed the information on each student's category after the interviews had been conducted. Across all the participating tertiary institutions, a total of 33 undergraduate students were interviewed, 19 final year forestry students and 14 natural resources students (Table 1).

Table 1: Tertiary institutions represented in the student BEIs

Institution	Programme	Representation (%)
University of Venda	BSc Agriculture (Forestry)	18.2
	BSc Environmental Sciences	18.2
University of KwaZulu-Natal	BSc Environmental Sciences	24.2
Nelson Mandela Metropolitan University	Diploma in Forestry	21.2
Stellenbosch University	BSc Forestry and Natural Resource Sciences	18.2

4.4.3 Research method: Semi-structured interviews

The key distinguishing characteristic of a BEI from a traditional interview is that a BEI is fact-finding; it focuses on the interviewee's actual past actions and not how they would have hypothetically behaved in a particular situation. At the beginning of each interview, the researcher introduced herself, gave a brief explanation of the purpose of this research to the student and established a sense of mutual trust between herself and the interviewee. The researcher went through the participant information sheet which assured the

interviewee of the anonymity and confidentiality of the information provided, showed the interviewee the permission granted by the University of the Witwatersrand to conduct the interview with them and requested the interviewee to give their voluntary consent by signing a consent form. With regard to answering interview questions, a student interview guide breaking down the Situation, Task, Action and Result (STAR) procedure the interviewee should follow when answering the questions was provided and explained to the interviewee. Furthermore, the guide had a percentage next to each area that should be covered by their answer; this percentage highlighted how much emphasis the interviewee should put on each area (Appendix I). A template of the BEI interview questions has been provided (Appendix II).

Behavioural interviews were conducted within the premises of the interviewee's tertiary institution on a date and time that was convenient to the interviewee. Most of the interviews conducted were between 40 and 90 minutes. For accurate data collection and reporting of results, interviews were audio-recorded with the permission of each interviewee. All audio-recorded interviews were then transcribed verbatim; this was done to increase the validity of the research findings as it enabled a valid description of what was heard during the interview (Robson, 2002). The transcripts were analysed and discussed in the sections to follow. An example of a student BEI interview transcript has been provided (Appendix III).

In addition to this, direct observations of the interviewee's behaviour during the entire process were noted using general competency based interview performance indicators. A template of the general competency based interview performance indicators has been provided (Appendix IV).

4.4.4 Limitations of BEIs:

- The researcher asked for decisions, actions, feelings and thoughts but not for the student's knowledge of forestry or the specific information that they used as a basis for their decisions, thoughts or actions.
- The critical analysis of interpretation and pattern finding from the interviewee's responses solely reside on the researcher who may not be an expert in behavioural interviews. However, the latter was minimised by the transcript analysis training which was offered to the researcher by the bigger global effort *i.e.* IUFRO-IFSA Joint Task Force (JTF).

- The possibility of some interviewees willing to participate in an interview but not giving their permission for their interview to be audio-recorded may pose potential inconsistencies in the analysis of the data hence such interviews were not included in the analysis and reporting of results.

  * Only one such interview was present in the data.
- All students that were on the list provided by the host lecturer were invited for an interview; however, all case studies across the tertiary institutions had an undesirable sample which was dominated by average performers.

4.5 Objective 3

4.5.1 Case study 3: Gap analysis

Since 1994, South Africa's education policy continues to be influenced by the global demands that are related to the needs and expectations of employers (Kruss, 2004). The most recent baseline study on South African graduates from the perspective of employers was conducted by Higher Education South Africa (HESA) and the South African Qualifications Authority (SAQA) in 2009. The purpose of the study was to establish employers' expectations of graduates entering the workplace as well as to determine the extent to which South African graduates demonstrate these attributes (Griesel and Parker, 2009). Ninety-nine employers representing a variety of sectors, from services, travel and tourism, science and technology to construction and many more from the South African Society for Cooperative Education (SASCE), the South African Graduate Recruitment Association (SAGRA) and the Department of Trade and Industry engaged in the study (Griesel and Parker, 2009).

A gap analysis was designed with two purposes in mind: 1) to identify the discipline specific knowledge and non-technical competencies that employers and academic experts rate as most important for new practicing professionals and 2) to measure the perceptions of employers and academic experts of how well South African tertiary institutions impart this knowledge and competencies. Employers and academic experts were asked to rate the importance of each knowledge area and non-technical competency on a scale of 1 to 5. The knowledge areas were developed from studies conducted by Arevalo *et al.* (2010) and Schuck (2009). The non-technical competencies were developed from the South African Qualifications Authority (SAQA) accreditation standards. In the context of this study, the term "forestry employers" covers all employer categories represented from the private and public sector.

4.5.2 Sampling strategy

Expert purposeful sampling was used for both target groups in this case study because the researcher's focus was on selecting employees who are knowledgeable about the area being investigated within the context of their organization and academic staff members who are in a position to give their expert opinion on the area investigated by objective 3. A pool of 8 employers made up of a diversity of organisations from around the country was developed for the interviews. A template of the employer interview questions has been provided (Appendix V). Employer categories and their geographical distributions can be found below in Table 2.

Table 2: Distribution of employer categories and their geographical distribution.

Employer Type	**Representation (%)**
Government Departments	25
Non-governmental organizations	12.5
Forestry Industry*	25
Forestry Consultant	12.5
Forestry Research Institutions	25
Geographic Regions of Employers	
Gauteng Province	37.5
KwaZulu-Natal Province	50
Eastern Cape Province	12.5

* The Forestry Industry employer category represents commercial forestry companies

Industry and consulting organizations that employ forestry graduates were selected using Forestry South Africa's (FSA) business directory, based on how far they are located from the institutions where the research was conducted. The researcher emailed the contact person on the directory from each chosen organisation and explained what this research is about and subsequently asked them to please provide the names and email addresses of employees who are knowledgeable about the area being investigated. All the suggested employees were invited for an interview and kindly requested to confirm their participation via email. Additional employer organizations were generated via contacts of the advisory committee.

A pool of 7 academic experts representing the same four tertiary institutions as the students was interviewed. Table 3 lists these institutions and their geographical distribution. Only those that were suggested by the relevant Head of Department (HoD) from each institution were contacted on their email addresses. A template of the academic expert interview questions has been provided (Appendix VI).

Table 3: Tertiary institutions represented in the academic expert sample and their geographical distribution.

Institution	**Programme**	**Geographic Region**	**Representation (%)**
University of Venda	BSc Agriculture (Forestry) BSc Environmental Sciences	Limpopo Province	33.3
University of KwaZulu-Natal	BSc Environmental Sciences	KwaZulu-Natal Province	16.7
Nelson Mandela Metropolitan University	Diploma in Forestry	Eastern Cape Province	16.7
Stellenbosch University	BSc Forestry and Natural Resource Sciences BSc Conservation Ecology	Western Cape Province	33.3

4.5.3 Research method: Semi-structured interviews

Semi-structured interviews are flexible in process and enable an interviewee's perspective on the topic to be critically examined through their detailed responses. In a semi-structured interview, the interviewer goes into the interview with a list of questions to be discussed but there is some flexibility in the order in which the topics are discussed and the interviewee has the freedom to elaborate on the topic (Bowling, 2002; Denscombe, 2003). Due to their open-ended nature, semi-structured interviews are more difficult to analyse as the interviewer cannot predict the interviewee's responses hence they require careful planning and sufficient time to be allowed for interpretation and analysis post the interview (Wengraf, 2001).

At the beginning of each interview, the researcher introduced herself, position, institution and explained the aim of this research to the interviewee. This brief introduction was followed by going through the participant information sheet which assured the interviewee of the

anonymity and confidentiality of the information provided, showing the interviewee the permission granted by the University of the Witwatersrand to conduct the interview with them and requesting the interviewee to sign a consent form and hand-over their organization's permission letter which the researcher sent via email prior to the interview. All this was done to formalise the interview and the interviewee with the research topic. A template of an organization's permission letter has been provided (Appendix VII).

The interviews were conducted within the premises of the interviewee's organisation on a date and time that was convenient to the interviewee. All interviews conducted were between 30 and 60 minutes. For accurate data collection and reporting of results, the interview was audio-recorded with the permission of the interviewee, also, the researcher took hand-written notes of the interviewee's responses during the interview. Most of the questions asked were open-ended in nature. All audio-recorded interviews were also transcribed verbatim like the student behavioural interviews; this was also done to increase the validity of the research findings as it enabled a valid description of what was heard during the interview (Robson, 2002). The transcripts were analysed and discussed in the sections to follow. An example of an employer's transcript has been provided (Appendix VIII).

4.6 Triangulation

Triangulation is a strategy that is used to strengthen the confidence of research results, it has the potential to minimise personal and methodological biases and increase the credibility and dependability of this study's output because the data has been gathered from different perspectives and by different research methods (Arksey and Knight, 1999; Decrop, 1999). Based on the different triangulations identified by Denzin, 1970, this research has accomplished data triangulation through collecting data from different sources such as academic experts, employers and students and methodological triangulation by using multiple methods such as semi-structured interviews, BEIs, direct observation and document analysis. Accomplishing methodological triangulation has enabled this research to overcome some of the weaknesses associated with depending solely on individual methods.

4.7 Ethics Clearance

Ethical approval for this research was obtained from the Human Research Ethics Committee (Non-Medical), at the University of the Witwatersrand. A copy of this letter has been provided (Appendix IX).

In addition, Stellenbosch University required this research to obtain internal ethical approval. All the relevant documents were submitted to the university's Research Admin Department and ethical approval was also obtained before any interviews were conducted. A copy of this letter has also been provided (Appendix X).

The key ethical considerations for this research are informed consent, anonymity of interviewees and the confidentiality of information. Each interviewee was provided with a participant information sheet which explains the purpose of this study and what their involvement would entail (Appendix XI). Potential interviewees were given sufficient time to confirm their participation. Participation was by voluntary informed consent which was initially obtained via email prior to the commencement of the interview. This approach enabled the researcher to carefully plan face-to-face interactions with all associated stakeholders. On the day the interview was conducted, written consent was obtained from each interviewee using a consent form (Appendix XII).

Issues associated with confidentiality and anonymity were also addressed as part of the informed consent process. The data collected for this study were treated with the strictest of confidence, only the researcher had access to the data and on completion of the study all audio-recordings will be deleted. The anonymity of all interviewees was protected as no individual names were disclosed at any point in the research. Each interview transcript was assigned a number which was used when presenting transcript quotations in the results section.

4.8 Data analysis

4.8.1 Document analysis

To establish the presence of both discipline specific and non-technical competencies with respect to research objective 1, the researcher conducted a conceptual analysis of the course outlines where the main focus was to look for the explicit occurrence of the concepts and competencies listed under these categories in the content. Coding for implicit occurrences and deciding on their level of implication is complicated as judgments will be based on a subjective system. The level of analysis decided upon was a basic unit of a single course outline that is fully representative of the entire undergraduate programme, the basis for this approach is that the larger the unit, the fewer units are required for analysis and the more meaningful the results. The number of concepts to code for was informed by a pre-defined set

of concepts and competencies in the respective categories, that is, twenty-one forestry subject areas and fifteen non-technical competencies. The process was inflexible because the researcher decided to only code from the pre-defined sets; no additional relevant categories were included in the sets as they were found in the content. Examining the content for very specific points meant that the researcher's focus would be kept on the task at hand. Having such a clearly defined focus meant that no time was wasted analysing unimportant aspects of the content, hence, all irrelevant information was disregarded.

A slight degree of flexibility was permitted during the process of deciding on the level of generalization. The concepts and competencies were predominantly coded exactly as they appear on the pre-defined sets with the exception of subtle differences in tense and spelling and the use of words or phrases which result in the same appearance but in different forms *i.e.* wood bio-fuel is a different form of forest bioenergy, non-timber forest products is a different form of non-wood products, ecosystem services is a different form of environmental services and so on. As briefly mentioned earlier, the researcher was coding for the existence of the concepts and competencies in the content, not for their frequency. This means that a very basic coding process was followed; each forestry subject area and non-technical competency was only counted once per course outline, no matter how many times it occurred.

4.8.2 Behavioural Event Interviews (BEIs)

Student BEIs were analysed thematically following a coding process, competencies were captured using the guidance of a coding template that was provided by the bigger global effort. The codes were abstracted using three different levels of analysis, namely, themes, codes and sub-codes. Only the codes for pre-defined competencies were captured, no additional codes were included in the sets as they were found in the transcripts. Again, examining the content for very specific things meant that the researcher's focus would be kept on the task at hand. The coding template was slightly revised in line with the objectives of this research. The transcripts were analysed line-by-line, not in sentence form and multiple codes were permitted for each line as suggested by Spencer and Spencer (1993). All the codes generated from each student's transcript were captured on an excel sheet and the codes for the three most frequent competencies under the two categories (success and failure) were noted.

The theory behind this approach follows that the competencies associated with an interviewee's success stories communicate differentiating characteristics while those that are

associated with their failures communicate threshold or essential characteristics for successful overall job performance (Campion *et al.,* 2011). Thus, success stories provide competencies attributed to those successes and in the case of failures, in all likelihood the competencies attributed to those failures were lacking in the event hence the end result was a failure. For example, If a student described an unsuccessful pathogen laboratory test on their transcript and mentioned something to the effect of “I should have been more accurate" in the process, (code: 3.2.2.l on the coding template), this is an indication that accuracy is a threshold competence for successful lab work. A copy of the coding template has been provided (Appendix XIII).

In addition to the visual examination of the excel sheet for the most frequent codes, the researcher was permitted to use their own judgment to decide which competencies also seemed important on the basis of the level of complexity at which they were displayed (Spencer and Spencer, 1993). This is because the relationship between the frequency of occurrence of a particular code and its importance is not one that necessarily goes hand in hand.

4.9 General limitations:

- The use of non-random sampling in all case studies means that the results of this research cannot be generalised. They do however; provide a clear picture of the different experiences and perceptions of stakeholders involved with tertiary level forestry education in South Africa.
- The sample population for student BEIs is limited in number not because of reasons associated with a lack of time or geographical dispersion but because of the low number of students undertaking forestry qualifications.

5. Results

5.1 Introduction

This section will present the results in the following order: first, the findings of the document analysis of course outlines. Followed by the findings of student Behavioural Event Interviews which were conducted to determine and compare the competency of students undertaking forestry and natural resources qualifications. Lastly, the findings of the gap analysis performed between forestry academic experts and employers. The gap analysis places South Africa's tertiary level forestry education system within the context of whether it fulfils the needs of the forestry sector in terms of the skills and knowledge required for successful overall job performance. In terms of this section, 'new graduates' are defined as students who have successfully completed undergraduate studies and have been awarded their first academic degree.

5.2 Objective 1: Document analysis

Table 4 compares the forestry subject areas explicitly addressed in programme course outlines of South African forestry institutions. All forestry experts previously indicated during the interview process that all twenty-one subject areas are covered in their department's programme, however, the results from the content analysis of the forestry programmes from NMMU, SUN and UV show that the programmes only cover 71.4%, 71.4% and 57.1% of the subject areas under investigation respectively (Table 4). The concepts of carbon sequestration, biodiversity and wildlife are lacking in at least two of the three course outlines provided. Interestingly, employers expressed a need for development in these concepts because from their perspective, new graduates underperform in these subject areas (Figure 5).

The analysis from the University of Venda identifies gaps because the programme's course outline provided inadequate information for the analysis of all thirty-six competencies under investigation. The modules offered under the university's BSc Agriculture (Forestry) programme are hosted in various departments; however, the course outline only contains summaries of the modules that are offered by the forestry department. Therefore their analysis is only based on the modules offered by the Department of Forestry, as a result, the presence of all the highlighted competencies is inconclusive and open to question.

Table 4: A comparison of the forestry subject areas explicitly addressed in programme course outlines across South African forestry institutions, n=3. Grey areas indicate information gaps resulting from the provision of course outlines that contain inadequate information.

✓ = Present ; × =Absent

Forestry subject areas	**NMMU**	**SUN**	**UV**
Forest bioenergy	✓	✓	
Environmental services	×	✓	
Forest products trade and marketing	✓	✓	
Forest economics	✓	✓	
Carbon sequestration	×	×	
Forest governance (incl. policy and legislation)	✓	✓	✓
Forest ethics and values	×	×	
Forest information systems (incl. GIS and RS)	✓	✓	✓
Non-wood products	×	✓	✓
Biodiversity	×	×	✓
Wildlife	×	×	✓
Forest ecology	✓	✓	✓
Genetics and breeding	✓	✓	
Forest planning	✓	✓	✓
Mensuration and inventories	✓	✓	✓
Forest soils	✓	×	
Forest health	✓	×	✓
Forest operations and technology	✓	✓	✓
Forest production and growth	✓	✓	
Silviculture	✓	✓	✓
Biology of trees (including physiology)	✓	✓	✓

Table 5 compares the non-technical competencies explicitly addressed in programme course outlines. The results show that NMMU covers 53.3%, SUN 73.3% and UV 40% of the fifteen non-technical competencies under investigation respectively (Table 5).

Table 5: A comparison of the non-technical competencies explicitly addressed in programme course outlines across South African forestry institutions, n=3. Grey areas indicate information gaps resulting from the provision of course outlines that contain inadequate information.

Non-technical competencies	**NMMU**	**SUN**	**UV**
Written communication skills	✓	✓	✓
Oral presentation skills	✓	✓	✓
Computer literacy	✓	✓	✓
Proficiency in English	×	×	✓
Ability to plan and execute tasks independently	×	×	
An appropriate approach to problem solving	×	✓	
Negotiation and mediation skills	✓	✓	
Creativity and innovation	×	✓	
Contribution to teambuilding and work	✓	✓	
Leadership ability	✓	✓	
Ability to network	×	×	
Understanding of economic and business realities	✓	✓	✓
Critical and analytical ability	×	✓	
Enquiry and research skills	✓	✓	✓
Interest in ideas and desire to continue learning	×	×	

Table 6 shows the forestry subject areas that natural resources experts indicated as covered in their department's selected natural resources programme. According to their expert opinions, the curriculum of the natural resources programme offered by SUN, UV and UKZN has a subject area overlap of 29%, 24% and 19% with the forestry competencies under investigation respectively. All three institutions indicated that their programme covers the concepts of environmental services, carbon sequestration and biodiversity.

Table 6: Forestry subject areas covered in natural resources programmes, n=3.

Forestry subject areas	**SUN**	**UKZN**	**UV**
Forest bioenergy			
Environmental services	✓	✓	✓
Forest products trade and marketing			
Forest economics			
Carbon sequestration	✓	✓	✓
Forest governance (incl. policy and legislation)			
Forest ethics and values			
Forest information systems (incl. GIS and RS)		✓	
Non-wood products			
Biodiversity	✓	✓	✓
Wildlife	✓		✓
Forest ecology	✓		
Genetics and breeding			
Forest planning			
Mensuration and inventories			
Forest soils			
Forest health			
Forest operations and technology			
Forest production and growth			
Silviculture			
Biology of trees (including physiology)	✓		✓
Total selected	**6**	**4**	**5**

However, the results from the content analysis show that SUN's BSc Conservation Ecology (B.Sc.ConsEcol) programme explicitly addresses only four of the six subject areas, compared to the selected 29%; this resulted in a lower overall score of 19%. The University of Venda's results show a drastic overall decrease from a score of 24% to 4.8%, only one of the five subject areas selected is explicitly addressed in their BSc Environmental Sciences (BEnvSc) programme. With regard to non-technical competencies, SUN and UV explicitly address 13.3% and 53.3% of the fifteen competencies respectively.

The modules offered under SUN's B.Sc.ConsEcol programme and UV's BEnvSc programme are hosted in various departments and both course outlines only contain summaries of the modules offered by the departments administering the programmes, that is, the Department of Conservation Ecology and Entomology and the Department of Ecology and Resource Management respectively. Consequently, this result is only based on the core and compulsory modules distributed over the 4 (SUN) and 3 (UV) years of undergraduate study for all students registered for these degree programmes. The University of Kwa-Zulu Natal was

eliminated from the content analysis because the documents provided for its BSc Environmental Sciences programme contained inadequate information.

5.3 Objective 2: Behavioural Event Interviews (BEIs)

Across all four institutions and both curriculum structures, the gender profile is slightly skewed towards female students where they make up 52% of the sample while male students only 48%. It is satisfying to see that women are adequately represented and have opportunities to get empowered in the field of natural sciences. Ethnic group representation in the sample is made up of 82% Black, 12% White, 3% Coloured and 3% Indian students. The marital status of all interviewed students is single which is not surprising because 97% of them are between the age of eighteen and twenty-four.

Students displayed an outstanding performance in the behaviours noted during the interviews. They averaged well above 80% in six of the seven positive performance indicators: (1) body language, nonverbal cues and use of eye contact, (2) candidate was polite and well-mannered to the interviewer, (3) candidate's demeanour was assertive, confident and focused, (4) candidate arrived to the interview on time with time to spare, (5) candidate was dressed appropriately for an interview setting and (6) candidate appeared to show genuine interest and enthusiasm for the role. In contrast, only 59% answered comprehensively and coherently, the remaining 41% performed below acceptable standards in answering competency based questions, their answers were very limited. This result indicates a need to develop oral communication skills.

Almost all of the competencies coded are non-technical. Discipline-specific competencies are very small in number that they are not considered in these results. Table 7 is a summary of the results obtained from students undertaking forestry qualifications. The three most important differentiating characteristics from success stories are leadership ability (3.2.2.c), education, training and supervision (3.2.1.d) and financial planning and budgeting (3.2.2.a). Overall, success stories were driven by competencies under the theme of Leadership and management skills. From stories of failure, accuracy and diligence (3.2.2.l), time management (3.2.2.e) and communicating in mother tongue (3.2.3.d) are the most essential characteristics for successful overall performance. Overall, failure stories were driven by competencies also under the theme of Leadership and management skills.

Table 7: Summary of all the important non-technical competencies coded from BEIs with students undertaking forestry qualifications, n=19.

Success	Frequency	Failure	Frequency
3.2.2.c Leadership ability	7	3.2.2.l Accuracy and diligence	2
3.2.1.d Education, training and supervision	6	3.2.2.e Time management	2
3.2.2.a Financial planning and budgeting	5	3.2.3.d Communicating in mother tongue	2
3.2.1.f Networking	4	3.2.1.b Teamwork and social	1
3.2.3.c Oral communication	3	3.2.1.c Organization and co-ordination	1
3.2.2.l Accuracy and diligence	2	3.2.1.d Education, training and supervision	1
3.2.1.b Teamwork and social	1	3.2.1.g Other	1
3.2.1.c Organization and co-ordination	1	3.2.2.a* Financial planning and budgeting	1
3.2.2.i Resistance to pressure	1	3.2.3.a Information Technology (IT)	1
3.2.3.d Communicating in mother tongue	1	3.2.3.c Oral communication	1
		3.2.4.a Information processing skills	1

*Competencies that may be assigned higher-priority on the basis of the level of complexity at which they were displayed.

Generally, students conveyed positive feelings in success stories and they were credited to a variety of learning experiences:

"Being chosen to go represent South Africa in Russia was the biggest success of my life because I proved to myself that I am worth something." Respondent 7

"Going to Germany, I got selected." Respondent 15

"I wasn't accepted any university, I was contacted late in the year, it is by actual luck that I am actually enjoying what I'm doing now." Respondent 19

"I didn't imagine myself completing this degree because the first time when I attended my classes, I was so bored; I didn't understand and I wanted to quit forestry. When I chose this career, I didn't know what was going on, I didn't do research. But then I started going into the field last year, getting exposure and now that I understand what it is all about, I am starting to enjoy it. I am proud that I didn't quit." Respondent 10

Negative feelings were also generally conveyed in failure stories and were also credited to a variety of learning experiences:

"In high school, I had zero commitment so when my results came out; I knew that I could've done better." Respondent 11

"I failed two modules last semester, it was the worst semester." Respondent 14

"The first time I failed a module at university was this year, Genetics." Respondent 16

"I like forestry very much but I was supposed to go to study something in the Faculty of Health at another university. Forestry was my second option. Due to the lack of information, I only applied to one institution." Respondent 1

"I failed to do the degree I wanted to do. I was supposed to do engineering, I really worked so hard to qualify for the degree programme but I never made it because of the financial challenges I had as a non-South African citizen." Respondent 6

"I didn't want to pursue a career in the forestry sector, I wanted to do engineering. My matric results forced me into forestry so that at the end of the day I would have a qualification. However, over the years things have changed, I love it now" Respondent 8

"I regret doing this degree because I feel like I have wasted my time." Respondent 17

"I really wanted to go study dentistry and I didn't get accepted." Respondent 18

Table 8 is a summary of the results obtained from students undertaking natural resources qualifications. The three most important differentiating characteristics from success stories are accuracy and diligence (3.2.2.l), Teamwork and social interactions (3.2.1.b) and Education, training and supervision (3.2.1.d). Again, success stories were more driven by competencies under the theme of Leadership and management skills. From stories of failure, resistance to pressure (3.2.2.i), time management (3.2.2.e) and the ability to take initiative (3.2.2.j) are the most essential characteristics for successful overall performance. Overall, failure stories were driven by competencies also under the theme of Leadership and management skills.

Table 8: Summary of all the important non-technical competencies coded from BEIs with students undertaking natural resources qualifications, n=14.

Success	Frequency	Failure	Frequency
3.2.2.l Accuracy and diligence	2	3.2.2.i Resistance to pressure	5
3.2.1.b Teamwork and social	1	3.2.2.e Time management	1
3.2.1.d Education, training and supervision	1	3.2.2.j Initiative	1
3.2.1.f Networking	1	3.2.2.l Accuracy and diligence	1
3.2.2.a* Financial planning and budgeting	1	3.2.2.m* Other (ability to adapt)	1
3.2.2.c Leadership ability	1	3.2.3.g Communicating in an international language	1
3.2.2.e Time management	1	3.2.4.f Ability to plan and execute tasks independently	1
3.2.2.i* Resistance to pressure	1		
3.2.3.d Communicating in mother tongue	1		
3.2.3.f Communicating in English	1		

*Competencies that may be assigned higher-priority on the basis of the level of complexity at which they were displayed.

In success stories, students generally conveyed positive feelings that leaned more towards academic achievements:

"Passing my grade twelve with a bachelor was a success." Respondent 23

"Finishing my degree is a success because it was very hard." Respondent 26

"Getting into Honours and being a Golden Key member." Respondent 31

By the same token, students generally conveyed negative feelings that also leaned more towards academic failures:

"In 2015 I failed two modules." Respondent 26

"I haven't done my best in certain modules like GIS because I don't like it and a failure for me is that when I don't like a module I don't put as much effort as I should." Respondent 29

"I failed my first year; it was a huge failure because I had to repeat." Respondent 32

Top performing students make up only 14% of the natural resources sample while they make up only 37% of the forestry sample size. In accordance with Hooghiemstra (1992) the desired minimum of top performers in a sample is 60%; therefore, analysis of differentiating and essential competencies in success and failure stories respectively between top performing

students and average performing students from both natural resources and forestry is not attainable in this context. Hooghiemstra (1992) continues to explain this prerequisite by stating that we are able to learn more about differentiating competences only from top performing individuals. Therefore, having sample sizes skewed towards average performing students may be the reason why no clear patterns emerged in the most important competencies between top performing students and average performing students from natural resources and forestry in this study.

5.4 Objective 3: Gap analysis

Table 9 and 10 show the importance ratings assigned by forestry experts to forestry subject areas and non-technical competencies respectively. The differences between subject area importance scores in Table 9 show that of the twenty-one areas evaluated, 51% received the same importance score across all three institutions, 40% received the same importance score from at least two institutions and only 5% received different importance scores from all institutions. In addition, the importance scores assigned to non-technical competencies (Table 10) show that of the fifteen competencies, 60% received the same importance score from at least two intuitions, 33% received the same importance score across all three institutions and 7% received different importance scores from all institutions. Compared to forestry subject areas, these percentages express an overall increase in the different perspectives held by academic experts towards non-technical competencies. Their responses entirely agreed for only 33% of the non-technical competencies compared to the 51% obtained by forestry subject areas.

Table 9: A comparison of the importance ratings assigned to forestry subject areas across South African forestry institutions, n=3.

NMMU **SUN** **UV**

	Importance Rating Scale				
Forestry subject areas	**Not relevant**	**Highly marginal**	**Relevant**	**Definitely important**	**Vital Importance**
Forest bioenergy					
Environmental services					
Forest products trade and marketing					
Forest economics					
Carbon sequestration					
Forest governance (incl. policy and legislation)					
Forest ethics and values					
Forest information systems (incl. GIS and RS)					
Non-wood products					
Biodiversity					
Wildlife					
Forest ecology					
Genetics and breeding					
Forest planning					
Mensuration and inventories					
Forest soils					
Forest health					
Forest operations and technology					
Forest production and growth					
Silviculture					
Biology of trees (including physiology)					

Table 10: A comparison of the importance ratings assigned to non-technical competencies across South African forestry institutions, n=3.

Competency	Importance Rating Scale				
	Not Relevant	**Highly Marginal**	**Relevant**	**Definitely Important**	**Vital Importance**
Basic skills and understanding					
Written communication skills				☝	☝☝
Oral presentation skills			☝		☝☝
Computer literacy				☝☝	☝
Proficiency in English			☝	☝	☝
Workplace skills and applied knowledge					
Ability to plan and execute tasks independently					☝☝☝
An appropriate approach to problem solving				☝	☝☝
Personal and interactive skills					
Negotiation and mediation skills			☝	☝	☝
Creativity and innovation			☝	☝	☝
Contribution to teambuilding and work				☝☝	☝
Leadership ability				☝	☝☝
Ability to network			☝	☝	☝
Knowledge and intellectual ability					
Understanding of economic and business realities				☝	☝☝
Critical and analytical ability			☝	☝	☝
Enquiry and research skills			☝		☝☝
Interest in ideas and desire to continue learning			☝☝		☝

From figure 2 to figure 7 below, the sample size is twelve (n=12) because a total of 12 participants (employees) representing 8 organizations (employers) were interviewed. The ideal scenario was to interview more than one individual from each organization, this approach would provide a more holistic view of the organization compared to obtaining all the information from an individual.

Figure 2 and 3 compare the importance ratings assigned by employers to forestry subject areas and non-technical competencies respectively. These ratings were assigned according to the importance of each competency for the employment of graduates in industry. In a

question where employers were asked how important having broad knowledge of the field of forestry is in their organization, 87.5% said very important while only 12.5% said not important. Interestingly, this preference is apparent in Figure 2 where they evaluated forestry subject areas; over 70% of employers in industry regard the importance of nineteen of the twenty-one subject areas between relevant and vitally important for successful overall job performance. The two exceptions are non-wood products (50%) and wildlife (67%). Figure 3 communicates the significance of non-technical competencies to a forester's job performance. Written communication skills, oral presentation skills and computer literacy are regarded as vitally important for successful overall job performance. Finally, one of the directions in which the roles of foresters are changing (Table 11) is highlighted by the fact that 75% of employers consider the understanding of economic and business realities as definitely important for successful overall job performance.

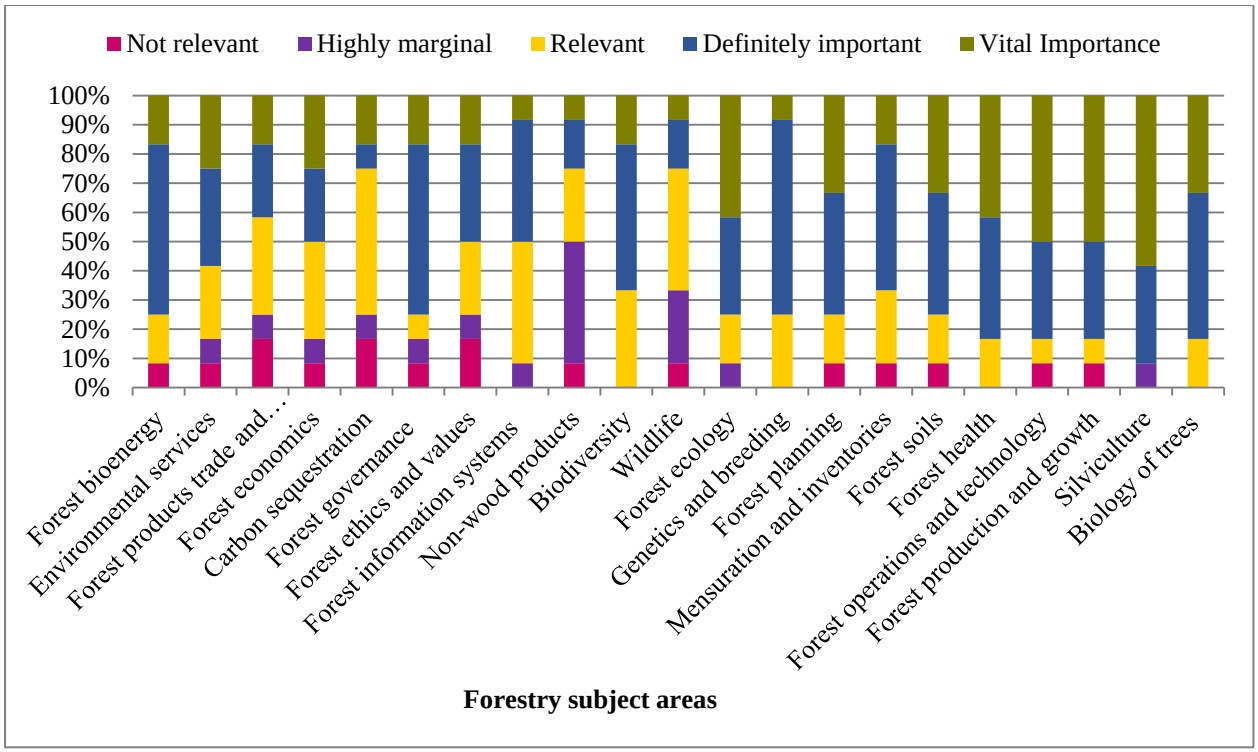


Figure 2: A comparison of the importance ratings assigned to forestry subject areas by different employer categories in the forestry sector, n=12.

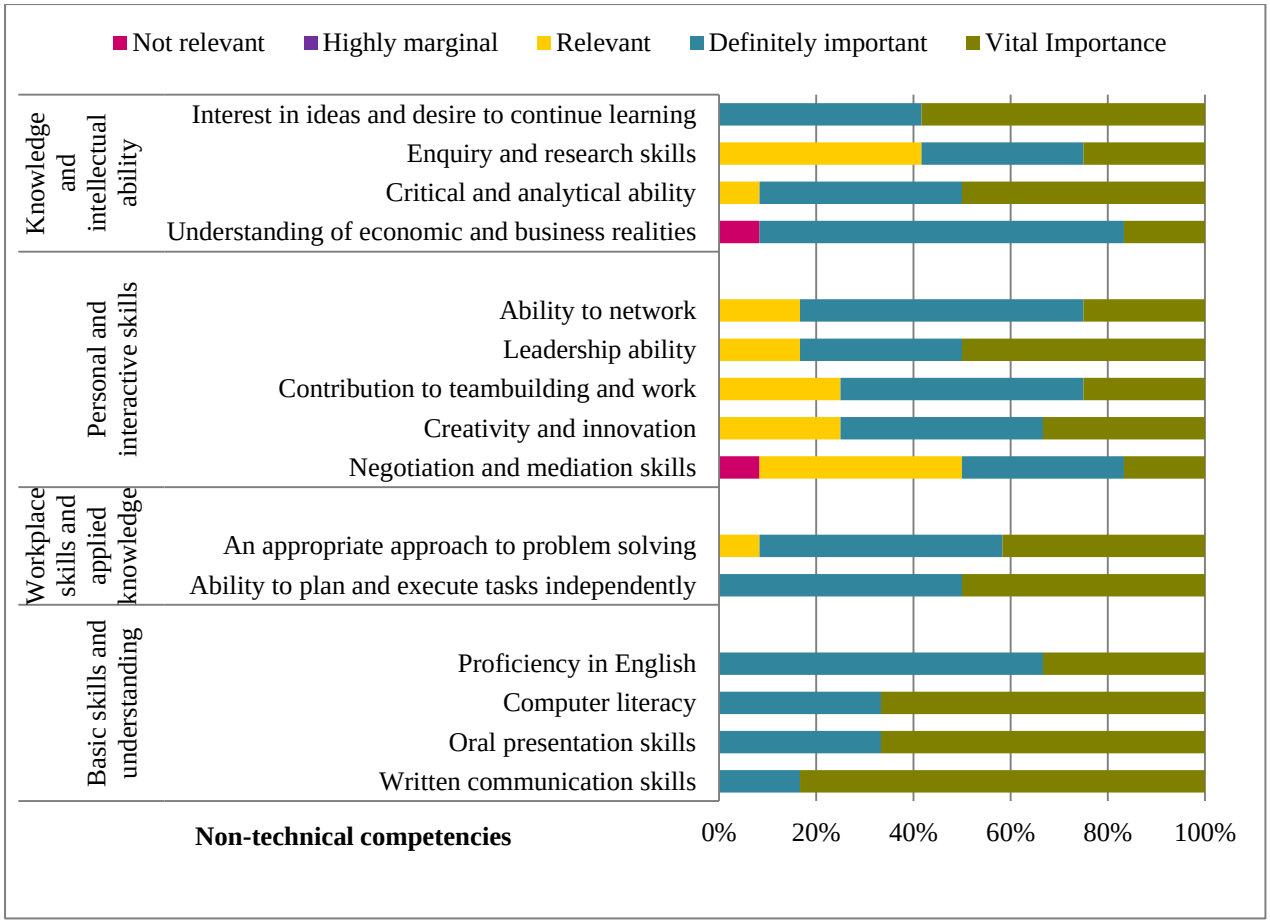


Figure 3: A comparison of the importance ratings assigned to non-technical competencies by different employer categories in the forestry sector, n=12.

Figure 4 compares the level of development achieved by new graduates in non-technical competencies between forestry experts and employers. Employers scored new graduates at a higher level in basic skills and understanding and knowledge and intellectual ability competencies, with the exception of understanding of economic and business realities. Similarly, experts scored new graduates at a higher level in workplace skills and applied knowledge and personal and interactive skills competencies. Computer literacy (77.1 %), contribution to teambuilding and work (71.7%) and proficiency in English (69.7%) are regarded as highly developed competencies across both sampled groups.

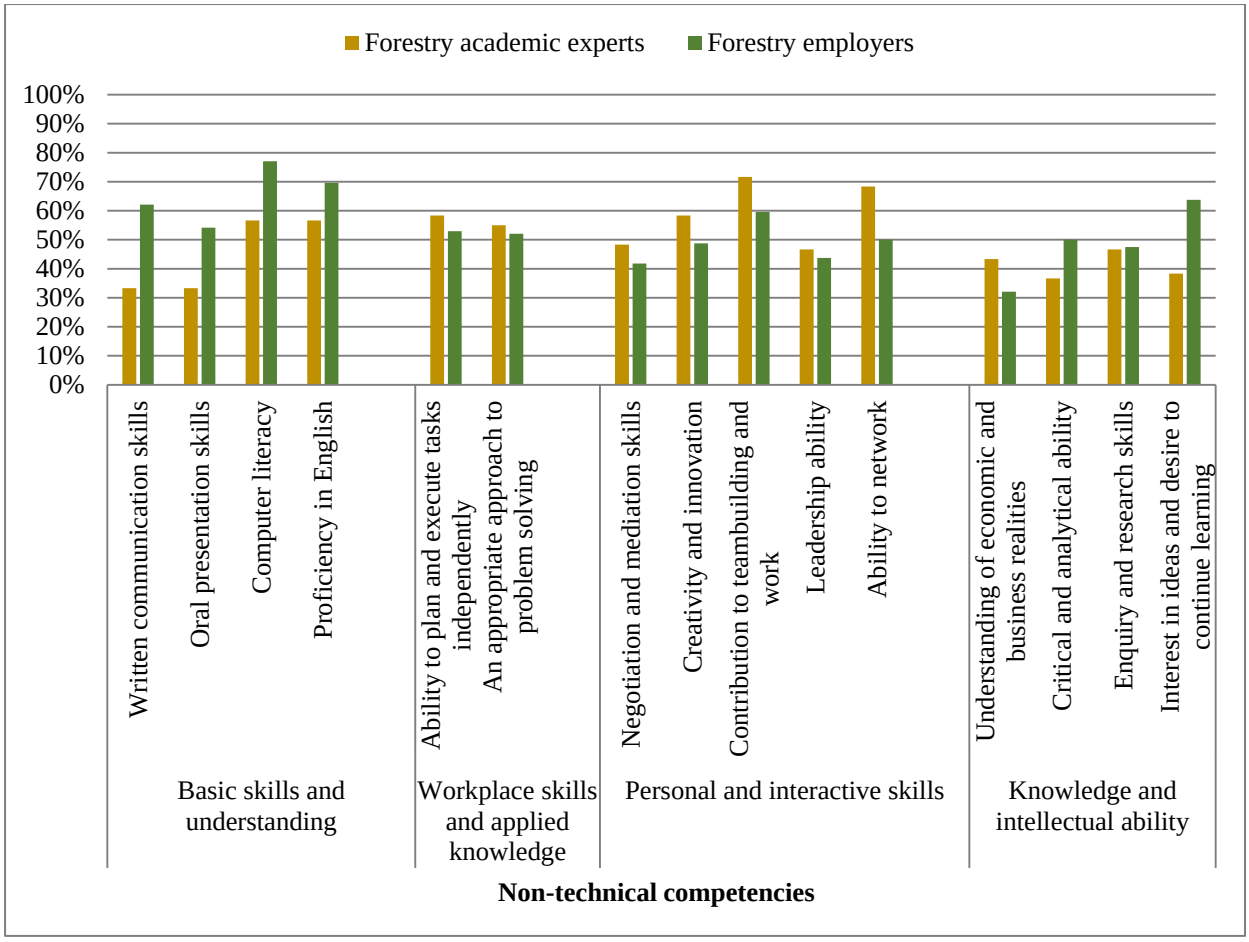


Figure 4: A comparison of the perceived level of development achieved by new graduates in non-technical competencies between forestry experts (n=3) and employers (n=12).

Figure 5 compares the level of development achieved by new graduates in forestry subject areas between forestry experts and employers. On the whole, employers tended to score new graduates at a higher level compared to experts, with the exception of carbon sequestration (35%), wildlife (42.5%), forest bioenergy (45.7%) and biodiversity (47.5%). From employers' perspectives, new graduates underperform in these areas. The traditional forestry competencies which received the highest levels of competence across both sampled groups are silviculture (75.7%), forest operations and technology (73.6%) and forest production and growth (70%). These competencies were also regarded as vitally important for successful overall job performance (Figure 2).

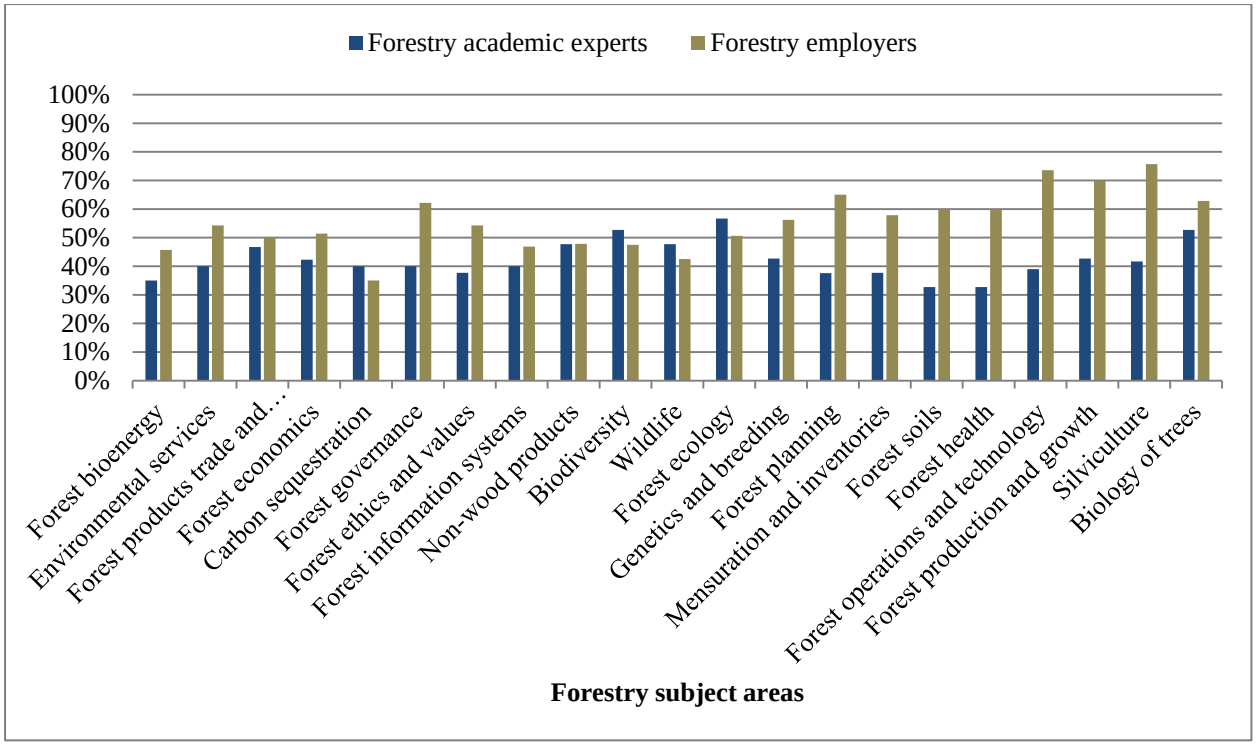


Figure 5: A comparison of the perceived level of development achieved by new graduates in forestry subject areas between forestry experts (n=3) and employers (n=12).

Across all employer categories, the importance of traditional forestry competencies such as silviculture (4.4), forest health (4.3), forest operations and technology (4.2) and the biology of trees (4.2) was relatively high (Figure 6). However, the competencies given the highest ratings were written communication skills (4.8), oral presentation skills (4.7) and computer literacy (4.7) (Figure 7). Also, having an interest in ideas and desire to continue learning (4.6) and the ability to plan and execute tasks independently (4.5) were given higher ratings compared to traditional forestry competencies (Figure 6). The emphasis placed on non-technical competencies resonates with previous other studies in forestry education (Sample *et al.*, 1999). Employers' ratings reveal that they are moderately pleased with the overall performance of graduates they have recruited in previous years. This is evident in that there are gaps between employers' importance ratings and their ratings of new graduates' performance for all thirty-six competencies under investigation. The biggest gaps lie in understanding of economic and business realities (2.3), leadership ability (2.1) and oral presentation skills (2.0) (Figure 7).

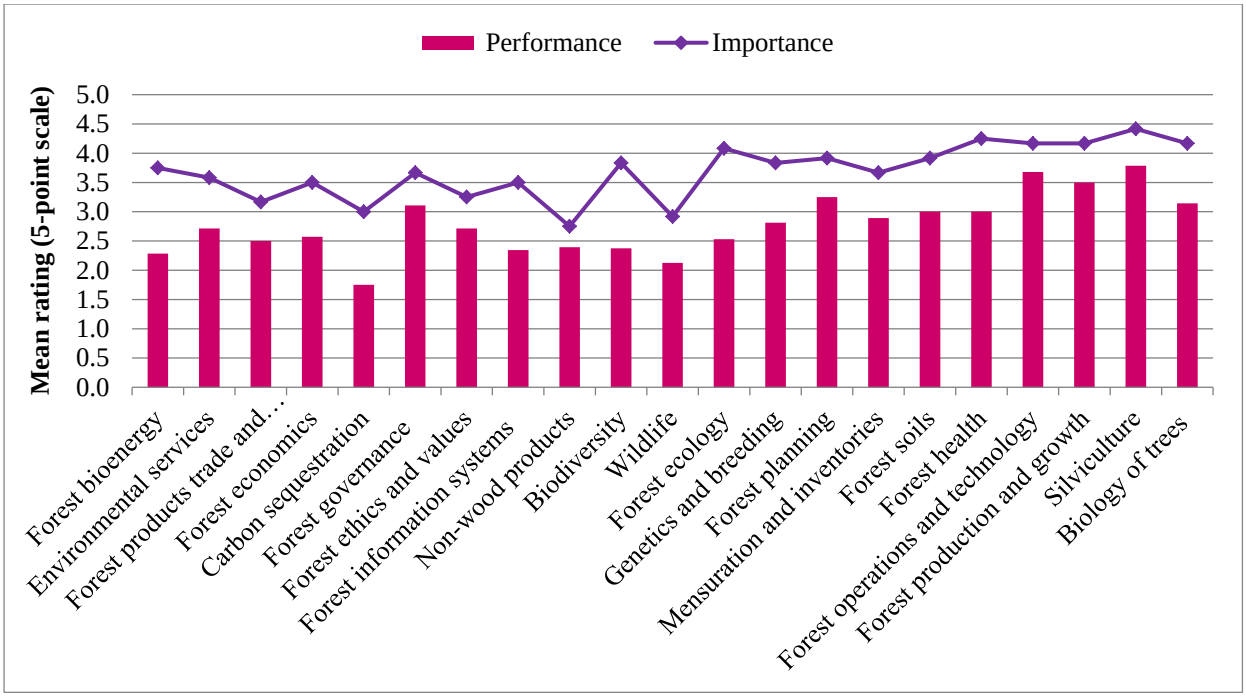


Figure 6: Employers' ratings of the importance of forestry subject areas needed for successful overall job performance versus the performance of new graduates, on a scale of 1-5, n=12.

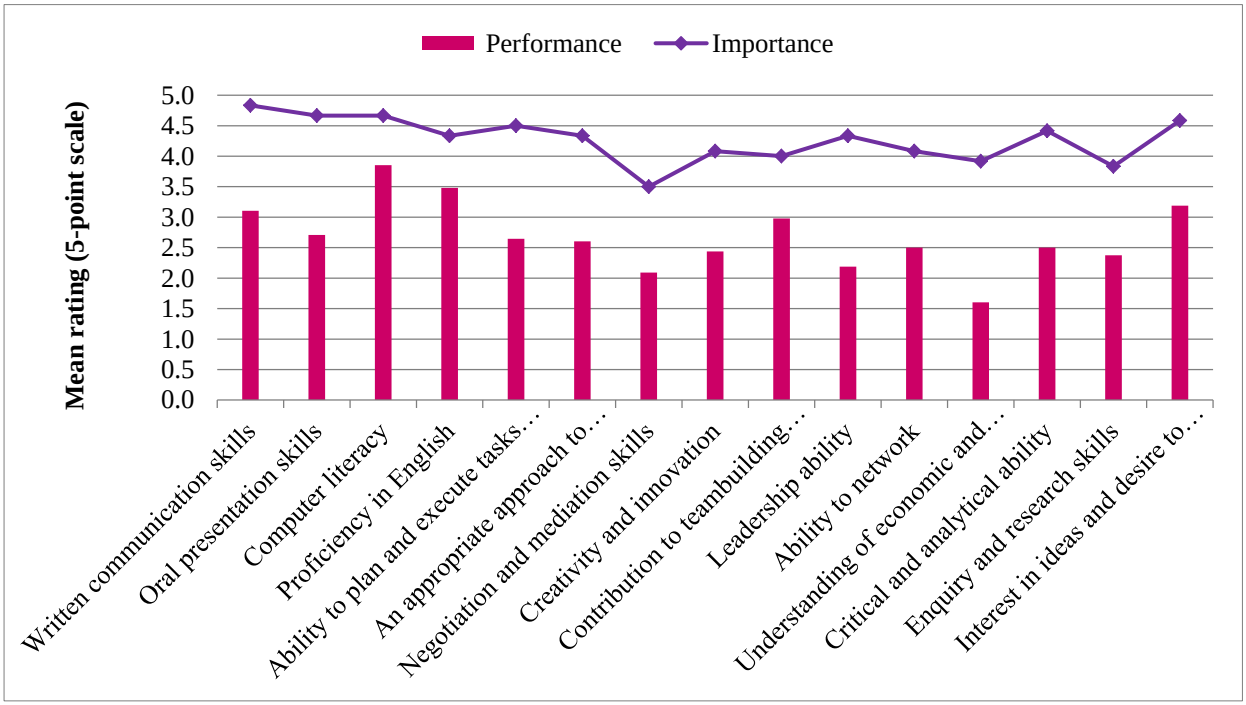


Figure 7: Employers' ratings of the importance of non-technical competencies needed for successful overall job performance versus the performance of new graduates, on a scale of 1-5, n=12.

Graduate employment

Two employer categories, a consultant and a research institution were eliminated from this result because they do not recruit graduates in their organizations. One is independent and the other is focused on post-graduate research in various disciplines in natural sciences respectively. In a question permitting multiple selections, employers expressed their institutional preferences for the forestry graduates they employ into their organizations (Figure 8). NMMU and SUN received an equal preference of 83.3%; this preference may be extrapolated as far as that most of the graduates employed in the industry come from these two institutions. This statement is further supported by the fact that both sampled groups listed almost half of the employers in this study's sample as part of the top five employers of South Africa's forestry graduates. The University of Pretoria is the only institution which consistently appeared in the "Other" category.

In another question that also permitted multiple selections, employers indicated the degree (s) that majority of the graduates they recruit hold. The results show that 66.7% of the graduates employed in industry hold different degrees from the ones that were provided as options, these include MSc or PhDs in disciplines such as agriculture and forestry, social sciences degrees such as a BA in environmental management as well as degrees in the education sector.

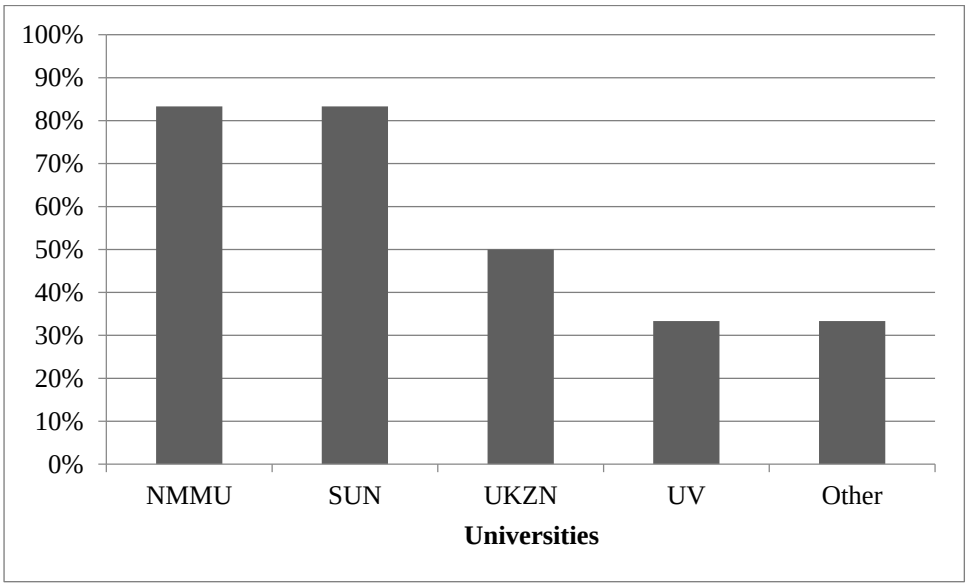


Figure 8: Employers' institutional preferences for the forestry graduates they employ, n=6.

Finally, half of the employers think that the graduates they get from South Africa's forestry education system are well equipped for the workplace. Thirty-three percent (33.3% to be

exact) felt that they generally experience both of the options provided. On the yes side, graduates are well educated on forestry subject areas, however, on the no side, it is because of the lack of experience:

"It is usually to do with the gap between the academic world and the realities of the workplace and working environment. To strengthen the transition process, the organisation must provide suitable support structures and at times mentorship programmes to facilitate the transition." Non-governmental organization representative

The remaining 16.7% think that graduates are not at all equipped for the workplace:

"Most of them struggle to express themselves and what they have learnt at university during their interviews. When you ask them environmental related questions some of them find it difficult to explain the concepts. Once they've been accepted into our programme, in terms of skills, I think they lack interpersonal skills. Their main problem is with soft skills." Government department representative

The changing role of foresters

The most frequently reported changes in the roles of foresters are listed in their order of popularity in Table 11. There is a consensus that foresters are currently assuming important socio-economic roles which were evident in employers' appreciation of the new directions the forestry industry is taking. In the context of South Africa, there is a general shift towards non-core activities such as social forestry, entrepreneurship and business management. Forestry experts reported that they are continuously making efforts to integrate industry changes in core modules and in other instances by introducing them in additional modules as electives.

Table 11: Changes in the roles of foresters between forestry experts (n=3) and employers (n=8).

Sample	Changes in the roles of foresters
Forestry experts	• Concepts of Sustainable Forest management • Social forestry Foresters need to be able to collaborate with communities • Competence in certification and legislation • Emphasis on entrepreneurship and business management as a result of outsourcing • Emphasis on communication skills, emotional intelligence, and ethics and values to deal with conflict resolution between stakeholders
Employers	• Most companies have transferred operational responsibilities to contractors Foresters more involved with supervising and managing contractors rather than operations on the plantation Negotiation skills critical as a result • Social forestry becoming increasingly important with changing land ownership Objectives of community management shifting in the direction of Community Based Natural Resource Management (CBNRM) • Legislation and policies are beginning to emphasize concepts such as climate change in forestry As a result, foresters are now expected to understand and integrate the impacts of climate change on South Africa's forestry industry Nowadays, especially in big corporates, the freedom of a forester is severely restricted within certain rules and regulations provided by the head office • Lifelong learning is becoming increasingly important as a lot of change is happening continuously in the industry Forestry as a profession needs to grow in this regard and foresters also need to update their knowledge

Resources, facilities and funding

The availability of resources, facilities and funding differs from one institution to another (Table 12). Library teaching materials and current publications are the only aspects that all institutions said are adequate in their forestry departments. Almost all of NMMU's resources, facilities and funding are adequate; in contrast, almost all of the aspects were reported as inadequate by UV. The financial situation for South Africa's tertiary level forestry education system is generally dire because national and donor financial support is inadequate (Temu *et al.*, 2005).

Table 12: Availability of resources, facilities and funding by institution, n=3.

✓ = Adequate ; ×= Inadequate

Aspect	NMMU	US	UV
Academic staff	✓	×	×
Support staff	✓	×	×
Library teaching materials	✓	✓	✓
Laboratories, equipment	✓	✓	×
Field training sites	✓	×	×
Current publications	✓	✓	✓
National financial support	×	×	×
Donor financial support	✓	×	×

Priority needs

The priority needs most frequently reported across forestry departments are:

1. Teaching and support staff

Appointment of full-time and part-time (inclusive of industry) staff

2. Field training sites

More support required for student placements and establishment of facilities such as a nursery centre

3. Budget improvement

Institutions are restricted by an inadequate operational budget

Enrolment trends

Enrolment is significantly increasing in the diploma programmes offered by NMMU and SUN, according to expert opinion, this can be attributed to forestry becoming a popular career choice amongst previously disadvantaged groups and the interest of non-forestry students to acquire forestry qualifications. In the degree programmes, enrolment numbers are stable both at SUN and NMMU as a result of capping. NMMU's BTech has become a popular choice for foresters because it enables them to occupy middle level management positions in industry and it also gives students the opportunity to specialize in clearly defined areas within forestry. In contrast, UV reported an increase in enrolment for its degree programme. This increase could potentially be attributed to an increase in the availability of forestry bursaries for students over the years as well as previous graduates increasing the profile of the institution as one of the providers of tertiary forestry qualifications. During the

time this research was conducted, the low student numbers in the selected forestry qualifications combined with the information provided on the number of forestry graduates in these programmes for the past ten years indicate that whilst the enrolment numbers are either stable or increasing, but relative to other courses, they are very low. For example, at SUN, the average for final year enrolment between 2009 and 2015 (7 years) in the BSc Forestry and Natural Resource Sciences is 13 while the average for the BSc Conservation Ecology is 30.

6. Discussion

6.1 Introduction

The aim of this research was to provide a baseline study that will highlight the range and improve our understanding of forestry education programmes in South African tertiary institutions. The objectives of this study were to:

1) Review forestry education programmes by analysing secondary documents.
2) Conduct Behavioural Event Interviews (BEIs) to determine the competency of undergraduate students acquiring forestry qualifications.
3) Conduct a Gap Analysis to determine whether the needs of the forestry sector are being met by the forestry education system.

This section will discuss the findings of this research, within the context of the presented literature and offer conclusions based on the findings. Recommendations on future research directions will also be discussed.

6.2 Bridging the gap through curriculum development

The results obtained from the content analysis of this research manifested some of the prevalent issues associated with forestry curriculum design. Firstly, social sciences is growing in importance in the field of forestry and undoubtedly, South Africa's current forestry context calls for social sciences as one of the fundamental requirements to a holistic understanding of the links between nature and society. An example of this is that it has been over two decades since the new areas of afforestation in South Africa's Eastern Cape and KwaZulu-Natal Provinces were declared. However, the delays in the introduction of the 100 000 hectares of new afforestation is partially a consequence of the lack of capacity in social sciences. The impacts of the country's changing socio-political landscape on the forestry sector have increased society's awareness of the importance of water conservation. This conservation pressure has resulted in the protection of wetlands and catchment areas which in turn is partly responsible for the overall reduction in total plantation area. The contested spaces between conservation initiatives and commercial forestry plantations require foresters who are able to evolve into a broader perspective by applying certain knowledge and skills that might have not been imparted during their training. Additionally, employers generally expressed a development need in concepts of carbon sequestration, biodiversity and wildlife

because according to them, new graduates underperform in these subject areas. This brings up the subject of the disciplinarity of forestry as a profession as opposed to more interdisciplinary studies where in addition to modules that have their foundations in the discipline of forestry, other natural sciences should be considered in curriculum design (Manning, 1998).

Building on from the idea of considering social and other natural sciences in the forestry curriculum, forestry employers have acknowledged that foresters are currently assuming important socio-economic roles, there is a general shift in the profession towards non-core activities such as social forestry, entrepreneurship and business management. From the perspective of employers, out of the thirty-six competencies which were investigated, the biggest gaps were observed in the understanding of economic and business realities, leadership ability and oral presentation skills. Data showed that a modern day forester is expected to collaborate with communities, manage conflict between the continuously expanding number of stakeholders that need to be engaged in the forestry sector, supervise and manage contractors and manage a business from an entrepreneurship perspective as a result of companies outsourcing operational responsibilities to contractors. With this in mind, the very same three competencies where the biggest gaps were observed are the basis of these "know hows" which are important for successful overall job performance. Consequently, the researcher is convinced that a higher level of integration of social sciences in forestry curricula is pivotal to resolving some of the challenges facing the forestry industry (Manning, 1998; Sample *et al.,* 1999).

6.3 Confronting the challenges of curriculum development

In contrast to the idea of considering social and other natural sciences in the forestry curriculum, the perspective of breadth versus depth becomes very important because the ever-increasing number of subject areas recommended for inclusion within the curricula of a 3-4 year degree programme poses serious challenges to forestry departments and the professional integrity of forestry qualifications (Manning, 1998). Moreover, in the absence of a global advisory function in forestry education, it is not surprising that forestry institutions are unsure on how to integrate emerging global environmental issues such as the Sustainable Development Goals (SDGs) and climate change into their curricula (Temu and Owgeno, 2007). In addition to the lack of guidance from a global advisory function, South African forestry institutions are experiencing declining capacity in various degrees. For example,

almost all of NMMU's resources, facilities and funding are adequate; in contrast, almost all of these aspects were reported as inadequate by UV. This result challenges the idea of expanding the diversity of curricula under the current financial pressures that forestry institutions are operating, however, it would be easier for an institution like NMMU to implement change relative to SUN and UV which are more in need of resources, facilities and funding. In addition to having resources, facilities and funding that are almost adequate, NMMU also has the highest enrolment numbers. Despite the fact that the institution is also operating on an inadequate budget, its problems are compounded by the difficulty involved with maintaining a programme with enrolment numbers that are adequate compared with very low numbers at SUN and UV.

6.4 The importance of explicitly specifying desired learning outcomes and course content

Conducting the content analysis of this research was challenging mainly because of the institutional structures of South Africa's forestry education system. The modules offered under the programmes investigated in this research are hosted in various departments that are related to the discipline of forestry such as agriculture, natural resource management and conservation ecology to name a few. As a result of these structures it was difficult to establish from the content analysis whether the module summaries provided reflect the course content in a basic sciences and introductory context (first 1-2 years of study) or forestry context. Being able to differentiate the latter context from the former context in formal documents like course outlines is very important especially for independent parties and review committees because it will assist them to unambiguously assess whether a course is meeting its intended purpose. If all modules offered under the programmes investigated in this research were hosted in fully-fledged forestry faculties, I would have no doubt that the modules are packaged purely in a forestry context. In other words, it stands to reason that if a programme is interdepartmental; its modules could potentially be positioned in the context of the related disciplines. This raises the important question of how forestry education can package its programmes with the most suitable content rather than overloading its programmes with counterproductive modules.

6.5 The need for stronger national collaboration between forestry education programmes

While forestry institutions are generally operating under declining capacity on one hand, this research shows that there is a lack of inter-institutional links on the other. For better use of scarce resources such as expertise, I strongly support the expansion of inter-

institutional links. An example of an aspect that illustrates the importance of inter-institutional links follows that in addition to UV competing with NMMU and SUN, two well-known institutions that have undergraduate forestry training records that speak for themselves, its geographical location significantly constrains the institution from opportunities. With this in mind isolationist attitudes should strongly be discouraged, ideally, forestry institutions should actively engage one another more within their circle as capacity builders.

As the last institutions to be profiled among providers of tertiary forestry qualifications, it has not been easy for UV and UKZN to maintain this status hence the termination of the qualification in UKZN in 2010. This background further explores the importance of partnerships. In addition to the idea of forestry institutions engaging one another, the role of forestry employers through supporting joint ventures and collaboration with them is equally as important. However, they should not adopt the academic functions or training responsibilities of Universities because this will compromise the objective of building capacity within forestry education and training Universities (Legilisho-Kiyiapi, 2004).

6.6 Students' motivations for choosing forestry as a field of study

The results of this research showed that a significant number of students enrolled in tertiary level forestry qualifications are there for many reasons other than wanting to become foresters; this group of students were not attracted to forestry because they particularly enjoy working with nature and the environment. They entered the forestry profession only after they were turned down as prospective students in other fields, predominantly in medicine and engineering. From a substantial amount of research conducted on tertiary level forestry education, this result was expected and it is consistent with the findings of many studies conducted on this topic; Africa and Europe have been struggling to attract quality students into their forestry programmes (Miller, 2004; Temu and Ogweno, 2007). Students from these regions seldom regard forestry as a profession that can sustain their livelihoods.

The truth that a significant number of forestry applicants are students that have been turned down by other fields and lack the desired motivation to pursue forestry as a profession is a serious cause for concern. On the contrary, forestry institutions may regard this as an opportunity rather than a hurdle; institutions could adopt a proactive approach where they raise the profile and value of forestry qualifications to these unsure students. Additionally, this could potentially improve their motivation, change their negative perceptions of forestry

over time and as a result minimise dropout rates in programmes with enrolment numbers that are very low (Arevalo *at al.,* 2010). There is a need to improve the profile of forestry education and the profession at a national scale.

Pursuing this further, out of the modest enrolment numbers, some students have not changed their negative perceptions about the value of their forestry qualification over time. The former is evident from the Behavioural Event Interview transcripts and is further supported by the direct quotations presented in section 5.3. Students generally conveyed negative feelings in stories of failure which are predominantly a result of their applications being declined by other fields of study such as medicine and engineering. They regard their forestry qualification as a backup plan and do not have intentions of practicing within the forestry sector; in fact they still want to pursue their dream careers in medicine and engineering. This situation will have serious implications for the future of the profession in terms of building capacity within national forestry education (postgraduate students) and training institutions (academic staff) and industry in terms of experiencing an inadequate supply of graduates. This may be true; however, we need to critically assess the country's needs before expanding the forestry education system without a clear direction as a means to overcome these potential future challenges.

6.7 Addressing capacity gaps in the midst of diverse challenges

Generally speaking, industry employers expressed a definite lack of capacity in South Africa with regard to postgraduate students. In the same way, research institutions find it even more challenging to come by well-qualified academic staff to fill research and lecturing positions. Some may say that the issue of a lack of postgraduate students is really complex because in addition to the lack of motivations for choosing forestry as a field of study, there are ample socio-economic factors that also influence a student's decision to study further. For instance, the pressure families put on students as well as the pressure the students put on themselves to become breadwinners, this makes it difficult for them to decline a job offer to pursue postgraduate qualifications. This is pertinent to South Africa's forestry education system especially since 88% of the final year students interviewed in this research are from previously disadvantaged ethnic groups.

UKZN is planning to introduce forestry postgraduate qualifications that could potentially fill the gap. Compared to the university's undergraduate forestry qualifications which were terminated in 2010, some academics think that their postgraduate degrees will stand a better

chance of success. This may be true, however, the challenges explored in this research indicate that the future of these qualifications is worrisome because enrolment numbers in undergraduate qualifications are very low and more so in postgraduate qualifications. Nonetheless from an opposing point of view this may be regarded as an opportunity for South Africa's forestry education system to expand and explore other avenues in forestry research in addition to traditional forestry areas like silviculture and forest operations and technology which have been dominating the research space. This additional perspective will be valuable because apart from South Africa's plantation-based forestry sector, forests assume other crucial positions in the socio-economic challenges facing Sub-Saharan Africa such as HIV/AIDS and global environmental issues such as the SDGs and climate change. These topics highlight the country's local context and for this reason, South Africa's forestry education system should consider explicitly addressing them in its curriculum.

6.8 Employers' perspective of South Africa's forestry education system

Employers' ratings of the importance of forestry subject areas and non-technical competencies needed for successful overall job performance versus the performance of new graduates revealed that employers are moderately pleased with the overall performance of the graduates they have recruited in previous years. A significant number of employers acknowledged that they do not expect graduates to know everything upon their arrival, they said that graduates still have a lot to learn and the value that they bring to an organization is based on what they learn and how much they are willing to learn while they are there. By contrast, when it comes to a competency like written communication skills, which is the highest ranked of the thirty-six competencies for successful overall job performance, it becomes difficult for them to grasp how a graduate managed to go through university up to postgraduate level in some instances and still cannot manage to write appropriately.

Employers' institutional preferences for the graduates they employ into their organizations are predominantly from NMMU and SUN. In general their argument for this is purely based on quality, some employers even expressed that these two institutions have captured the market when it comes to undergraduate forestry qualifications because of their good track record. Furthermore, this preference is also linked to joint ventures and collaboration such as participating in these institution's advisory boards. This process enables employers to actively engage and advise on their curricula and training. Interestingly, on the basis of the South African Qualifications Authority (SAQA) regulations, NMMU, SUN and UV are all

accredited to offer their respective undergraduate qualifications. The results of this research revealed the complex realities within South Africa's forestry education system. As a student, possessing a forestry degree in the respective area you studied in is not the only thing that matters, the institution your degree affiliated to is equally as important to forestry employers.

6.9 The role of employers in bridging the gap

Generally, the priority needs reported across forestry institutions are teaching and support staff, field training sites and budget improvements. South African forestry institutions have inadequate financial support. This is potentially an opportunity for forestry employers to step up because they have interests in the profile of the graduates produced by the country's forestry education system. There are a number of directions they may take to partner with and support forestry institutions while concurrently ensuring that their needs are met. First, with regard to teaching and support stuff, it was expressed that forestry departments would appreciate the appointment of part-time staff members from industry who will offer guest lectures in some modules and work together with the institutions to secure field training sites for students as they are also listed as a priority need. Furthermore, experiential learning opportunities are important because they bridge the gap between academic studying and the workplace by helping students gain meaningful workplace experience to complement their studies. Employers may also consider offering term break internships that will expose students to fieldwork and conditions that are part of professional forestry practice. Experiential learning opportunities are important because they enable students to bridge the gap between academic studying and the workplace by helping them gain meaningful workplace experience to complement their studies. Nobody denies that it is impractical to expect graduates to have learned everything in a 3-4 year programme whose delivery process is severely restricted by budget constraints (Sample *at al.*, 1999). It is also equally as important to recognize the value of close collaboration with the Fibre Processing and Manufacturing (FP&M) Skills Education Training Authorities (SETA) because as a representative of industry, this body has the potential to impact and influence the teaching and research capacity of training institutions. This direction will undoubtedly assist institutions to obtain a much needed balance between theory and practice (Legilisho-Kiyiapi, 2004).

Conclusions

The aim of this research is to provide a baseline study that will highlight the range and improve our understanding of forestry education programmes in South African tertiary institutions. This empirical research is distinctive because no researcher has carried out a baseline study of forestry education programmes in South African tertiary institutions in such depth. This research offers insight into the views of the most important stakeholder groups within the forestry education system. That is, the students undertaking forestry qualifications, academic experts who are representatives of training institutions as well as forestry employers whose needs are provided by this education system.

The study implements a document and gap analysis to explore competencies that are crucial for forestry graduates. These competencies were compared to those that manifested in Behavioural Event Interviews. Almost all of the competencies coded from Behavioural Event Interviews are non-technical in nature. What is interesting is that both the most important differentiating competencies (from success stories) and essential competencies (from stories of failure) for successful overall performance are all under the theme of Leadership and management skills. This result shows that non-technical competencies are critical for the overall success of both a forester and an environmental scientist in their respective jobs.

The results from the gap analysis are largely reflected in the results obtained from the Behavioural Event Interviews. Across all employer categories, the importance of traditional forestry competencies was relatively high; however, non-technical competencies were given the highest ratings. From the perspective of forestry employers, non-technical competencies are more important for new practicing professionals.

The number of themes addressed is unique in the consolidated review of forestry curricula in South African tertiary institutions: content analysis, Behavioural Event Interviews (BEIs), gap analysis, graduate employment, the changing roles of foresters, availability of resources, facilities and funding for institutions, and enrolment trends. The findings of each theme shed light on the issues and explore some of its challenges and opportunities within forestry education and the profession in South Africa.

How can we apply the current results? The direct quotations from Behavioural Event Interviews are fruitful ingredients for motivating students. The results from both the

document and gap analysis would be a good basis for providing work-life relevant content for learning and training in undergraduate degree-based education. They provide a unique local reference point for tertiary level forestry education which is a good basis for further curriculum development.

Finally, the research publications produced as a result of this research have contributed to the field of forestry as a profession in that the opportunity to publish and engage in conversations on forestry education issues with one's peers has allowed other researchers to have access to the research. These publications are listed below:

1. Mgaga, P. and Scholes, M.C. 2017. A review of Forestry Curricula in South African tertiary institutions, in *Proceedings of the 7th Forest Science Symposium*, Pietermaritzburg, South Africa, July.
2. Mgaga, P. and Scholes, M.C. 2017. A review of Forestry Curricula in South African tertiary institutions, in *Proceedings of the IUFRO 125th Anniversary Congress*, Freiburg, Germany, September.

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Forestry South Africa (FSA). 2017. Timber Plantations Getting to Know the Trees. Forestry Explained. http://forestryexplained.co.za/info-graphics/homepage/introducing-our-timber-plantations/timber-plantations-getting-to-know-the-trees-3/

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APPENDIX I

Student Interview Guide

STAR Method

Area to cover	What to include	How much emphasis on this area
Situation	Brief background on the event so that the interviewer understands the context. Where? When?	15%
Task	Describe the challenge and expectations. What needed to be done? Why?	15%
Action	Elaborate on your specific action. What did you do? How?	55%
Result	What was the outcome? What happened in the end?	15%

APPENDIX II

Student Behavioural Event Interview (BEI)

Basic skills and understanding

Written communication skills

1. How do you feel writing a report differs from preparing an oral presentation?

2. What positive and negative feedback have you received about your writing skills? Give an example where one of your reports was criticised.

Oral presentation skills

3. What is the worst communication situation that you have experienced?

4. Describe a situation where you had to explain something complex to someone What problems did you encounter and how did you deal with them?

Workplace skills and applied knowledge

Ability to plan and execute tasks independently

5. Give an example when a strict and challenging deadline had to be met.

6. How do you prepare for an important meeting?

Appropriate approach to problem solving

7. Describe a recent problem you had to solve. What alternatives did you consider?

8. Describe a situation when you were given an assignment that was difficult to complete because you were uncertain of several key elements. How did you go about completing the project?

Personal and interactive skills

Negotiation and mediation skills

9. Give an example where you delegated a task to the wrong person. How did you make that decision at that time? What did you learn from it?

10. Describe a situation when you had to deal with a conflict between people.

Contribution to teambuilding and work

11. When working in a group, how do you ensure that every member is allowed to participate?

12. Give an example where you worked in a dysfunctional group. Why was it dysfunctional and how did you attempt to change things?

Leadership ability

13. Please tell me about a time you made a mistake and accepted responsibility for it.

14. Leaders often take unpopular positions. Describe a time when you took an unpopular position. What was the result?

Knowledge and intellectual ability

Enquiry and research skills

15. Tell me about a time when you had to complete a task that required the use of information that was not easily accessible. Describe the process you went through to obtain that information.

16. Describe a specific situation in which you had to conduct a research to complete a project. Describe in detail the process you used to conduct this research.

Interest in ideas and desire to continue learning

17. How do you keep current on local and global issues? Give an example of local or global information that you recently shared with someone else and why?

18. Describe two-three past successes. What did you learn from the experience and how have you applied what you learned?

19. Describe two-three past failures. What did you learn from the experience and how have you applied what you learned?

Integrity and Ethics

20. When have you experienced a potential conflict of interest?

21. Give a specific situation in which it was imperative that you maintain confidentiality, yet someone asked you to release the confidential information.
What did you do?

APPENDIX III

Student Behavioural Event Interview (BEI) Transcript

	1. Generally when I do research, I read papers and then I write the report and answer the question. I feel an oral presentation is a lot easier to prepare for because I can always say what I'm thinking or react to a statement that's being made whereby a report I find I need to say everything I want to have said in a limited time or space whereby in oral communication you can say something really quickly and change your mind really quickly. When I'm writing a report I always feel like I'm over thinking things, almost revising of what I'm trying to say because what I might be saying is not necessarily what I'm thinking or could be misinterpreted whereby tone of voice is a lot easier to understand than reading a sentence where grammar errors might be. Coming from a bio background, writing is a lot easier than talking because we haven't had as many presentations as yet. With honours we do communicate a lot more and we actually stand up and talk and it's getting a lot easier with practice, it's getting more comfortable. But I think just because of the science side, we're used to writing reports but it just takes a lot longer.
	2. Positive: I think in general because of the classes that were large in varsity, the whole undergrad there were more than 200 students up until last year so they wouldn't really make any criticisms on your particular essay just for you. They'd write a comment for the entire class for the environmental sciences side of things. Biology, we didn't write as many essays if I can say that, we wrote scientific reports and we'd get comments from postgrads that were marking our work in the pracs. Comments that were generally made were good writing or you need to improve on this and generally depending on what the topic was. **Negative:** One of my weaker sides was getting to grips with statistics. It took quite a while to get into that and they'd often comment please improve on your statistics and please read up on your tests again but I felt with my writing as such, it's quite good. I was told in school to rather go do a BA because of my writing skills or to do law but I wasn't so keen on that because I don't know…it's just not me. So when I said no I want to go into environmental science, I was told to do environmental journalism or environmental education or environmental law. I do get criticised but I learn from the criticism, I see what they say and then I attempt to change what they looking for improving myself.
	3. I'm German that alone is a confusion of its own. Sometimes I misinterpret what people are trying to tell me because I'm trying to understand what the word actually means because I don't have the English vocab. Another problem is often I say stuff that I don't necessarily mean because I'm still trying to formulate my sentence but they expecting an answer write away. So for e.g. last year doing my research project, I was looking at how seeds which pass through the gut of an animal that is accelerated by digestion, so looking at the germination of seeds by digestion basically and in the end there were more seeds growing than we had counted to plant so I said to my supervisor, well what can we do to manipulate and by that I was trying to say how do we approach this. She just said you can't just manipulate results…and that was me saying exactly what I was thinking. I could have formulated it differently. I also think just writing simple emails to people, if you miss a comma or an exclamation mark or something, the whole thing gets taken out of context.

	4. I think that also depends on the person you're interacting with. A friend of mine, when she doesn't understand something it takes about 10 minutes for me to explain and she gets it. But I had a friend who struggled to learn and when she didn't understand something it was very difficult to explain to her because she often didn't listen while you were trying to explain so she would just zone out and I often got the feeling that she was getting frustrated with me, but I was also getting frustrated with her because I could see she wasn't listening. I generally think that if you sit down with somebody and patiently try to explain something or ask what they understand by this and then you can see where they are lost and find them. From my perspective, I think that's one of the best ways to explain a complex matter to somebody. Personally, I say if I can't describe it simply then I haven't understood the concept.
	5. I'm quite an organised person, my time management is very efficient and I cannot handle it when people mess with my time management. One of the most horrible deadlines that I can think of was third year, we had to do a project, 3 people per group, one of them was my best friend and the other was a good friend of mine. We split the work and then the day before everything was due we decided that we were going to send all the information to one computer and work on it and then submit it. And then the good friend of mine whose value almost degraded in my eyes after that session had sent us a page and it was completely plagiarised. We did his whole section, I promise you, I didn't talk to him for 2 weeks because I didn't like the way he had approached it. I understand he was going through some difficult situations in his life but I still think he should've just mentioned that and said he's not coping and if we could help. I've never stressed so much in my life or slept so little in my life. In the end we still got a 65% but I think it's only because we redid everything. We spoke to him afterwards and told him that what he did was wrong and he can't do it. Some of his morals and values aren't what I saw as correct.
	6. With my youth group, I'm a youth leader at church, what I generally do is I write everything down that I want to say. I basically wing my meetings, I just sit and decide to talk, I don't prepare mentally how I'm going to say this, I just write down what I want said.
	7. When I face a problem, the first thing I do is freak out. I completely avoid it for a while and then eventually I say I really need to look at this now and let's work with it. If it's related to time I try and work ahead of my time and make sure that by that stage I've done a certain thing. For e.g. my honours, I knew what I wanted but I couldn't get it through the university system. I wanted to do grasslands science honours but they scraped it so I spoke to the respective people and asked them for advice. Communication is key there, talking to the right people and getting them to communicate with each other. I have three honours supervisors based in two different departments so I had to get the communication between them going and make sure that both departments are happy with what I'm doing. Writing list s is key to make sure that I've thought of everything.
	8. In most cases if I don't know what I'm doing, at school I used to not say if I had a problem because I felt like most of the teachers would get so annoyed of me not understanding something. At varsity, I know that I'm paying a lot of money to get an education so I'll sit on their cases and ask for help and advice. With my honours right now, half the time I don't understand what my research is about so I email my supervisors and ask to meet because I'm confused. Talking to other people interested in this field also helps, motivation and having support (family) is also key to solving problems and conflict.

	9. Because I'm a control freak I don't easily hand out work to somebody I don't know whether they'll be able to do it. From a group assignment perspective, you don't have a choice so I give each person something I know is in their capability. I'm a perfectionist so I can't handle it if they don't do it correctly. There is a case where I gave something to someone who said they can handle it and I completely trusted them and then the day before our event, I asked him some questions and offered my help and they started freaking out and then I realised how bad his organisation skills really were. I learned from that day that every time I asked him, I need to remind him the day before and check that he has got everything but I always have everything on backup in case he does something wrong. I guess you learn people and get to know what they strengths and weaknesses are, how organised they are or how busy they are that they often forget things.
	10. Conflict is something I can't handle. I'm not a people's person when it comes to that, I'm not the most patient person and I don't see how people think so there was a conflict situation a week ago between my friends and I told them don't get me involved. They wouldn't talk to each other; they drove separately to the same place because they were fighting so badly. I told them to sort their crap out; I'm not going to be part of this.
	11. I think talking to the people and finding out what they strengths and weaknesses are especially if it's a group which was chosen for you…it's a bit difficult compared to choosing your own group, you know the people and their limits. I had a group like this last year and we had a vote off for the tasks allocated. When I know the group, I ask if people mind doing specific tasks.
	12. As already mentioned in my earlier example, that guy that completely screwed us over with that project. That to me was dysfunctional because he wasn't pulling his weight. If there are issues, I normally go to the person who handed out the assignment and tell them about the problem and ask for their advice because they are an outside person, objective and a good mediator. This is someone everyone can talk to without feeling guilty.
	13. I generally have the personality of apologising there and then when I've done something wrong, I ask what I can do to make it up. I think I've subconsciously blocked out all the times I've made mistakes.
	14. If you're working with a large group like my youth group, there are about 30 people and each of them has a different opinion, it's very difficult to decide on what needs to be done and have everyone agree with it. I had an event and nobody liked the idea because there was another event planned somewhere else which they would rather go to. So I explained to them that I planned this event before that one was planned, I don't mind if you ditch our event for theirs and the fact that I made that decision made me very unpopular. The people I worked with stayed, they were loyal to our event and I thanked them for their support and told them that it's what I need to be able to do what I'm doing. I think the best thing you can do is to agree to disagree. I told them that they can feel free to attend either event, the ball is in their court and by that I made myself popular again because they could see that I understood their side of the story as well, I wasn't just being selfish. I was trying to be reasonable as well.
	15. I don't think at any stage of my life have I had to access information which was difficult to get. I think the worst was looking for a scientific paper which I don't have access to and had to pay for it. Generally I just think it's about knowing the right people and remaining respectful while looking for what you're looking for.

	16. My 390 germination by digestion project from second semester last year. I was put together with someone I don't get along very well; her work ethic was not up to my standards. We were supposed take responsibility for getting all the equipment, animals and fruit we were investigating into the lab and I did all of that on my own. She never came, every time I messaged her she was never available and when arrived I was nearly done. My biggest problem was that when my results came out my grandfather passed way so the night before we had worked together, she was there for a change which was quite nice. The next morning my mom called and broke the news so I left everything and messaged her that I can't do anything right now, I'm going home. I emailed my supervisors and the guy that was in charge of the lab just to let them know that if anything happens I did mention that I can't be there anymore. When I came back, she hadn't cleaned up for a week, the lab assistant took the bats out for me and made sure that they were fed which was our responsibility but she never pitched. I cleaned up on my own. Our results didn't work out the way they were supposed to so they gave us somebody else's data because we were running out of time. We know you can do the research now but we want you to show that you can work with statistics. They sent us the raw data; I sat for a week with the girl who got those results just to figure out what was going on because I didn't understand the way she set her things out. I think that was one of the most stressful cases in terms of research because there were so many changes in the procedure from what we had originally.
	17. I follow a lot of pages on Facebook. I'm generally not an up to date person I generally hear things via somebody else. I like talking to people and communicating about what we saw. The local issue I shared was about fracking of the midlands (KZN) because I read their reports because it actually affects us. General issues like the drought, where it's all over and you don't even need to read the paper to know what's going on.

18. Successes:

Code	Template
	I think getting my degree. It's such an awesome feeling coming out saying I've learnt something I didn't know
	before, something I enjoy doing as well. I see it as a highlight because I question whether I'm the right person for
	this, or whether I'm good enough, whether I've got the ability for what is needed. So from that perspective,
	proving to myself that I can do this.

Code	Template
	I've got a strong personality and I'm very stubborn at times and to see myself develop as I realise that people have
	emotions too from the control freak side. Working with people on a level I never thought I could reach. I know I
	have leadership skills and working with my youth group, I'm enjoying the feedback and people responding to the
	way I interact with them. There were kids that never used to come to the youth meetings but ever since I've been
	there, they are present every Sunday as a result of the way I've interacted with them which to me just tops
	everything.

19. Failures:

Code	Template
	Disappointing people. Seeing someone you've tried to keep happy so to say and you see that they aren't or they
	Possibly feel different to what you thought they would.

	20. Because I'm Christian, there is always conflict somewhere. Just thinking of my housemate who's not Christian. Growing up as a Christian you know what values you stand by and having somebody question them almost and say no but I don't believe that and Christianity you can't prove, it's faith, it's something beyond understanding which I think causes conflict because I'm a by the bible kind of person and it the bible says it it's true. Having other people interpret what they think it means is wrong to me. So I often shut up just to avoid conflict but sometimes I put my foot down.
	21. In most cases it's quite easy for me to keep something confidential depending on who it is and what it's about. The first person I generally tell is my mom because she has no association with that person, talking to someone outside gives you a different perspective on how to deal with it should it become difficult. Generally I won't say anything at all. Like when my boyfriend's brother's wife was pregnant, when they told me I didn't tell anyone because I knew that it was going to come out eventually. I'm an honest person so I usually just tell someone that it is not my place to say or rather don't tell me because I might blurb it out. It depends on what the situation is and who it's going to affect.

APPENDIX IV

General Competency Based Interview Performance Indicators

Positive		**Negative**	
1. Body language, nonverbal cues and use of eye contact was welcoming and open.		Body language, nonverbal cues and eye contact was unwelcoming or inattentive.	
2. The candidate was polite and well-mannered to the interviewer.		The candidate was rude, abrasive and dismissive to the interviewer.	
3. The candidate's demeanour was assertive, confident and focused.		The candidate appeared excessively anxious, self-conscious or unconfident.	
4. The candidate arrived to the interview on time/ with time to spare.		The candidate arrived to the interview late.	
5. The candidate was dressed appropriately for an interview setting.		The candidate was dressed inappropriately for an interview setting.	
6. The candidate appeared to show genuine interest and enthusiasm for the role.		The candidate appeared uninterested in the interview.	
7. Competency based questions were answered comprehensively and coherently.		Competency based questions were answered incoherently and vaguely	
8. In the event the candidate was late, adequate notice was given to the interviewer.		The candidate arrived late and did not give notice to the interviewer.	

APPENDIX V

Employer Interview

A review of Forestry Curricula in South African tertiary institutions

Part A: Background questions

1. Name of respondent:
2. Job title:
3. Approximately how many employees does your company have?

<50	50-150	151-300	>300

4. Number of years in the organization:

<5	5-10	11-15	>15

5. Does your organization belong to the public sector? (entirely owned by the government or the government has a majority share)

Yes	
No	
I don't know	

Part B: Non-technical competencies

1. **(A)** According to the South African Qualifications Authority (SAQA), below is a list of some of the competencies ranked by employers as important for graduates to possess. Please rate each competency on a scale of 1-5 based on your perception of its importance to students, where **1 is not important** and **5 is very important**.

   (B) Based on the company's recruiting experiences. What percentage **(e.g. 50)** of new graduates do you think are capable in these non-technical competencies?

	A						B
	1	2	3	4	5		Percentage (%)
Basic skills and understanding							
Written communication skills							
Oral presentation skills							
Computer literacy							
Proficiency in English							
Workplace skills and applied knowledge							
Ability to plan and execute tasks independently							
An appropriate approach to problem solving							
Personal and interactive skills							
Negotiation and mediation skills							
Creativity and innovation							
Contribution to teambuilding and work							
Leadership ability							
Ability to network							
Knowledge and intellectual ability							
Understanding of economic and business realities							
Critical and analytical ability							
Enquiry and research skills							
Interest in ideas and desire to continue learning							

Part C: Discipline-specific competencies

1. **(A)** Below are the key subject areas in the field of forestry. Please rate each subject area on a scale of 1-5 based on your perception of its importance to students, where **1 is not important** and **5 is very important**.

   (B) Based on your experience with this programme. What percentage **(e.g. 50)** of new graduates do you think are educated in these subject areas?

	A						**B**
	1	2	3	4	5		Percentage (%)
Forest bioenergy							
Environmental services							
Forest products trade and marketing							
Forest economics							
Carbon sequestration							
Forest governance (incl. policy and legislation)							
Forest ethics and values							
Forest information systems (incl. GIS and RS)							
Non-wood products							
Biodiversity							
Wildlife							
Forest ecology							
Genetics and breeding							
Forest planning							
Mensuration and inventories							
Forest soils							
Forest health							
Forest operations and technology							
Forest production and growth							
Silviculture							
Biology of trees (including physiology)							

Part D: General questions on employment

1. Do you think that the roles of foresters have changed considerably as a result of new trends in the forestry market?

Yes	
No	
I don't know	
No answer	

If yes, please discuss these changes in the context of South Africa.

_____
_____
_____

2. Does your company regularly review the skill and training needs of individual employees?

Yes	
No	
Partly (only for some employee groups)	
I don't know	
No answer	

3. In 2015, did employees participate in any external or internal training courses that were entirely or partly paid for by your company, except any training obliged by law (e.g. health and safety)?

Yes	
No	
I don't know	
No answer	

4. Do you currently have vacancies proving hard to fill due to the lack of adequate skills of applicants?

Yes	
No	
I don't know	
No answer	

If yes, please list these vacancies.

_____
_____
_____

5. How important is having broad knowledge of the field of forestry in this organization?

Does not apply	
Not important	
Fairly important	
Very important	

6. Which companies do you think are the main employers of South Africa's forestry graduates? Please identify a maximum of five.

_____

_____

_____

_____

_____

Part E: Graduate employment in your company

1. Does your company recruit graduates?

No	
Yes	

If No, why not?

_____
_____
_____

2. If yes, which university do most of your graduates come from?

University of Stellenbosch	
Nelson Mandela Metropolitan University	
University of Kwa-Zulu Natal	
University of Venda	
Other	

If other, please specify.

_____
_____

3. What degree do majority these graduates hold?

BSc Forestry and Wood Sciences	
BSc Environmental Sciences	
BTech Forestry	
BSc Biological Sciences	
Other	

If other, please specify.

_____
_____

4. Do you think that the graduates employed by this organization are well equipped for the workplace?

No	
Yes	

If no, what do you think they lack in terms of preparation for the workplace?

_____
_____
_____
_____

5. What additional knowledge and skills do you think should be incorporated into undergraduate university curriculum?

_____
_____
_____
_____

APPENDIX VI

Academic Expert Interview

A review of Forestry Curricula in South African tertiary institutions

Part A: Background questions

1. Name of respondent:
2. Job title:
3. Approximately how many employees does your department have? (please circle)

<50	50-150	151-300	>300

4. Number of years in the department:

<5	5-10	11-15	>15

Part B: Non-technical competencies

5. **(A)** According to the South African Qualifications Authority (SAQA), below is a list of some of the competencies ranked by employers as important for graduates to possess. Please indicate which of these competencies are covered in this programme and rate each competency on a scale of 1-5 based on your perception of its importance to students, where **1 is not important** and **5 is very important**.

   (B) Based on your experience with this programme. What percentage **(e.g. 50)** of new graduates do you think are capable in these non-technical competencies?

	A							B
	Covered in this programme? Yes/ No	1	2	3	4	5		Percentage (%)
Basic skills and understanding								
Written communication skills								
Oral presentation skills								
Computer literacy								
Proficiency in English								
Workplace skills and applied knowledge								
Ability to plan and execute tasks independently								
An appropriate approach to problem solving								
Personal and interactive skills								
Negotiation and mediation skills								
Creativity and innovation								
Contribution to teambuilding and work								
Leadership ability								
Ability to network								
Knowledge and intellectual ability								
Understanding of economic and business realities								
Critical and analytical ability								
Enquiry and research skills								
Interest in ideas and desire to continue learning								

Part C: Discipline-specific competencies

1. **(A)** Below are the key subject areas in the field of forestry. Please indicate which of these subject areas are covered in this programme and rate each subject area on a scale of 1-5 based on your perception of its importance to students, where **1 is not important** and **5 is very important**.

   (B) Based on your experience with this programme. What percentage **(e.g. 50)** of new graduates do you think are educated in these subject areas?

	A							B
	Covered in this programme? Yes/ No	1	2	3	4	5		Percentage (%)
Forest bioenergy								
Environmental services								
Forest products trade and marketing								
Forest economics								
Carbon sequestration								
Forest governance (incl. policy and legislation)								
Forest ethics and values								
Forest information systems (incl. GIS and RS)								
Non-wood products								
Biodiversity								
Wildlife								
Forest ecology								
Genetics and breeding								
Forest planning								
Mensuration and inventories								
Forest soils								
Forest health								
Forest operations and technology								
Forest production and growth								
Silviculture								
Biology of trees (including physiology)								

Part D: General questions on forestry education

1. What was the number of forestry graduates in the following programmes for the past ten years in the department?

Academic year	Diploma	Degree
2015		
2014		
2013		
2012		
2011		
2010		
2009		
2008		
2007		
2006		

2. Would you say that the number of student enrolments in forestry programmes is increasing or decreasing and why?

Program	Increasing/ Decreasing	Possible explanations
Diploma		
Degree		

3. Which companies do you think are the main employers of South Africa's forestry graduates? Please identify a maximum of five.

_____
_____
_____

4. (i) Do you think that the roles of foresters have changed considerably as a result of new trends in the forestry market?

_____
_____
_____

(ii) If yes, please discuss these changes in the context of South Africa and whether or not they have influenced curricula.

Changes in the roles of foresters	Incorporated in curricula? Yes/ No	If Yes, how? If No, why not?

5. Please tell me about the adequacy of the following aspects of the department's resources, facilities and funding and comment on each.

Aspect	Adequate/ Inadequate	Comments
Academic staff		
Support staff		
Library teaching materials		
Laboratories, equipment		
Field training sites		
Current publications		
National financial support		
Donor financial support		

6. What do you regard as the department's most important needs? Please list and explain.

_____
_____
_____

7. Please tell me the reasons why you think some of these non-technical and discipline-specific competencies are not covered in the curriculum.

_____
_____
_____

APPENDIX VII

Organization's Permission Letter

My name is Palesa Mgaga; I am a MSc. student at University of the Witwatersrand. The topic in which I'm conducting the research is as follows;

A review of Forestry Curricula in South African tertiary institutions

I hereby request your permission to invite employees to participate in the interviews. Your permission and support for this research at your organisation will be highly appreciated.

This document is to certify that Palesa Mgaga has asked the Manager for permission to interview employees in their organization.

The conditions are as follows;

- Participation is voluntary and participants are free to withdraw at any time, without giving a reason.
- The information participants provide to this study will be anonymous - no individual names will be disclosed and the results will be reported in summary form only.
- The records of this study will be kept strictly confidential.
- The interview will be audio recorded only if a participant gives their permission.
- Participants will **NOT** be paid for taking part in an interview.

I (Name) ……

The Manager of (Organization) ……

hereby grant Palesa Mgaga the permission to conduct interviews with employees from my organization.

……....

Signature

……....

Date

APPENDIX VIII

Employer Transcript

Part B and Part C

The high scores are the things we feel graduates come with and the lower scores are the ones where we feel that those are the skills that people need to learn once they get into the work environment.

Knowledge and understanding in a lot of broad areas is also important even though someone for example here at the institution might be coming in as a plant breeder or a specialist in GIS. The ones that we think are important but are not found in graduates are the ones we would then communicate to the institutions and tell them that we think that this is an important skills set.

Part D: General questions on employment

1. There is an increase in the diversity of the kind of trees that we grow, the sites we grow them on. Climate change, increased risk, having to deal with local communities. One of the people described forestry in this country as a mosaic, where there are pockets of forestry in amongst communities and agriculture, and that means you don't get these big areas of plantation forestry anymore. Changing land ownership means that smaller areas are owned by communities so other challenges have come in. It is changing and with that a diversity of skills set is also arising. Many of the companies have also outsourced their operations…big companies are subcontracting out forestry jobs. Instead of having a forester at every plantation, you will find that one forester is in charge of ten areas. In this regard, it is a different responsibility to what it used to be.
2. Within the institution we have a performance management system and our staff are assessed annually and one of the criteria we assess them on is skills and training and obviously that is aligned to our objectives. If you are a graduate in this area, we look to see how we can get you to a phd level, ideally all researchers at the institution hold PhDs as a minimum requirement.
3. Every year we send staff for training, many of them are doing short courses that are relevant to the business. Currently, we have a few on an R training course, related to statistical analysis in genetics.

4. We do have vacancies, we currently have two. We are struggling to find graduates to fill those jobs, people with MSc or PhD. One of the biggest areas in this country where we lack qualified personnel is forest management, growth and yield, mensuration research and forest protection as well. We've lost two people now and it's not easy to find an MSc or PhD person, there's always a lag phase which means that the project will need to slow down while you're growing and developing the candidate to a higher level in the system. What happens normally at the institution is that we'll develop the candidate for two to three years and then the big companies like Sappi or Mondi come and poach them because now they will not only have someone with the qualification but also the experience. The institution is sometimes perceived as the learning ground, we have graduates that come here for maybe five years and then move on into the companies. We do supply experienced graduates into the companies but then we lose because we find it difficult to replace them.

With forest management for example, I do feel that the lack of qualified personnel is also a result of the lack of the subject area being addressed in the curriculum. Even though US does have forest management as part of the degree programme but they don't have a postgraduate. Someone with a PhD in forest management is non-existent. So I think that postgraduate qualifications in areas such as forest management and production are critical because the graduates are just not there. So the universities need to think about that…and I think what's happened is that there are no supervisors, we have no experts to support the students. I think US is the right place to train postgraduates in the previously mentioned areas.

The reason why UKZN's undergraduate forestry programme failed was because the university didn't really support it even though it received a lot of support from industry, forestry didn't really fit in with the others such as agriculture and dietetics of which the university is well known for. It didn't have a lot of overlap and cohesion with the other areas covered by the other schools so eventually there were two members of staff trying to run the whole undergraduate degree all by themselves and it was a battle. They tried to work with industry and industry supported them but it just fizzled out, the energy and enthusiasm ran out. Some of the staff from the institution were conducting the lectures because the university didn't have the staff to offer the training. Currently, they are talking about having an honours programme to start with, and then a masters and then a PhD.

They've approached the institution to help them with the process and I think that's the right way to go. I think that when it comes to undergraduate training, US and NNMU have pretty much captured the market and are doing a very good job (however they curricular does need to be looked at, funny enough they have their advisory committee meeting next week and a number of people in the industry and from places like here [institution] go down there and advise them on their curricula and training…which is good), which is also why UKZN's undergraduate programme failed (late 199s), they were competing with institutions that have a long long history in offering undergraduate training. Their postgraduate degree will fill a gap because we'll work with them, we'll be co-supervising and I think it has a good chance of doing well.

I'm glad that UKZN is considering a postgraduate qualification because even though there is postgraduate training in US, it's very much in forest operations, on the ground basic forestry. There's postgraduate at NMMU and UP (very strong in forest protection [FABI]). We are in a geographically different area, in the heart of plantation forestry, we have strong support from the forestry companies so putting trials on the ground, working with projects that are relevant…that are going to solve specific aspects in partnership with UKZN has a much better chance of success.

FABI in UP has quite a strong link with UniVen, they work quite strongly with them. I don't think that their postgraduate group is big and I think the problem is that they don't have a strong research slant and that makes us as a research institution not to see it as a potential university for graduates. We would like to support them, we support Fort Cox, we have a good relationship with them, and we have undergraduate interns coming from them next year, four from NMMU and one from them, they are all coming to do their work experience here (2nd year of your BTech at NMMU [9 MONTHS]; and Fort Cox student is in final year). So I guess as a very small research organization without a very big budget we feel we have a role to support those students but also the fact that UniVen is geographically far away from us is one of the reasons why we haven't touched base. It is sad for the students that study there because they have limited opportunities…the biggest constraint for us with them is their geographical location (isolated) which leads to cost constraints. It's a challenge and I guess the big thing is we have to work toward reaching out to them and Fort Cox too.

In terms of the quality of the students going in and graduates coming out of the UniVen system, I cannot really comment much on that because we haven't really worked with them in that perspective. However, I would imagine that being constraint financially, they are probably not at as a high standard but then bright students will succeed wherever they are but probably it is more challenging there because I'm sure they are under resourced in terms of facilities and support. The students come from a secondary education system that is also not as good or anywhere near…it's a bit the same as in Fort Cox.

But we just spoke about yes you get graduates with a certain skills set but a lot of it they still have to learn so their training is just a base, that's the start, the value that you bring to an organization is also what you learn and how you're willing to learn when you get there. Nobody asks you when you start a job what marks you got, they might ask what university you studied at but primarily they are interested in the areas in which you studied in up until postgrad…the only thing that matters is that you have a degree, from which university it's from, that doesn't really matter.

5. Very critical!

6. Sappi, Mondi, York Timbers, PG Bison, MTO, NCT and TWK (two private grower consortiums).

There are an increasing number of graduates who spend a few years in a job working for a company and then set themselves up as independent consultants and more and more now, I see graduates become consultants. I've done some surveys and it seems like a number of years ago, the amount of time on average someone spent in a job was 5-7 years, now it's 2-3 years.

Part E: Graduate employment in your company

1. Yes we do recruit graduates from a number of universities.

2. We've never recruited from UniVen…we've never had anyone apply for a job at the institution.

3. Depending on the job and the skillset, we take from a number of different universities. This is quite frightening you might think but most of our graduates (90%) aren't trained in forestry. We have to researchers who have formal qualifications in forestry…the rest are geneticists, plant breeders, botanical trained and so on. That's interesting because we are a forestry research organization but 90% of our graduates aren't trained in forestry. I think

what I'm saying is that to do research in forestry, it doesn't mean you have to have a postgraduate forestry qualification

4. I think generally yes, the areas where we find graduates that come straight out of university to us struggle is that they have an understanding of their discipline but they don't understand the forestry sector or the context of forestry. Just to give you an example, we just employed a graduate, she's our senior research scientist in forest protection, she's a very very bright student from UKZN, she has a PhD in Plant Pathology but when we took her on, and she knew absolutely nothing about forestry. So that's her biggest learning curve, she's got to learn about forestry in the forestry sector but she has the skills in understanding plant diseases which is what we needed.

Most of the graduates that come to us have never put in a field trial and that is a skillset they don't have and they are not required to have as part of their degree. Some of them have done projects but have really ever had to go and plan a field trial. So those are things we teach graduates about. We expose them to the forestry sector and teach them practical things like how to plan and put in a trial. So I have technicians here, who have to go to the field and teach the researcher how to put in a trial…which is interesting because a BTech person is teaching someone with a PhD how to do this, which is good.

5. Social skills, economic skills. We think that maybe the universities could help us by doing a course in basic project management. We find very few people come to us understanding how to start a project, plan a project, cost a project, and write a project plan. Sadly, many of the graduates that come here have undergraduate and postgraduate degrees but cannot write. You know how many people that come here but cannot write…and I don't understand how you manage to get through university and do a master's degree and still struggle to write. It's really sad, one of the things that most struggle with is interpreting and writing…they are very good with analysis. When I came here, many of them even struggled to stand up and present, I run a professional communication course where I actually teach people how to speak, whether it's one to one communication skills or standing up in front of an audience and giving a formal presentation. You get better with experience but it's also just the fundamentals that people lack, like eye contact.

Comments

The importance of tertiary level institutions working with potential future employers is really important. Most universities have advisory committees, in terms of being relevant it's critical to involve industry players like Sappi, Mondi, ICFR etc. to make sure that the qualifications you put out there meet the needs of the market you want. Ten years ago, people said there were no jobs in forestry and it wasn't a career that excited them, there was no potential. Now we are in a different space and the graduates that are coming through are not the old original forester who trained at Saasveld or Stellenbosch. Now you have graduates with different skills doing different jobs so as forestry have changed, the graduates have had to change and it is working to some extent but I think keeping those two entities engaged is what the student needs. They need to know that that the courses they doing are relevant and most importantly will get them a job. The motivation for studying is to get a job.

APPENDIX IX

Ethics Clearance Certificate from the University of the Witwatersrand

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Mgaga

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H16/06/01**
PROJECT TITLE	A review of forestry curricula in South African tertiary institutions
INVESTIGATOR(S)	Ms P Mgaga
SCHOOL/DEPARTMENT	Animal, Plant and Environmental Sciences/
DATE CONSIDERED	24 June 2016
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	29 September 2019

DATE 30 September 2016 **CHAIRPERSON** (Professor J Rees)

cc: Supervisor : Professor MC Scholes

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

Signature **Date** 30 / 09 / 2016

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX X

Ethics Clearance Certificate from Stellenbosch University

UNIVERSITEIT • STELLENBOSCH • UNIVERSITY
jou kennisvennoot • your knowledge partner

25 October 2016

Ms Palesa Mgaga
School of Animal, Plant and Environmental Sciences
University of the Witwatersrand

Dear Ms Mgaga,

Concerning research project: ***A review of Forestry Curricula in South African tertiary institutions***

The researcher has institutional permission to proceed with this project as stipulated in the institutional permission application. This permission is granted on the following conditions:

- Participation is voluntary.
- Persons may not be coerced into participation.
- Persons who choose to participate must be informed of the purpose of the research, all the aspects of their participation, the risks to participation, their role in the research and their rights as participants. Participants must consent to participation. The researcher may not proceed until she is confident that all the before mentioned has been established and recorded.
- Persons who choose not to participate may not be penalized as a result of non-participation.
- Participants may withdraw their participation at any time, and without consequence.
- The data must be responsibly and suitably protected.
- The researcher must pay due diligence in seeing that the data is handled in the strictest confidence.
- Data must be collected and processed in a way that ensures the anonymity of all participants.
- The use of the collected data may not be extended beyond the purpose of this study.
- Individuals may not be identified in the report(s) or publication(s) of the results of the study.
- The privacy of individuals must be respected and protected.
- The researcher must conduct her research within the provisions of the Protection of Personal Information Act, 2013.

Best wishes,

I. Cloete.

Prof Ian Cloete
Senior Director: Institutional Research and Planning

APPENDIX XI

Participant Information Sheet

University of the Witwatersrand
1 Jan Smuts Ave
Braamfontein
Johannesburg
2000
October 2016

Project title: A review of Forestry Curricula in South African tertiary institutions

My name is Palesa Mgaga; I am a MSc. student at the University of the Witwatersrand (WITS). I am participating in a global research project on tertiary level forestry education. The research will be conducted on each continent; South Africa will be one of the countries participating on behalf of Africa. The aim of my project is to highlight the range of forestry curricula and improve our understanding of forestry education programmes in South African tertiary institutions and to assess if the skills needs of the forestry sector are being met.

I would like to invite your participation for an interview. Your unique contribution will be extremely valuable and most appreciated. If you choose not to participate, your marks will not be affected in any way. The interview will require approximately 60 minutes of your time. For accurate data collection and reporting of results, your interview will be audio recorded, but only if you give your permission. The interview will be conducted within the premises of your university at a place, date and time convenient to you.

Participating in the interview is voluntary and you are free to withdraw at any time, without giving a reason. The information you provide to this study will be anonymous - no individual names will be disclosed and the results will be reported in summary form only. Thus your answers cannot be linked to you in any way, so the information will be confidential.

I would be happy to provide any further information you may require.

Researcher's Name: Palesa Mgaga
Phone Number: 0796965348
Email Address: 668383@students.wits.ac.za

Thank you for your time

WITS
UNIVERSITY

APPENDIX XII

Consent Form

Project title: A review of Forestry curricula in South African tertiary institutions

I have had the research explained to me, and received an information sheet about this study. I have been told that:

- My participation is voluntary and that I am free to withdraw at any time, without giving a reason.
- The information I provide to this study will be anonymous - no individual names will be disclosed and the results will be reported in summary form only.
- The records of this study will be kept strictly confidential.
- The interview will be audio recorded only if I give my permission.

I agree to be interviewed for Ms Mgaga's study

I agree to the interview being audio-recorded ☐

I do not agree to the interview being audio-recorded ☐

_____	_____	_____
Name of Participant	Date	Signature

APPENDIX XIII

Behavioral Event Interview (BEI) Coding Template

1. Who was involved in the situation?

1.1	**Number of participants**
a	Interviewee was alone in the situation
b	The situation involved someone else
c	The situation involved a number of individuals
1.2	**Member group**
a	Colleagues
b	Customers
c	The situation involved individuals from multiple groups

2. What feelings did the interviewee convey in the situation?

a	Positive feelings
b	Negative feelings

3. Discipline-specific competencies "the know-hows of the forestry sector"

3.1	**Forestry expertise**
a	Forest bioenergy
b	Environmental services
c	Forest products trade and marketing
d	Forest economics
e	Carbon sequestration
f	Forest governance (incl. policy and legislation)
g	Forest ethics and values
h	Forest information systems (incl. GIS and RS)
i	Non-wood products
j	Biodiversity
k	Wildlife
l	Forest ecology
m	Genetics and breeding
n	Forest planning
o	Mensuration and inventories
p	Forest soils
q	Forest health
r	Forest operations and technology
s	Forest production and growth
t	Silviculture
u	Biology of trees (including physiology)

Non-technical competencies

3.2	**Non-technical competencies**
3.2.1	Human relations skills
a	Negotiation and mediation
b	Teamwork and social
c	Organization and co-ordination
d	Education, training and supervision
e	Managing social discomfort
f	Networking
g	Other
3.2.2	**Leadership and management skills**
a	Financial planning and budgeting
b	Understanding of economic and business realities
c	Leadership ability
d	Project management
e	Time management
f	Decision making
g	Responsibility
h	Reliability
i	Resistance to pressure
j	Initiative
k	Subordinate
l	Accuracy and diligence
m	Other
3.2.3	**Communication skills**
a	Information Technology (IT)
b	Written communication
c	Oral communication
d	Communicating in mother tongue
e	Communicating in another local language
f	Communicating in English
g	Communicating in an international language
h	Communicating with non-experts
i	Other
3.2.4	**Inquiry and research skills**
a	Information processing skills (incl. statistical data analysis)
b	Critical and analytical ability
c	An appropriate approach to problem solving
d	Creativity and innovation
e	Interest in ideas and desire to continue learning
f	Ability to plan and execute tasks independently
g	Ability to apply knowledge in practice
h	Ability to work in a multidisciplinary group
i	Ethical commitment
j	Evidence of methodology skills (incl. laboratory and field skills)
k	Other