An Empirical Investigation into Green Solutions in NWU (Mafikeng Campus)

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Declaration

I, Shirene Klink, declare that I am a student at the North West University. The basis contained in this dissertation for the Degree Master of Business Administration does not contain materials previously published or written and where it has been used, it is duly acknowledged.

Signed: .....

Date: .....

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I would like to take this opportunity to thank God for guidance and wisdom that he has bestowed upon me.

A very special thanks to my husband and best friend Michael, who never gave up and kept pushing so hard, you are my rock. To my daughters, my wish is that you take this as a learning expedition when your turn comes.

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Abstract

A green campus can be defined as a higher education community that is improving energy efficiency, conserving resources and enhancing environmental quality by educating for sustainability and creating healthy living and learning environment. The research contained herein, aims to study the green activities currently on NWU Mafikeng Campus. The implication of this study serves to ensure that there are clear objectives with regard to adopting and promoting green education and awareness and to try for the implementation and promotion of new innovative green teaching methods. The result shows that is there is no consensus that the campus has clear objectives to promote a green campus and also no conclusive comment on the questions of if the campus continues to promote new methods of energy, water and waste consumption on the campus. One of the main objectives of a green building is to promote the construction of energy and resource efficient buildings but respondents could not comment on whether campus implements environmental impact assessments for new and existing buildings. However, students indicated they would be interested in attending green campus modules to effectively gain education on green and environmental affairs.

Keywords: Green Campus, Environmental, Knowledge, Research, Sustainability, Carbon footprint, Stakeholders, Resources, Educate, Higher Education

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List of Abbreviations

CO_2	-	Carbon Dioxide
DOC	-	castor de-oiled cakes
E-book	-	Electronic book
Et al	-	(Et alii) and others
EIA	-	Environmental Impact Assessment
Etc	-	Etcetera
ETP	-	Effluent Treatment Plant
GHG	-	Greenhouse Gas
HEI	-	Higher Education Institutions
HVAC	-	High Ventilation Air Conditioning
ISO	-	International Organisation Standardisation
Lb	-	Pound
m^3	-	cubic metre
NOx	-	Nitrogen Oxides
NWU	-	North West University
OCC	-	Old Corrugated Cardboard
PET	-	polyethylene terephthalate
PV	-	Photovoltaic
SMP	-	Sustainability Management Plan
SOx	-	Sulphur Oxide
SPSS	-	Statistical Package for Social Sciences
t	-	Tonne
TOU	-	Time of use
UiTM	-	UniversitiTeknologi MARA
UABC	-	University of Baja California
UNBC	-	University of Northern British Columbia
UoS	-	University of Southampton
USD ($)	-	United States Dollar
VFDs	-	Variable Frequency Drives

Chapter One

Overview of the study

1.1 Introduction

Organisations are faced with new and higher demands every day and innovative and more environmentally friendly solutions have also become necessary in the daily work within various markets. Across South Africa, university campuses and the communities which host them are confronting the challenges of the ever increasing electricity, water, sanitation, fuel and job demands and more sustainable approaches of these uses according to McComas, Stedman, Sol and Hart, (2011).

The increasing concerns on different environmental issues and more recently a need to respond to climate change, Geng, Liu, Xue and Fujita, (2012) suggested that universities should create knowledge and integrate sustainability in educational and research programs, as well as promote environmental issues to the society. Under such a circumstance, green university efforts have to be initiated worldwide.

Similar to a community, the operation and maintenance of one university is a process of socioeconomic absorption taking in various materials, energy and water and transforming them into recyclable waste. Each unit (administrative/teaching/research) interacts with others through a complex network. Without consideration of greening campuses such a transformation is a linear process, indicating lower eco-efficiency and heavy environmental burdens to the surrounding communities (Geng et al., 2012).

1.2 Background of the study

Lukman (2009) states that Higher Education Institutions (HEI) generate environmental impacts through both direct and indirect activities—the former, which includes the use of lecture halls, offices, catering and laboratories while the latter include commuting and consumption of food and drink at work by students and employees.

According to centerforgreenschools.org green campus focuses on more than the life cycle of buildings, grounds and infrastructure. It encourages research, promotes advocacy efforts, develops curriculum, and supports academic and mission-based goals that further sustainability on-campus. The success of a green campus is dependent on an integrated approach to planning and implementing sustainability initiatives. Engaging stakeholders early will result in a plan that reflects the realities and needs of the campus and community while furthering the institutional mission.

Across university campuses, large volumes of waste, much of which could be recycled, are routinely hauled to and disposed of in landfills. Smyth, Fredeen, and Booth, (2010) concludes that as much as 55 – 90% of university waste streams could be recycled. The collection, transportation, and disposal of this waste come at a significant economic cost to the institution, and landfills, which are rapidly filling to capacity, have become sizable point sources for groundwater contamination and the generation of methane, a powerful greenhouse gas. The challenge of campus waste management thus becomes finding ways to minimise the institutional waste stream by reducing the generation of trash and increasing rates of recycling and composting, much of which translates to student and staff: perception, awareness, education, responsibility and behaviour.

Giovanni (2008) reported that universities waste streams is predominantly comprised of (1) office, library and mailroom paper waste, (2) cafeteria and dining food waste and (3) student residences waste. Most Institutions can

make significant strides towards reducing paper waste by encouraging double sided printing, reducing hardcopy printing through increased digital correspondence and providing paper recycling receptacles in strategic locations, adjacent to departmental copy machines, library printers and campus mailrooms for example. Similarly, dining hall food waste can be diminished through no take-away dining initiatives and the creation of campus composting programs to handle pre-consumer and in some cases post-consumer, food waste from the cafeterias. Residence housing waste has proven more challenging as it is more diffuse and its reduction relies heavily on student behaviour, responsibility, education and a well-developed recycling program, (Giovanni 2008).

Centerforgreenschools.org continues further that tools and techniques needs to implement innovative green technology and methodology through comprehensive sustainable plans that integrate curriculum offerings, research initiatives, student engagement opportunities and collaborative partnerships. In the process, green campuses provide students opportunities to develop green job skills that prepare them to be top candidates in an increasingly competitive job market.

Sharp (2002) concludes that the implementation procedure consisted of initial discussions with academic and local authority staff at a university environmental forum, the formation of a working committee, the preparation of a funding proposal and the establishment of an externally funded research, educational and promotional program led by an individual staff member. A campus environmental committee must be established in order to facilitate communication on environmental matters between senior university management, residence and facilities management staff, academic staff and students.

The individual staff member and the committee within the university will be able to effectively:

- define clear organisational goals and objectives;
- maintain goal and objective focus;

- explore the nature of arising problems and generate alternative solutions to problems.

Support from senior management must exist in the form of a written environmental policy and a signed commitment to environmental responsibility on campus and university funding support followed the success of the initial funding application (Sharp, 2002).

Rapid economic development, population growth, change in life style, inadequate infrastructure and expertise, and land scarcity make the management of green campuses a most critical environmental issues. Production of waste through the consumer products generate high amount of extra packaging such as food containers, plastics, soft drink cans and bottles (Sharp, 2002).

This integrated model, according to Geng et al., (2012), aims to manage all the campus activities on a sustainable basis by minimising energy and materials use, achieving economic benefits (reducing operation and maintenance costs), mitigating the ecological impacts of various academic activities, enhancing both research and education abilities on sustainability issues and improving general public environmental awareness. It addresses all the issues related with one university's absorption and ensures that the views and goals of different stakeholders are considered collectively. Such a holistic approach requires that all pertinent factors related with university operation should be considered in the decision-making process, avoiding the problems raised from fragmented institutional framework. It also requires all the stakeholders to fully understand the absorption process of any one university so that environmental and social implications of their activities can be recognised (Geng et al., 2012).

The use of a life cycle approach for these estimations is essential so as to obtain the full picture of the environmental implications of running a university. Examples of such applications include assessing the life cycle impact of an internet infrastructure at a university (Loerincik, 2003), new university buildings (Scheuer, 2003), and printed books and e-book reading devices (Kozak, 2003).

A recently proposed sustainable university model (Velazquez, Munguia, Platt, and Taddei 2006) provides a structured framework for visualising and achieving a sustainable university system by benchmarking the best practices used by 80 universities worldwide. However, to our knowledge, no study has so far addressed the impacts from everyday university activities alongside its infrastructure impacts.

Wang, Wei, and He, (2010) reviewed all the Chinese practices on establishing green universities, including indicators, criteria, best practices and relevant policies. Zhou and Shao (2005) studied the influence of ISO 14001 on creating a green university and presented the detailed procedures of establishing ISO 14001 within a university campus. Lu, Liu, Bai, Li, and Fu, (2007) established an indicator system to evaluate performance of one green university project and raised their recommendations on further greening this campus. Wang (2011) defined the concept of green university and reviewed different indicator systems for assessing the overall performance of one green university project. Wen (2011) discussed how to promote green education within universities and clarified the roles of different stakeholders during such a process. Zhu and Wu (2010) presented an innovative model on establishing green culture within a university campus.

1.3 Statement of the Problem

Organisations are faced with new and higher demands every day and innovative and more environmentally friendly solutions have also become necessary in the daily work within various markets. Across South Africa, university campuses and the communities which host them are confronting the challenges of the ever increasing electricity, water, sanitation, fuel and job demands and more sustainable approaches of these uses according to McComas et al., (2011).

Higher educational institutions have a vital leadership role to play in this regard. Since colleges and universities educate and train our future community and business leaders, teachers and policy makers. Institutions of higher education

have a unique responsibility and opportunity to approach and take action on sustainability. While all institutions and individuals share an obligation to pursue their daily activities in recognition of future generations under the sustainability concept the manner in which academic institutions define and approach sustainability could be very divergent, addressing issues such as health, education, safety and security, employment, while reflecting cultural, economic and political diversity. Universities should work at this course from a practical standpoint in that they are distinctively equipped to help solve the challenge of sustainability through innovation in teaching and learning (McComas et al., 2011).

With the increasing concerns on different environmental issues and more recently a need to respond to climate change, Geng et al., (2012) suggested that universities should create knowledge and integrate sustainability in educational and research programs, as well as promoting environmental issues to the society. Under such a circumstance, green university efforts have been initiated worldwide.

1.4 Research Objectives

The research aims to study the green activities currently on NWU Mafikeng Campus. The research will then evaluate the perception and awareness of students and staff about the green activities on the Mafikeng Campus. It will suggest ways to engage and involve students and staff on green issues in NWU and to contribute to make NWU a Green Campus and subsequently propose a Green Integrated model that is suitable for the Mafikeng Campus. The study is exploratory as there is currently no green model on the campus.

1.5 Rationale of the Study

The implication of this study serves to ensure that there are clear objectives with regard to adopting and promoting green education and awareness and to try for the implementation and promotion of new innovative green teaching

methods. It also aims to assess and address the number of general awareness campaigns implemented on campus while assessing whether there are clear objectives with regard to the promotion and adapting of operations on campus to be green. The end result will be to adopt green policies to continuously monitor energy usage on campus; the use and promotion of alternative energy sources on campus and the implementation of practices to reduce energy usage on campus. It also aims to address the implementation and promotion of new innovative methods to conserve energy on campus and the continuous improvement and promotion of energy management practices on campus. The campus can then use the study as a model to address its carbon footprint and its effects thereof.

1.6 Keywords

Green Campus, Environmental, Knowledge, Research, Sustainability, Carbon footprint, Stakeholders, Resources, Educate, Higher Education

1.7 Research Design

1.7.1 Methodology

According to Lozano (2006), a university consists of five areas of activity: education, research, operations, outreach, assessment and reporting. The first part of this study focuses mainly on operations and includes environmental impacts associated with recycling (paper, glass, plastics), electricity (heating – both geysers and heaters), lighting and water consumption. The second part considers evaluation, perception, awareness and green solutions of students and staff about the green activities on NWU.

Lastly an integrated model which aims to manage all the campus activities on a sustainable basis by minimising energy and materials use, achieving economic benefits (reducing operation and maintenance costs), mitigating the ecological impacts of various academic activities, enhancing both research and education

abilities on sustainability issues and improving student and staff environmental awareness will be proposed.

1.7.2 Sample Design and Analysis

The research was carried out as an empirical investigation into green solutions with respect the North West University (Mafikeng Campus). Qualitative methods were used to evaluate the development of waste management practice on the campus. Data was collected from both staff and students from various levels.

Collected data was collated and analysed using statistical tools applicable to achieve the objectives of the study in order to draw up relevant conclusions.

1.7.3 Data Collection Instruments

This research is mainly based on a survey by way of a questionnaire and internet searches of campus web pages, reviewed pertinent literature, analysed campus plans, and collection of local and college newspaper articles. All these constitute key data sources. The survey was designed based on various higher education institutions successful implementation of green campus initiatives and was administered during the first two weeks of September 2013.

1.8 Scope of the Study

The study will take place on the NWU Mafikeng Campus. It will include both employees as the campus offers on-campus accommodation to students it will include these students as well. The study will therefore include both residences as well as academic buildings.

1.9 Plan of the Study

Chapter 1 introduces the reader to a general overview of the basic significance of the background of the study, the problem pertaining to the research and the research objectives.

Chapter 2 indicates the literature review for the study. The literature review will communicate the current as well as previous studies that were conducted relating to green campus initiatives across the world.

Chapter 3 outlines the research methodology followed in the study, with the necessary rationale, the research design and analysis followed in the current study. The aspects to be covered are research design, sampling, measuring instrument and data analysis.

Chapter 4 deals with the response of the participants of the study, the results of the study and the interpretation to the objectives of the research as indicated in Chapter 1.

Chapter 5 contains the outcomes of the study and the necessary conclusions are drawn and corrective recommendations are made to remedy the research problem.

1.10 Conclusion

The aim of this chapter was to present the main problem of this study as well as the background of the problem in general terms and detailed statement of the problem is provided. The study outlined four objectives and the research design encountered followed by a discussion. The research design is tentative and consists mostly of quantitative research that indicates the methods sampling technique and the targeted population that will be used to conduct the study. The structured self-administered questionnaire method will be an instrument to collect data.

Chapter 2

Literature Review

2.1 Introduction

Education is a highly effective tool for delivering messages to the broader community and for making strong impacts, which is why universities are constantly striving to be trendsetters and ambassadors in important areas of society (Stephens, Hernandez, Roman, Graham and Scholz, 2008). They define the education sector as a vital incubator for future leaders as well as for research, innovation and demonstrating a variety of model practices. It is also regarded as a way of moulding student's values and aiding them as they gain the knowledge and skills that they will take with them into broader society.

The education sector plays an important role in instilling and spreading the value and practices of sustainability as it is training future generations who will need to envision, endorse and implement sustainable development while harbouring a potential influence for the rest of society by enhancing outreach, engagement and collaboration. Stephens et al., (2008) concluded that institutions and campuses nowadays are increasingly focusing on environmental and sustainability issues in response to climate change and related ecological topics; raising student awareness on environmental issues will enhance the education for students while better equipping them with the skills to become leaders in promoting environmentally sustainable practices.

The researcher used various keywords in exploring the literature. The following keywords are examples used in this search: education, research, plan, sustainability, management, resources, collaboration, outreach, awareness and environmental issues/ sustainability and these keywords aim to address its roles in this chapter. The search engines used in this chapter are Google Scholar and ScienceDirect.

This chapter starts with an introduction into green campus and the role the education sector plays in green environmental sustainability. The chapter continues to address sustainability and green campus and the various interpretations thereof. It then goes on to address the principles and strategies of developing a green campus. The chapter further explores on the various findings relating to approaches to green campus initiatives and how energy, water and materials and waste consumption can be addressed. It also tackles how transportation can be managed and the erection and promotion of green building. The final section of the chapter then speaks to the adoption of an integrated model to sustainability.

2.2 Sustainability

The most commonly referred to definition of "sustainability" comes from the Brundtland Report of the World Commission on Environment and Development (1987) is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In other words, while sustainability as a concept is focused on the environment, it is inclusive of the way people are involved in the equation and how they gather, distribute, and utilise resources and services as well as social and natural capital.

Velazquez et al., (2006) defined a sustainable university as: "a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimisation of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfill its functions of teaching, research, outreach and collaborations, and stewardship in ways to help society make the transition to sustainable lifestyles."

While some disagreement still exists over the precise meaning of sustainability, three concepts are reflected in almost all definitions that natural resources are finite; that environmental, economic, and social goals must be pursued within these limits; and that a need for inter- and intra-generational wellbeing exists.

Sustainability efforts can thus take shape within and around various facets of university life: research; curriculum and education; university policy; management and operations; programs and services; as well as the attitudes and behaviour of students, faculty and staff (Velazquez et al., 2006).

2.3 Principles and Strategies of Developing a Sustainable Campus

The main principles for developing a sustainable campus (Saleh, Kamarulzaman, Hashim and Hashim, 2011) while doing a study at the UniversitiTeknologi MARA (UiTM) includes sustainability governance framework, formal policy or statement of commitment to sustainability, flagship projects or initiatives to reduce environmental impact, green funding and investment, sustainable operations, sustainable buildings, sustainable transport and travel, sustainability reporting, sustainability education and research and grassroots sustainability projects.

Saleh et al., (2011) also came up with some strategies for sustainability that includes commitment to sustainable development and changes in the regulatory environment together with the mounting evidence of environmental degradation to review current practices and adopt a more sustainable approach. The institution of higher learning must establish its "Sustainability Committee" to develop appropriate policies and procedures for sustainability within the university while their purpose will be to provide a forum which shall enable the development of appropriate policies and procedures for sustainability within the university.

The university must develop a sustainability management plan (SMP), which details strategies to be implemented in five years for achieving improved sustainable performance in the areas of recycling and waste management, energy and emissions management, water management, transport, increased community awareness, environmental management; information regarding the implementation of sustainability policies, procedures and sustainability

management plans must be provided to senior management via the operations and commercial services on a regular basis and sustainable building for optimum orientation, ecologically designed storm-water and waste water treatment and natural ventilation strategy. Sustainability goes beyond hardware, it providing green facilities. More importantly, it requires the building up of an environmental sensitive culture to bring about enduring momentum towards sustainability (Saleh et al., 2011).

2.4 Green Campus

The first Earth Day in 1970 stimulated student groups, staff, and faculties all over the world to begin greening campuses. Through the 1990s, efforts focused primarily on increased recycling, more efficient lighting, water conservation, and waste reduction and procurement, including purchasing recycled paper (Rappaport, 2008)

The 1990s also ushered in an era of dramatic growth on campuses. New classrooms, expanded libraries and residences, more computers, and new and better-equipped laboratories all enhanced the educational mission. Colleges also invested in spectacular facilities, including indoor kayak runs and state-of-the-art movie theaters. All these amenities increase the campus environmental footprint. Students today are different from their 1990s counterparts; they arrive at college loaded with electronic devices and consume a great deal more energy. These factors combine to create a situation in which electricity efficiency measures on most campuses are negated by increased usage (Betts, 2001).

Some universities are calling for the need to "green" the campus, but there are several interpretations of the green agenda, some use the terms green campus, eco-urbanism, green urbanism, green building and high performance buildings to describe the concept (Nixon, 2002).

The ways the green campus initiative is implemented also varies from one university to another. The following items were most frequently referred to as essential elements of successful campus "greening" initiative involve staff throughout all stages of a campus greening initiative; obtain institutional commitment like financial support, staff time, information access, public statements of commitment and policy are all crucial to a long-term strategy; involve students as this can have tremendous educational benefits and build positive relationships between stakeholders (Ying, 2010).

2.5 Approaches of leading Green Campus Initiatives

Green campus initiatives are not always successful; some have been more successful than others in surviving and expanding their effectiveness than others (Sharp, 2002).

He suggested a number of approaches that maximises the surviving and expansion of these initiatives that includes management support that is a secure commitment from management that can be gradually substantiated with action. He also suggested effective coordination to have a communicator that is dedicated, skilled, respectfully persistent and a creator. The maximisation of face to face communication leads to effective dialogue, resulting in learning from other people their language and cultural differences. Active listening skills are essential for moving ahead with the change process as this can assist in building both informal and formal support that ensures understanding and support before formalising systems (Sharp, 2002).

The building of partnerships in seeking collaborations to support projects, optimise synergies, maximise broad relevance and flow of effects are factors to be considered when looking at the process of going green. Ideas and the path of least resistance is a sure way to go with the ideas which have the most support and use this as a means of generating the foundation for more challenging ideas. When looking at maximisation, integrated planning and integrated design is needed to exploit arrangement thinking to understand interrelationships and to perceive valuable design solutions. The process of

trial review and expand can eliminate risk and create organisational support by running pilot projects and continuous improvement (Sharp, 2002).

One should seek conscious development of a learning organisation where the learning prospective of experience and process can be optimised. With the right management framework the coordinator must have freedom to engage all levels of the university community and have access to generate and strategically draw upon the highest levels of management. Risk tolerant management staff are staff that are willing to support low risk innovation and mentor staff working to forward the organisational vision for change, can be a important factor when successful outcomes are expected. Student partnerships are also crucial in these initiatives when trying to tap into talented committed students and involving them through paid positions and/or research projects while ensuring that their work is relevant and integrated into university systems (Sharp, 2002).

Lastly there must be continuity to allow two to three years to establish foundation of trust relationships, organisational familiarity and skill base to be effective in medium to long term projects. There must be relative forums created for broad base community engagement, discussion and consideration and profile sharing of the learning experience with everyone who has any interest. The institution must maintain a profile within and beyond the University for the Effort being undertaken by using information systems as a means of capturing and presenting information in digestible formats for all levels of management. Sharp (2002) concluded that in order for the successful application of these approaches it requires high competencies in listening, communication, relationship building, vision development, responsiveness and continuous strategic adaptation.

2.6 Energy Consumption

Energy is one of the most fundamental parts of the universe. It is used to light the cities, power different types of vehicles, heat and cool homes as well as

many more countless applications. In other words, everything people do is connected to energy in one way or another. One of the most cost-effective ways to save energy and reduce Greenhouse Gas (GHG) emissions is through changing energy consuming habits and behaviours (Spirovski, Abazi, Ijazi, Ismaili, Cassulo, and Venturin 2012).

Considering the energy crisis faced all over the world, especially South Africa and India, co-generation systems have proven to be a very useful tool to combat the increasing energy demand as reported by (Patel and Patel, 2012). Through the simultaneous production of power/electricity, hot water, and/or steam from one fuel, cogeneration plants can reach system efficiencies exceeding 60% depending upon the type of applications.

In the Patel and Patel (2012) study of the Sustainable Campus of Claris, the campus has since their inception in 1999, installed a captive cogeneration power plant which runs on biomass and hence saves use of coal or lignite which is green-house gas emitters. The biomass based cogeneration plant is an absolute energy-efficient and environment-friendly method of producing electricity (power) and steam for process and utility, thereby fulfilling on-site energy requirements with one fuel. The fuel used in cogeneration power plant includes bio-mass which is currently processed through castor de-oiled cakes (DOC), saw dust and bagasse. The cycle used is the conventional ranking cycle which burns the biomass in a high pressure boiler to generate steam with the help of which a turbine is operated. The cycle has the efficiency to generate 23–25% of net power. The exhaust of the steam turbine is used to fulfill process steam requirements and partly to produce power (Patel and Patel, 2012).

Claris on other hand has gone ahead with cogeneration plant which has the potential not only to capture the wasted heat energy that would have been lost but also to triple the energy efficiencies of ordinary power plants. Furthermore, the biomass co-generation plant at Claris substantially cuts carbon dioxide emissions (and other greenhouse gases) and nitrogen oxides (NOx) and is absolutely environment friendly. While, biomass can cut CO_2 emissions by up

to 70% vs. a coal plant when utilised in a cogeneration plant, nearly 100% cuts in SOx are possible (Patel and Patel, 2012).

In addition to the fulfillment of power and steam requirements, there are certain other focus areas related to the cogen plant which contribute to the sustainability aspect of the Claris campus. Fly ash utilisation, the fly ash removed from the Power plant is used in making bricks at the campus and agro waste in the form of leaves, lawn grass, pruning waste, dry bamboo leaves collected from the campus are used for firing in Cogenplant (Patel and Patel, 2012).

In a study conducted by Kwan and Hoffman (2010), they found that the campus could reduce its current annual energy consumption by 18.2% simply by improving energy efficiency. The study concluded that the campus would need to install a 4601 kW solar photovoltaic (PV) array to meet the remaining total campus energy demand, eventually increasing to as much as an 8200 kW array by 2020 after taking into account campus build-out plans.

Kwan and Kwan (2011) studied the financials of constructing a solar PV for net-zero energy operations on Los Angeles Community College District's nine campuses. They found that their models provide a good starting point for solar PV array analysis but also include several limitations like the inability of the models to account for time of use (TOU) energy charges and the inability to incorporate actual hourly campus energy demand profiles. They also found an inability to incorporate actual hourly solar insulation received; RETScreen model only allows for average cost of energy calculations; the lack of accounting for solar PV array degradation and inability to compare different solar PV array configurations. Campus management should also look into installing hybrid solar systems into buildings and develop best practice energy manuals (Escobedo, Briceño, Juárez, Castilloa, Imaz, and Sheinbaum, 2014).

Each hour the Earth receives more energy from the sun than the world can use in one year. Of this plentiful energy supply, South Africa receives its fair portion with one of the world's highest levels of solar radiation. This amount of solar

radiation ranges from around 1450 kWh/m² to 1950 kWh/ m², compared to the European average of 910 kWh/m² per year (PDC Solar, 2008). Solar energy is collected by a panel which is connected by pipes to a hot water storage device, like a hot water cylinder. The worldwide trend in solar heating technology is growing in agreement with Solco Solar (2007) for reasons such as an increased drive to cleaner energy production, an increased awareness of global climate change and an increasing reliability and effectiveness of residential and industrial solar water heaters.

2.7 Water Consumption

Residential universities, with their high density housing complexes and community dining facilities, tend to consume large quantities of water for drinking, hygiene, irrigation and food preparation and disposal. Water conservation can be achieved via the collection f rainwater and storm water for irrigation use and design landscapes with drought-resistant, native plants and grasses, and that support integrated pest management (Alshuwaikhat and Abubakar, 2008).

To ensure treatment of waste water and recycling for greening the landscape Claris has installed membrane filtration technology as an effluent treatment plant in order to recover useful chemicals and re-use water for plantation. They have also tried to make sure that no waste water is discharged into rivers and hence after treatment at the Effluent Treatment Plant (ETP) as well as blow down water from power plant are used for gardening as well as farming purpose. Claris has to achieve efficient water resource management with a rainwater harvesting system, 13 recharge wells and a well-designed storm water drainage channel system to preserve ground water and maintain the water level (Patel and Patel, 2102).

2.8 Materials and Waste

Universities are considered to be similar to small towns because of their large size, population, and the various complex activities taking place on campuses. As such, they not only need to maintain an appropriate physical infrastructure, they require similar services to small towns, including accommodation, transport, retail, leisure and, of course, waste management (Alshuwaikhat and Abubakar, 2008).

Universities contribute to the waste stream by consuming striking amounts of office supplies and other materials needed to support their educational and research missions (Evangelinos et al., 2009). The university's laboratories, art and architecture studios and car pools produce hazardous waste which must be disposed of with special care, tracking and reporting. Campus capital improvement projects also introduce large amounts of construction and demolition debris to the waste stream. Despite the recyclability of many of these materials, a considerable amount still winds up in landfills.

Many universities use waste management activities, especially recycling, as a starting point for green campus initiatives. However, setting up environmental initiatives such as recycling programmes is no easy task. The following widely recognised elements are crucial to successful environmental projects at universties: understanding how universities work, especially how internal decisions are made; commitment and demonstrated support for environmental actions; sufficient funding; a university-wide co-ordination; adequate communication and knowledge; well-planned infrastructure and reliable contractors (Tan, Chen, Shi and Wang 2014).

However, without realising it, most students have developed many automatic behaviors that are detrimental to the environment, such as throwing away recyclables, leaving computers and printers on through the night and not turning off lights when leaving a room. The University of Southampton (UoS) is continually working to extend its partnerships and share learning and practice

in sustainability with the local community. As an example, it aims to promoting sustainability in the local community by encouraging students in private accommodation to manage their waste responsibly, thereby avoiding nuisance and pollution from waste. It also collaborates with local charities to enable them to gain donations and monetary value from the reuse and recycling of materials from the University as reported Zhang, Williams, Kemp, and Smith, (2010).

Claris on the other hand have instituted a mechanism to harvest biomass from un-utilised solid waste as an integrated solution for this multifaceted problem of solid waste disposal. The production of methane via an-aerobic digestion of kitchen waste and left over food has benefited the campus by providing a clean fuel from renewable feed stocks. This further aids in reducing the use of fossil-fuel derived energy and reduce environmental impact. The biogas generation at Claris has led us to achieve the complete return from the reusable; control over pollution caused by the decomposition of waste; control over methane gas emissions and hence over expenses to mitigate GHG emissions (1t of methane is equivalent to 21t of carbon dioxide) and a rich energy generation in terms of methane and production of manure, an alternative source of energy that can be used for agriculture at no extra cost while safeguarding the depleting fossil fuel (Patel and Patel, 2012).

During the 2007–2008 academic year the Prince George campus produced between 1.2 and 2.2 metric tonnes of waste per week, of which more than 70% could have been diverted through waste reduction, recycling and composting activities. Paper and paper products, disposable drink containers and compostable organic material represented three of the most significant material types for targeted waste reduction and recycling efforts (Smyth et al., 2010).

2.9 Building Environment with a Focus on Energy

The green buildings initiative is a set of projects designed to decrease production of waste and hazardous materials, reduce level of energy consumption and promote the design of energy efficient buildings. The green

building initiative represents a sustainable design concept, because buildings have a significant impact on the environment, accounting for one-sixth of the world's freshwater withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy, leaving a large negative impact on the environment and health (Alshuwaikhat and Abubakar, 2008).

One of the main goals of this initiative is to promote the construction of energy and resource efficient buildings. This goal is achievable by a choice of environmentally friendly building materials and design of integrated and flexible systems in buildings, which can impact indoor air quality and are also energy-efficient. The green building concept also promotes the use of local materials, which can help regional economies and reduce transportation costs in terms of money and pollution as well as the adoption of safer construction practice that includes mitigating the impacts of construction storm water run-off, noise, dust, personnel and traffic (Alshuwaikhat and Abubakar, 2008).

The green building initiative offers many advantages over traditional building design concepts but cannot alone guarantee sustainability as it lacks a systematic and continuous campus quality improvement. Even more challenging is that much of university campuses' structures and infrastructure have already been built unsustainably and sustainability by its very nature requires an integrated and holistic approach to decisions making and investments (Alshuwaikhat and Abubakar, 2008).

Pérez, Rincón, Vila, González and Cabeza, (2011) studied green vertical systems for buildings as passive systems for energy savings. They found that that a microclimate between the wall of the building and the green curtain is created, and it is characterised by slightly lower temperatures and higher relative humidity. This means that the green screen acts as a wind barrier and confirms the evapo-transpiration effect of the plants.

2.10 Natural lighting and ventilation

In general, there are four basic reasons why natural lighting systems are required by building codes in many parts of the world. The reasons are to facilitate the performance of visual tasks and ensure visual comfort and to provide visual communication channels between people and their outdoor environment. Other reason includes making provision for psychological impact to lighting schemes and to conserve lighting energy, during daylight hours, and help reduce the total energy requirements in buildings (Patel and Patel 2012).

Since its 1999 inception, Claris has also introduced natural lighting in all their buildings in that it has installed around 1708 sky domes over the ceiling area which helps in utilising the natural light during day time and reduces the lighting load. These sky domes are installed where they remain exposed to direct sun throughout most of the day. A great amount of attention has been paid while installing them so they face the sun as much as possible, in order to keep sky domes as small as possible. The sky domes have proved to be significantly effective for manufacturing and maintenance operations at the campus. Fully glazed glass panes and partitions provide better visibility and transparency of operations and it has helped reduce the lighting loads and possibility of accidents (Patel and Patel, 2012).

In addition to sky domes Claris has installed 88 variable frequency drives (VFDs) in order to increase energy efficiency. High Ventilation Air Conditioning (HVAC) & Natural Turbo Venti- lation are installed at manufacturing units for even cooling and saving energy. It is well known that natural light harvesting saves electricity and reduces carbon emission by 36,800 Lb every year whereas turbo ventilation saves electricity and saves 55,200 Lb carbon emission every year (Patel and Patel, 2012).

2.11 Transportation

Although not a major contributor to the campus footprint, transportation nevertheless plays a role in emissions and also in the use and consumption of resources. Reducing car commuting will produce demonstrable and tangible benefits to a university (Tolley, 1996). For example, being 'green' may be a factor in students' choice of university particularly as environmental issues have become more prominent in the curriculum of many schools.

The most obvious cost, however, is the provision by the university of facilities that enable people to commute by car, particularly parking space. The costs of providing parking facilities include the salaries and associated overheads for car park attendants, the administration costs, the asset value of the land used for car parking, taxes paid on the car-parking space, the capital costs of establishing the car parks and the maintenance and repair costs for them and fees and other payments to clamping (Tolley, 1996).

Tolley, (1996) came up with several approaches to reduce this burden, which includes that new buildings must not be provided with any more than essential access. Parking areas could be used as sites for new facilities, off-setting the need to buy land at a cost, or could be sold on the open market for a one-off financial benefit.

However, should car parks be retained, their costs could be audited and charges introduced to cover these in full; plentiful on-street parking near to the campus may undermine university restrictions thereby encouraging the local authority to introduce parking management strategies that is essential and the bicycle is the ideal alternative to the car over short distances because it produces no pollution, uses no energy, is silent, takes little space and is fast and cheap (Tolley, 1996).

Tolley, (1996) suggested measures specifically to reduce car commuting by restraining cars and introducing full-cost car parking charges and abandoning car parking expansion and reclaiming some car park space for other uses.

Physical measures, providing plentiful, secure bicycle parking including at halls of residence and ensuring easy access to showers and changing rooms for commuters. Another measure is the construction of bicycle paths or tracks or modifying existing roadways to ensure that they are conducive to safe and efficient cycling. The institution could also look at administrative measures, whereby establishing a bicycle advisory committee would look after cyclists' needs and running safety education programmes and bike repair/ maintenance classes.

The university could also provide on-campus bike repair facilities and take publicity and promotion measures by publicising cycling initiatives through newsletters, salary slips and notice boards. The opening of channels of communication with the local authority to ensure linkage of campus facilities with those off campus (or to encourage provision where it is lacking) while operating 'bike-mate' schemes to give confidence to new or returning cyclists Tolley, (1996).

Economic measures should also be taken into account by offering a incentives to people who sign an agreement not to commute by car possibly by way of providing an interest-free loan for a bike or operating a bike leasing scheme. Under this, the most promising approach, the university would lease bikes (for perhaps R100-R200 per month) and place them free of charge at the employee's disposal. The lease company would be responsible for maintenance and repair. After three years, the user may buy the bicycle for around R250 – R350 (Tolley, 1996).

In the 21st century there exists many reasons that encourage cycling as an environmental friendly activity (Jalalkamali and Ghraei, 2012). Cycling not only decreases the problems created by global warming, it also improves the health and well-being of individuals. A quantitative survey was conducted between the students staying at a campus in one of the Malaysian universities to investigate the potentials of cycling habits between these students.

It can be concluded from the respondents' opinion that the use of bicycle is mostly affected by the topography of the university and the weather constraints. University campuses may be located in rural or urban areas, irrespective of this, their layouts vary according to their locations. A rural campus tends to present horizontal connectivity, while an urban campus tends toward vertical connectivity. Rural campuses are normally more automobile dependent than urban ones (Jalalkamali and Ghraei, 2012).

2.12 Services, Waste, and Food

Across university campuses, large volumes of waste, much of which could be recycled, are routinely hauled to and disposed of in landfills. Previous studies (DeVega, Benítez, and Barreto, 2008; Smyth et al., 2010) have shown that as much as 55–90% of university waste streams could be recycled.

The collection, transportation, and disposal of this waste come at a significant economic cost to the institution, and landfills, which are rapidly filling to capacity. The challenge of campus waste management thus becomes finding ways to minimise the institutional waste stream by reducing the generation of trash and increasing rates of recycling and composting, much of which translates to student education, responsibility, and behaviour (DeVega et al., 2008; Smyth et al., 2010).

Residential buildings will likely have the most diverse waste streams on a campus as a result of the assortment of activities that occur in the residence halls on a daily basis including eating, school work, socialising, and daily living. Characterising, analysing, and understanding the composition of a campus' residential waste stream is a critical first step toward developing successful and effective waste management strategies across university campuses (de Vega et al., 2008; Smyth et al., 2010).

Mason, Oberender, and Brooking, (2004) did a source separation systems study for solid residuals to the kitchen/cafeteria and concourse areas of a 9000

student university campus. Over a 5 week in-semester period, they found the total source separated residuals stream generated in the kitchen/cafeteria area comprised 37% (w/w) food residuals, 3% (w/w) paper, 5%(w/w) plastic, 33% (w/w) "rubbish", 15% (w/w) cardboard, 1% (w/w) glass, 1% (w/w) newspaper and 5% (w/w) steel cans, whilst the proportions generated in the concourse area were 25% (w/w) food residuals, 4% (w/w) paper, 18% (w/w) plastic, 53% (w/w) "rubbish". Food residuals were found to be suitable for composting in combination with on-campus green (yard) waste, whilst most other separated streams were either accepted in practice, or technically suitable, for recycling. They concluded that improved ongoing education and training is required in order to achieve a high standard of source separation performance from both the kitchen/cafeteria staff and the university community Mason et al., (2004).

Baldwin and Dripps (2012) did a multi-year study (2008–2011) assessment of the composition and spatial variability of the residential waste stream by both weight and volume. Waste audits were conducted on a dumpster by dumpster basis over the three-year period, with garbage being sorted into eight separate waste categories. Of the total 587.4 kg and 14.8 m^3 of residential waste sampled, 25% by weight and 41% by volume could have been recycled under the university's current waste management program, and 61% by weight and 63% by volume could have been diverted from the landfill through a combination of the university's recycling plan, the county's recycling program and the composting of food waste.

Baldwin and Dripps (2012) found distinct spatial differences in the composition of the waste stream with regards to the glass, compost material, and cardboard content among the different housing complexes. Their analysis found the observed variability to be the result of differences in the age and class of the student residents, the meal plans of the residents, social patterns of alcohol consumption within the residence halls, and the presence or absence and quantity of kitchens in each building. An efficient waste management program requires not only an assessment of the waste stream but also an understanding of the mechanisms and behaviors responsible for generating this garbage (Baldwin and Dripps, 2012).

Integrated waste management systems are one of the greatest challenges for sustainable development. For these systems to be successful, the first step is to carry out waste characterisation studies. DeVega et al., (2008) reported the results of a waste characterisation study performed in the Campus Mexicali I of the Autonomous University of Baja California (UABC).

The aim of this study was to set the basis for implementation of a recovery, reduction and recycling waste management program at the campus. It was found that the campus Mexicali I produces 1 ton of solid wastes per day; more than 65% of these wastes are recyclable or potentially recyclable. These results showed that a program for segregation and recycling is feasible on a University Campus. The study also showed that the local market for recyclable waste, under present conditions and number of recycling companies and amounts of recyclables accepted, can absorb all of these wastes. Some alternatives for the potentially recyclables wastes are discussed. Finally some strategies that could be used to reduce waste at the source are discussed as well (DeVega et al., 2008).

Due to academic and research endeavours paper and paper products (printer paper, mixed paper, newspaper, corrugated cardboard, boxboard and paper towel) represent the single largest component of the Prince George campus of the University of Northern British Columbia (UNBC) waste stream in consonance. Further examination of the paper recovered from the UNBC waste stream indicates the following sequence of material prevalence: mixed paper > paper towel > old corrugated cardboard (OCC) > newspaper > printer paper (Smyth et al., 2010).

Smyth et al., (2010) also concluded that disposable drink containers make up 34% of the recyclable material in the UNBC waste stream. Of the drink container types, single-use hot beverage containers, typically used for "to-go" coffee and tea, constitute highest proportion (% by wt.). It is estimated that UNBC sends over 5000 single-use hot beverage cups to landfill each week, a number which increased significantly ($n = 15$, $p = 0.023$) over the study period.

This level of needless waste production is inadvisable at an institution that has committed itself to being Canada's Green UniversityTM.

The excessive waste associated with drink containers has led numerous colleges and universities to focus waste reduction efforts on single-use hot beverage cups through the promotion of refillable cup campaigns. The University of Wisconsin-Madison, for example was one of the first campuses to initiate a refillable mug program and test their usage, selling over seventy-two thousand mugs to date and raising $ 11,000 USD annually (Smyth et al., 2010).

2.13 Integrated Model

Similar to a community, the operation and maintenance of one university is a process of socioeconomic metabolism, taking in various materials, energy and water and transforming them into wastes. Each unit (administrative/ teaching/ research) interacts with others through a complex network. Without consideration of greening campus, such a transformation is a linear process, indicating lower eco-efficiency and heavy environmental burdens to the surrounding communities (Geng et al., 2012).

In order to improve its sustainability, Geng et al., (2012) proposed an integrated model so that various dimensions (material/energy/water/teaching/research) can be addressed in a systematic way. Their integrated model aims to manage all the campus activities on a sustainable basis by minimising energy and materials use, achieving economic benefits (reducing operation and maintenance costs), mitigating the ecological impacts of various academic activities, enhancing both research and education abilities on sustainability issues and improving general public's environmental awareness.

It addresses all the issues related with one university's metabolism and ensures that the views and goals of different stakeholders are considered

together. Such a holistic approach requires that all pertinent factors related with university operation should be considered in the decision-making process, avoiding the problems raised from fragmented institutional framework. It also requires all the stakeholders to fully understand the metabolism process of one university so that environmental and social implications of their activities can be recognised (Geng et al., 2012).

Zhu and Wu (2010) suggested a campus for the "old" at the changing of the millennium with four aspects of our design research, "original nature, organic spaces, rational construction, and humanistic affection". Specific reference is made to the garden and the establishment of court incorporating hills and waters are intended to form a campus with traditional implications, human nature and spirit preserved and developed.

2.14 Research Questions

After systematically reviewing the literature around the knowledge of green campus initiatives a numerous questions were raised. The author felt the following questions evolved as a direct result of having duly examined the available literature:

- Does the campus has clear objectives with regard to the promoting and adapting of green operations on the campus?
- Does research has a measureable impact on environmentally sustainable society?
- Does the campus continue to promote new methods of energy, water and waste consumption?
- Does the campus implements environmental impact assessments for new and existing buildings?

2.15 Conclusion

A sustainable organisation respects the interdependence of economic, social, and environmental issues, and meets its current needs without compromising the ability of future generations to meet their own needs. These principles of sustainability have been increasingly embraced by corporations, government agencies, and institutions of higher education as a means to recognise and take responsibility for their respective societal roles. Sustainability takes on an even deeper meaning for institutions of higher education, whose central mission it is to prepare students to participate and ideally improve society at large. In shaping the lifestyles and habits of millions of graduates, many of whom will become leaders in some form or fashion.

The next chapter focuses on the methodology used in this research and the design used to achieve the research.

Chapter 3

Research Methodology

3.1 Introduction

The purpose of research is amongst others, to Generate new knowledge (Collis & Hussey, 2003). Clough and Nutbrown (2002) on the other hand define the term research as "an investigation of an idea, subject or a topic from a particular prospective for a purpose". Research methodology thus focuses intrinsically on a particular problem that can be explored in a research study. The study therefore varies according to the problem being examined.

This chapter outlines the research methodology used in the study of green solutions in higher education with particular reference to NWU Mafikeng Campus. It includes the research design and the data analysis methods used relating to the research in the selection of the population and sample, measure of instruments and procedure for data collection and statistical techniques. The chapter ends with the researchers' conformance with ethics.

After systematically reviewing the literature around the knowledge of green campus initiatives the following questions/ statements were raised:

Does research have a measureable impact on environmentally sustainable society?

Does the campus have clear objectives with regard to the promoting and adapting of green operations on the campus?

Does the campus continue to promote new methods of energy, water and waste consumption?

Does the campus implement environmental impact assessments for new and existing buildings?

3.2 Research Types

3.2.1 Qualitative and Quantitative Research

Quantitative research focuses on measuring an occurrence, is dependent on collecting structured data and analysing instruments that place a suitably varied understanding into set responses. Although the design of quantitative research is harder it is easier to collect and analyse. Qualitative research, as opposed to Quantitative research, is more subjective in nature. Qualitative research can be easier to start, but may prove often to be difficult to interpret and to present the findings resulting in the findings being challenged more easily. The results of this research were expressed as statistics hence there is an element of quantitative data when compared to qualitative data (Babbie 2004).

Table 3.1 Comparison of Qualitative and Quantitative Research Methodology

Description	Qualitative	Quantitative
Objective/ purpose	Aims to increase understanding of underlying reasons and motivation while trying to uncover common trends in thought and opinions	Aims to quantify data and generalise data from a sample to the population of interest
Sample	Is normally a small number as respondents are selected to fulfill a given proportion	Number of occurrences representing the population of interest is large
Data collection	Uses unstructured or semi-structured techniques e.g. individual depth interviews or group discussions. Such interviews ensues a confidential conversation between an interviewer and a respondent	Uses structured techniques tools, such as questionnaires or equipment to collect numerical data
Data analysis	Non-statistical. The researcher discloses biases, values, and experiences that may	Findings are conclusive and usually descriptive

	impact the interpretation of the results	in nature
Outcome	Findings are not conclusive and cannot be used to make generalisations about the population of interest.	Used to recommend a final course of action

3.2.2 Research Method used in this study

The research method used in this study comprises the quantitative approach aiming to enhance both research and educational ability on sustainability issues and improving general public's environmental awareness at NWU Mafikeng Campus.

3.3 Data collection methods

3.3.1 Primary and Secondary Data Collection Methods

Primary data is data that is collected for the first time and are always original in nature. This data type needs the application of statistical methods for the purpose of analysis and interpretation. Secondary data, on the other hand, are those sets of data that was previously collected and analysed by another party and has thus already been through the primary phase (Hox, 2005). Both primary and secondary data have advantages and disadvantages to it as listed in table format below:
(http://communitymedicine4asses.wordpress.com/2013/01/07/types-of-data-primary-and-secondary-data/)

Table 3.2 Advantages and Disadvantages of Primary data

Advantages	Disadvantages
• Data collected relates to problem being studied	• Data collection may be a taxing on the researcher
• The quality of the data is first class	• Ensuring that the data collected of a high standard
• Further data may be required during study should the necessity evolve	• Cost of obtaining this data is high

Table 3.3 Advantages and Disadvantages of Secondary data

Advantages	Disadvantages
• The data is already available	• The quality of the data may not be good
• Researcher is not responsible for the quality of the data	• The data may not be reliable or adequate
• It is less expensive	• Further data collection may prove to be difficult

There is a need for a prescribed data collection process that is necessary as it certifies the data collected. Based on this, the ensuing decisions and subsequent arguments represented in the findings are proven valid. In doing so, a basis is formed whereby corrective measures, if required, can be put into place.

3.3.2 Sample Method

Onwuegbuzie and Collins (2007) define sampling designs as representing the framework within which the sampling occurs, comprising the number and types of sampling schemes and the sample size. The study made use of a simple random sample where every member of the population (N) had and equal chance of being selected for this sample (n). There are two advantages to sampling namely that the cost is lower and the collection of data is faster than measuring the entire population.

This qualitative data was statistically analysed to show the results and subsequent addressing using a simple random sample. The sample may appear distorted and not a true reflection of the status of environmental sustainability due to the number of respondents. The quantitative aspect surrounding the same sample involved the campus community who used the questionnaire to air their opinions and give feedback regarding campus environmental management systems (if any) on the campus.

3.3.3 Sampling Technique

Given a large enough sample, of all sampling schemes, random sampling offers the best chance for a researcher to obtain a representative sample.
For strictly descriptive statistics about finite populations, the standard error of descriptive estimates is correctly reduced by the application of a finite population correction factor. In the simplest case of simple random sampling, the finite population correction factor is:

$$fpc = 1 - \frac{n}{N}$$

where n is the sample size and N is the population size. Staff and students across the campus formed part of the sample or population. If the purpose of the analysis is analytic, then, even in the simplest case of statistical significance of the observed difference between two domain means, the use of the finite population correction factor is inappropriate (Cochran, 1977).

The sampling technique employed was a simple random simple whereby students and staff were given a questionnaire to complete. This was done in no particular order with the understanding that it was purely a questionnaire for research purposes and to test whether they had any knowledge or input into green research or green operations on the campus.

3.3.4 The research questionnaire

The strength of the analysis depends on good quality data that in turn stems from good design of the data collection instrument, i.e. the questionnaire, and of the collection procedures (Burgess, 2001). An intelligent and well-designed questionnaire requires consideration and might. IT thus needs to be planned and developed in a number of stages.

It is important to be clear about the type and nature of information you need to collect and exactly who your target population is. An important aspect of questionnaire design is to make sure that each question adds value, is clear and easy to understand. The numbering of questions should be

understandable to the respondent. A technique, known as 'funneling', begins with general questions before focusing down to more specific questions. This technique is commonly applied in structured and well-designed questionnaires.

Gender, age, ethnic origin and disability are sometimes used to monitor whether a representative cross-section of the population was reached accounting for equalities. Also, respondents needs reassure respondents that the responses they give on the questionnaire are confidential and that their identities or personal details will not be disclosed to others, except for research purposes. It is best to try the questionnaire on a small sample prior to sending out the questionnaire to the population to address confusion that may arise.

The questionnaire to this study was done on NWU Mafikeng Campus and comprised of a welcome message introducing the aim of the research encouraging people to take part thereby increasing the response rate. A moderate list of questions was asked whereby the highest score was indicative of greater certainty. The structure of the questionnaire was such that the exact questions to be asked were decided on in advance. The questionnaire consisted of closed-ended questions that were used to explore respondent's beliefs, attitudes, and practices around green issues.

Table 3.4 Questionnaire Outline

A short disclaimer describing the purpose of the study – Refer Appendix A	
Questionnaire – Refer Appendix B	
Section A	Assembles biographical data on the respondents including age, gender, qualification and whether a student or a staff member

Section B	This section focuses on whether there is green research awareness on the campus and the (non) interest of students therein
Section C	This area focuses on green operations on the campus and the general feel of respondents surrounding awareness of green campus issues

3.4 Data Analysis and interpretation

For purposes of this study the research data collected consisted of descriptive statistics and bivariate analysis. The types of variables used in this study are nominal and ordinal. They refer to the levels of measurement associated with the variable and are briefly described below. Bivariate correlations estimate the correlation coefficients between two variables at a time, ignoring the effect of all other variables (McCrum-Gardner 2007). The analysis method used in this study was Statistical Package for Social Sciences (SPSS) using the comparables of charts and tables to further describe the analysis.

3.4.1 Nominal variables

Nominal scale is sometimes referred to as the qualitative scale based on the name and qualitative classification they belong to. Nominal scale categories used in this research is the gender and levels of study. This study shows how many males and females participated in the study and their levels of study and the frequencies tables shows the most general answer within any category of questions.

3.4.2 Ordinal variables

Ordinal data is ranked categorically as in scales with unequal intervals, such as a scale like "strongly disagree", "disagree", "no comment", "agree" and

"strongly agree"). If a theme is measured ordinally, then the likelihood of chance agreement changes accordingly.

3.5. Ethical considerations pertaining to the study.

The ethical behaviour of individual researchers is under unprecedented scrutiny (Best and Kahn, 2006; Field & Behrman, 2004; Trimble & Fisher, 2006). Researchers must guard against unethical research practices through his or her personal individual knowledge under all circumstance.

3.6 Confidentiality

The researcher undertook to keep all information of participants in the questionnaire confidential and in no way will their details be made known. This was done to ensure coherence and acceptance of responsibility on the side of the researcher.

3.7 Conclusion

The information that was gathered through the data collection methods was used to explain the findings/ results through both the quantitative and quantitative methods. These findings are discussed in the following chapter.

Chapter 4

Results and Discussion

4.1 Introduction

This chapter provides the analyses and discussion of the data that has been collected through the research methodology in Chapter 3. They survey was conducted through specific questions in order to establish whether there is a relationship between awareness of green campus and actual projects relating to such events. The data was collected from respondents through questionnaires that were randomly distributed.

The survey asked specific questions and the analysis was done based on the application of Pearson correlation coefficient. According to Higgins (2005), the correlation coefficient is a single summary number that gives you a good idea about how closely one variable is related to another variable. Correlation quantifies the extent to which two quantitative variables, X and Y, "go together." When high values of X are associated with high values of Y, a positive correlation exists. When high values of X are associated with low values of Y, a negative correlation exists.

Since the North West University, Mafikeng Campus is situated in a largely rural area, the researcher found that many of the student respondents are from the area and first time entrants into a higher education institution. The researcher therefore wanted to know whether any and all respondents were aware of global awareness and how it affects the community in which they live. Also the researcher wanted to create awareness surrounding green initiatives and the role the youth of today plays in this.

4.2 Analysis of the Variables

A sample of 246 respondents was taken for the survey on green solutions in higher education North West University (Mafikeng Campus). The researcher aimed to establish a relationship between green campus initiative awareness and how the education sector fits into it.

4.2.1 Demographic Analysis

The respondents were asked their gender, age, level of study, ethnicity, occupation (if the respondent is an employee) and general qualification of the respondents. The pie charts below in figures 4.1 – 4.4 specifically relates to the demographic analysis of this study. The majority was young adult students doing either their first or second year between the ages of 18 – 22 (figure 4.2) doing an undergraduate degrees amongst the five faculties on campus. This suggests that age may have an impact on green campus initiatives and awareness thereof. No conscious effort was made to ensure equal gender distribution but there is a close balance between the male and female respondents (figure 4.1).

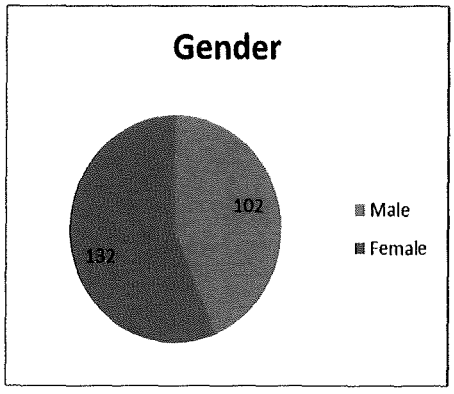

Figure 4.1

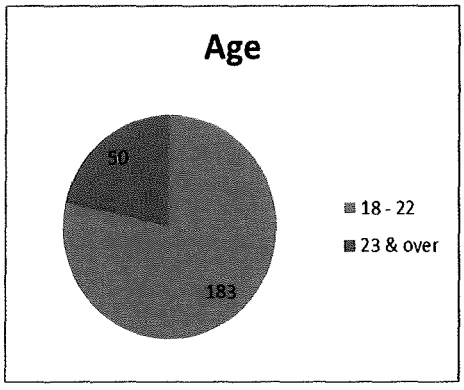

Figure 4.2

The Mafikeng Campus has a majority black student populace, hence the respondents in the majority are black and second most responded that they are African, which cannot be interpreted here as African can refer to any race (figure 4.4). This does not fully reflect the present race component of South

Africa. No preference was given to race therefore the sample breakdown is considered fair for research purposes of this study. 96 out of the 246 respondents completed the section of level of study and the first years are in the majority with 48%. It can be concluded that first year are influential of this questionnaire.

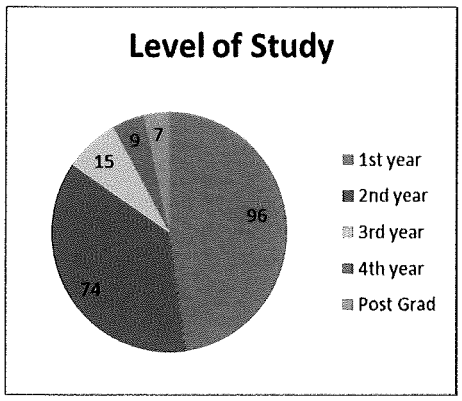

Figure 4.3

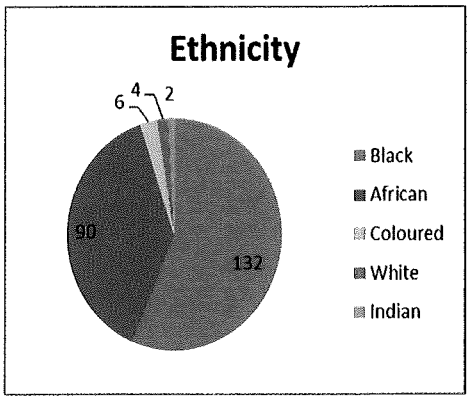

Figure 4.4

4.3 Descriptive Statistics

4.3.1 Data Analysis of Green Research Evaluation

The full findings of this research are not made available here and totals can be found in the appendices.

Clear Objective to Promote Green a Campus

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	11	4.5	5.1	5.1
	Disagree	53	21.5	24.4	29.5
	No comment	89	36.2	41.0	70.5
	Agree	58	23.6	26.7	97.2
	Strongly Agree	6	2.4	2.8	100.0
	Total	217	88.2	100.0	
Missing	System	29	11.8		
Total		246	100.0		

Table 4.1: Clear Objective to Promote a Green Campus

In the above Table 4.1, out of 217 respondents on the clear objective to promote green campus, 89 respondents had no comment, while the 58 agree and 53 disagree. These amounts are almost equal along with the strongly agree 6 and strongly disagree 11. With the responses being so close to one another there cannot be a conclusion as to whether there is agreement or disagreement that the campus has clear objectives to promote a green campus.

4.3.2 Data Analysis of Green Operations Evaluation

Monitor Energy Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	12	4.9	5.1	5.1
	Disagree	43	17.5	18.3	23.4
	No comment	72	29.3	30.6	54.0
	Agree	94	38.2	40.0	94.0
	Strongly Agree	14	5.7	6.0	100.0
	Total	235	95.5	100.0	
Missing	System	11	4.5		
Total		246	100.0		

Table 4.2: Monitor Energy Consumption

From Table 4.2 above, we can see that majority of the respondents agree that there is monitoring of energy consumption. Out of 235 respondents 99 agreed that the energy consumption on the campus was monitored. This indicates the majority percentage of 40% agreeing. This could be attributed to respondents being aware of such monitoring or there could be sharing of such information to respondents. Respondents later agrees that there is information sharing of energy consumption and can be found in the appendices.

In order to properly manage energy consumption and ultimately receive energy savings, the campus management should look into installing hybrid solar systems into buildings and develop best practice energy manuals for the cafeteria areas. All this should be done by develop internal energy savings campaign amongst students and staff alike and then monitor these systems permanently as done in the study of Escobedo et al., (2014).

Practice to Reduce Energy Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	13	5.3	5.9	5.9
	Disagree	45	18.3	20.4	26.2
	No comment	82	33.3	37.1	63.3
	Agree	72	29.3	32.6	95.9
	Strongly Agree	9	3.7	4.1	100.0
	Total	221	89.8	100.0	
Missing	System	25	10.2		
Total		246	100.0		

Table 4.3: Practice to Reduce Energy Consumption

In Table 4.3 majority of the respondents reply to their knowledge of any Practice to Reduce Energy Consumption on the campus that they had no comment. One of the most cost-effective ways to save energy and according to Spirovski et al., (2012) is through changing energy consuming habits and behaviours. In their study in the Sustainable Campus of Claris has installed a captive cogeneration power plant which runs on biomass and hence saves use of coal or lignite which is green-house gas emitters (Patel and Patel, 2012).

Measurable Energy Efficiency Practice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	14	5.7	5.9	5.9
	Disagree	47	19.1	19.7	25.6
	No comment	100	40.7	42.0	67.6
	Agree	69	28.0	29.0	96.6
	Strongly Agree	8	3.3	3.4	100.0
	Total	238	96.7	100.0	
Missing	System	8	3.3		
Total		246	100.0		

Table 4.4: Measurable Energy Efficiency Practice

In Table 4.4 above respondents were asked whether they knew if energy efficiency practices outcomes on the campus were measurable and majority responded that they had no comment. A study of energy efficiency practices, like the one conducted by (Kwan and Hoffman 2010), should be done on the campus to find out where and how the campus can make the best use of its energy consumption. The study should concentrate on how to effectively decrease the demand for energy as well as controlling the current consumption. Solar panel installation has proven to be the solution to best practice and in an area with maximum sun, the Mafikeng campus is ultimately best based for a venture of this kind.

New Methods of Energy Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	18	7.3	8.1	8.1
	Disagree	61	24.8	27.5	35.6
	No comment	78	31.7	35.1	70.7
	Agree	58	23.6	26.1	96.8
	Strongly Agree	7	2.8	3.2	100.0
	Total	222	90.2	100.0	
Missing	System	24	9.8		
Total		246	100.0		

Table 4.5: New Methods of Energy Consumption

Table 4.5 above indicates that majority of the respondents had no comment when asked whether new methods of energy consumption were promoted. It is clear that while the group who disagrees (61 respondents) and those who agree (58 respondents) are going head to head. It therefore seems clear that the ones with no comment could not decide whether there are indeed new methods of energy consumption on the campus. Areas that should be addressed in this are how to evaluate the energy consumption and the cost implications thereof. Questions that arise are does the energy consumption meet the requirements of the energy efficiency regulator and if there are any energy losses, how is it dealt with?

As with Tan et al., (2014) study in China, with the aim of new energy consumption methods and energy efficiency the development of energy efficiency should be expanded across the campus by the campus management. Since the national government is in charge of Eskom, the main provider of energy, government support and funding could be useful when looking into new methods. However, one must not merely think that there will not be loop holes or everything will run smoothly as collaborations need to be forged in order for the plan to succeed.

Monitor Water Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	31	12.6	14.2	14.2
	Disagree	43	17.5	19.7	33.9
	No comment	45	18.3	20.6	54.6
	Agree	83	33.7	38.1	92.7
	Strongly Agree	16	6.5	7.3	100.0
	Total	218	88.6	100.0	
Missing	System	28	11.4		
Total		246	100.0		

Table 4.6: Monitor Water Consumption

In Table 4.6 above majority of the respondents agreed that there is monitoring of water consumption on the campus. It is noted that residence halls, even if the cafeteria is not attached to it, makes up most of the water consumption on the campus and the Mafikeng Campus does not have dining halls or a cafeteria attached to it.

As opposed to its sister campuses, Potchefstroom and the Vaal Campuses, this is a separate function on the campus. Additional monitoring of water can be done by conserving of water through the collection of rainwater and storm water, which can in turn be used for irrigation and design landscapes with drought-resistant, native plants and grasses, and that support integrated pest management according to Alshuwaikhat and Abubakar (2008).

Promotion of Alternative Water Sources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	37	15.0	15.8	15.8
	Disagree	55	22.4	23.5	39.3
	No comment	71	28.9	30.3	69.7
	Agree	59	24.0	25.2	94.9
	Strongly Agree	12	4.9	5.1	100.0
	Total	234	95.1	100.0	
Missing	System	12	4.9		
Total		246	100.0		

Table 4.7: Promotion of Alternative Water Sources

In Table 4.7 above majority of respondents had no comment about promotion of alternative water sources. The respondents who agree and disagree are almost level with one another. According to Solco Solar (2007) there is a growing worldwide tendency in solar heating technology. South Africa receives plenty energy supply from the sun with its fair portion of solar radiation. The cause of this is increasing awareness of global warming and the effect is and increasing reliability and effectiveness of solar water heaters.

Additional Infrastructure Technology to Reduce Water Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	9.3	9.8	9.8
	Disagree	60	24.4	25.5	35.3
	No comment	92	37.4	39.1	74.5
	Agree	58	23.6	24.7	99.1
	Strongly Agree	2	.8	.9	100.0
	Total	235	95.5	100.0	
Missing	System	11	4.5		
Total		246	100.0		

Table 4.8: Additional Infrastructure Technology to Reduce Water Consumption

In Table 4.8 above majority of respondents had no comment to the awareness of additional infrastructure technology to reduce water consumption, while those who agree and disagree are almost in line with one another. As in Patel and Patel's (2012) study of Claris, the harvesting of rain water is but one way of collecting water through wells which can be stored in tanks for direct use or recharged into the ground water and maintain water levels at any given time. There are also cost benefits attached to an efficient water management system.

Water storage tanks can then be used to supply water to manufacturing units and also serve as service water. Service water is water that is identified in usage of housekeeping, washing and landscaping. To ensure treatment of waste water and recycling for greening the landscape Claris has also installed membrane filtration technology as an effluent treatment plant in order to recover useful chemicals and re-use water for plantation. They have also tried to make sure that no waste water is discharged into rivers and hence after treatment at the Effluent Treatment Plant (ETP) as well as blow down water from power plant are used for gardening as well as farming purpose.

Water Efficiency Practice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	9.3	10.2	10.2
	Disagree	53	21.5	23.5	33.6
	No comment	75	30.5	33.2	66.8
	Agree	70	28.5	31.0	97.8
	Strongly Agree	5	2.0	2.2	100.0
	Total	226	91.9	100.0	
Missing	System	20	8.1		
Total		246	100.0		

Table 4.9: Water Efficiency Practice is measurable

Table 4.9 above majority of the respondents had no comment about whether the water efficiency practices are measurable. Alongside this number are the respondents who do agree that it is indeed so.

In agreement with Alshuwaikhat and Abubakar (2008), environmental quality, aimed at improving water, etc. is a successful component in achieving sustainability. Green campus initiatives assist with the preservation and maintenance of, amongst others, water.

Promotion of Alternate Waste Sources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	17	6.9	7.5	7.5
	Disagree	58	23.6	25.7	33.2
	No comment	65	26.4	28.8	61.9
	Agree	66	26.8	29.2	91.2
	Strongly Agree	20	8.1	8.8	100.0
	Total	226	91.9	100.0	
Missing	System	20	8.1		
Total		246	100.0		

Table 4.10: Promotion of Alternative Waste Sources

In above Table 4.10, 66 of respondents agree that there is promotion of alternative waste sources, with 58 disagreeing and 65 respondents have no comment. No conclusion can be made regarding respondents who did not have any comment as it is too close to the respondents who agreed.

The campus would do well to replace traditional waste bins with ones clearly marked for recyclable waste such as paper, plastic etc. and others for non-recyclable waste. In doing this, both students and staff are assisted to simplify the items that can be recycled and those that cannot be recycled. Another similar initiative that can be looked into is to initiate a waste separation project that was done by Geng et al., (2012) on polyethylene terephthalate (PET) bottle, glass bottles, and aluminium cans.

Implementation of Practice to Reduce Waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	6.1	6.4	6.4
	Disagree	43	17.5	18.5	24.9
	No comment	61	24.8	26.2	51.1
	Agree	87	35.4	37.3	88.4
	Strongly Agree	27	11.0	11.6	100.0
	Total	233	94.7	100.0	
Missing	System	13	5.3		
Total		246	100.0		

Table 4.11: Implementation of Practice to Reduce Waste

According to Table 4.11 above, majority of the students agree that there is implementation of practices to reduce waste on the campus. Students thus have a degree of knowledge of waste separation and the functionality of a well-designed plan to implement such a waste reduction plan. In an investigation done by Geng et al., (2012), students got an environmental lecture whereby specific instructions were given on waste separation. An effort was made to safely manage hazardous and toxic wastes. Since both students and staff were using different laboratories with different types of chemical and biological compounds, different types of wastes were generated (such as acid chemicals, pathological waste and microbiological waste).

New Methods of Waste Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	20	8.1	8.9	8.9
	Disagree	47	19.1	21.0	29.9
	No comment	86	35.0	38.4	68.3
	Agree	54	22.0	24.1	92.4
	Strongly Agree	17	6.9	7.6	100.0
	Total	224	91.1	100.0	
Missing	System	22	8.9		
Total		246	100.0		

Table 4.12: New Methods of Waste Consumption

In Table 4.12 above 86 out of 224 respondents had no comment on the question of whether the campus has new methods of waste consumption. It is imperative that waste consumption be looked at optimally. If alternate waste consumption can be considered, the environmental impact can be minimised or partially controlled at affordable cost. A case study done by Lukman et al., (2009) demonstrates significant potential for improving environmental performance and reducing the costs of the university operations. These types of improvements can alter the way the teaching of green initiatives are addressed, if there are any and also create best practice programs for both the campus community as well as the society as a whole.

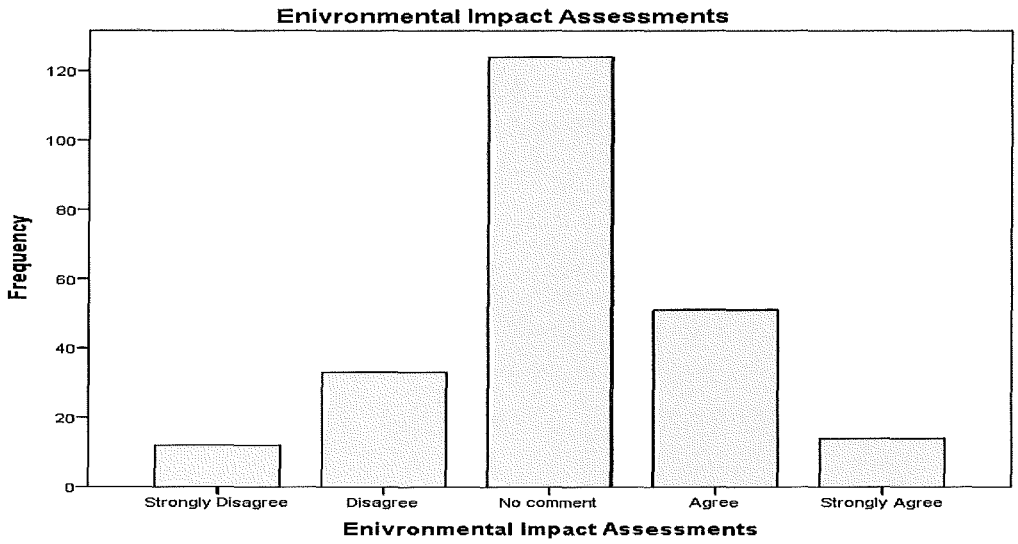

Figure 4.5 Environmental Impact Assessments

In Figure 4.5 above, 128 out of 237 respondents had no comment on the question of any awareness implementation of environmental impact assessment (EIA) for new and existing buildings. The ultimate aim of EIA is to promote the construction of energy and resource efficient buildings. This goal can be achieved by choosing environmentally friendly building materials and design of integrated and flexible systems in buildings, which can impact indoor air quality and are also energy-efficient. EIAs have many advantages over traditional building design and guarantee sustainability and offers continuous campus quality improvement. The challenge lies in that many university campus structures and infrastructures are built unsustainably and sustainability

by its very nature requires an integrated and holistic approach to decisions making and investments (Alshuwaikhat and Abubakar, 2008).

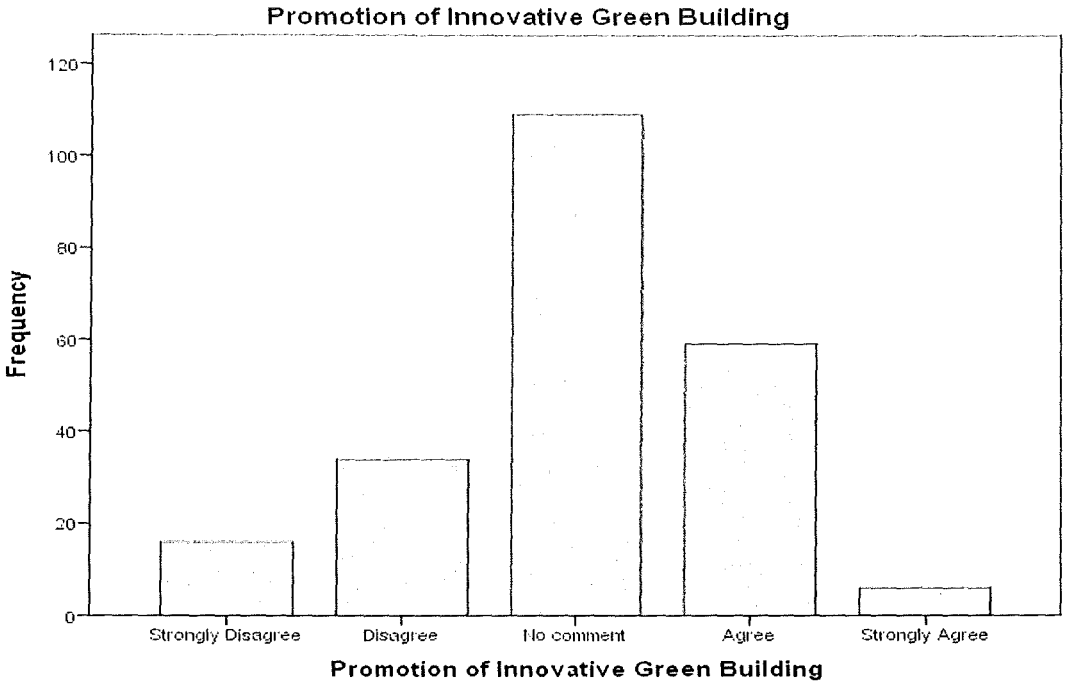

Figure 4.6: Promotion of Innovative Green Building

In Figure 4.6 above majority of respondents had no comment on whether there was continuous improvement or promotion of innovative green buildings on campus. One of the main objectives of a green building is to promote the construction of energy and resource efficient buildings.

Thus, the green buildings initiative is a set of projects designed to decrease production of waste and hazardous materials, reduce level of energy consumption and promote the design of energy efficient buildings and represent a sustainable design concept, because buildings have a significant impact on the environment, accounting for one-sixth of the world's freshwater withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy, leaving a large negative impact on the environment and health (Alshuwaikhat and Abubakar, 2008).

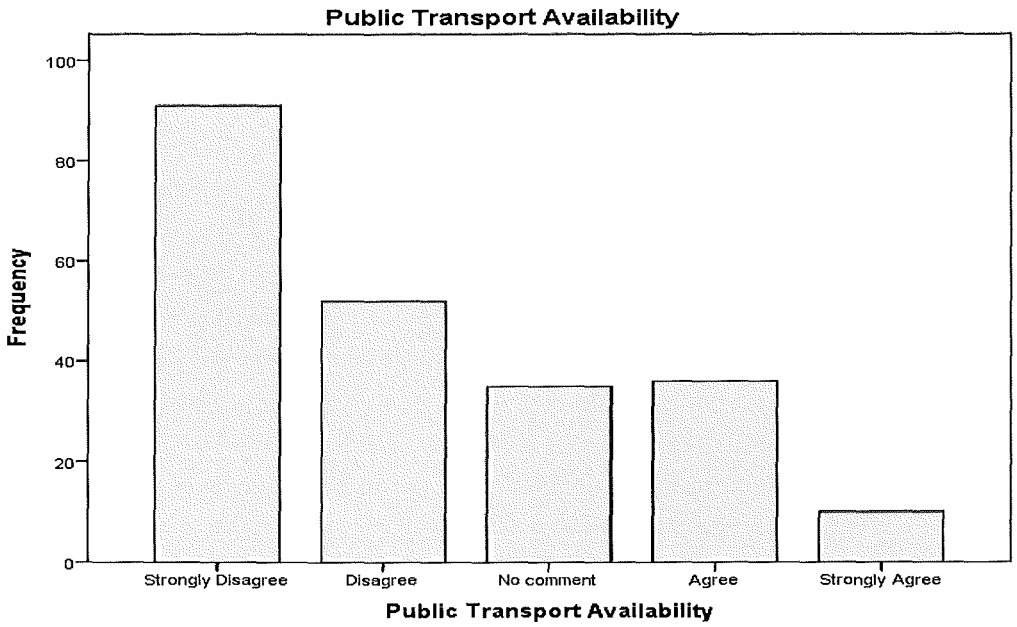

Figure 4.7: Public Transport Availability

In Figure 4.7 above 91 out of 230 respondents strongly disagreed that there was public transport available on the campus and those in agreement was strong in the minority side. Although not a major contributor to the campus footprint, transportation nevertheless plays a role in emissions and also in the use and consumption of resources. Reducing car commuting will produce demonstrable and tangible benefits to a university (Tolley, 1996).

A good example of this is that in 2012 the sister campus, Potchefstroom, has commenced a cycling programme on the campus in order to show their contribution to eliminating their carbon footprint. In order to preserve this initiative, the institution could look at administrative measures, whereby establishing a bicycle advisory committee would look after cyclists' needs and running safety education programmes and bike repair/ maintenance classes.

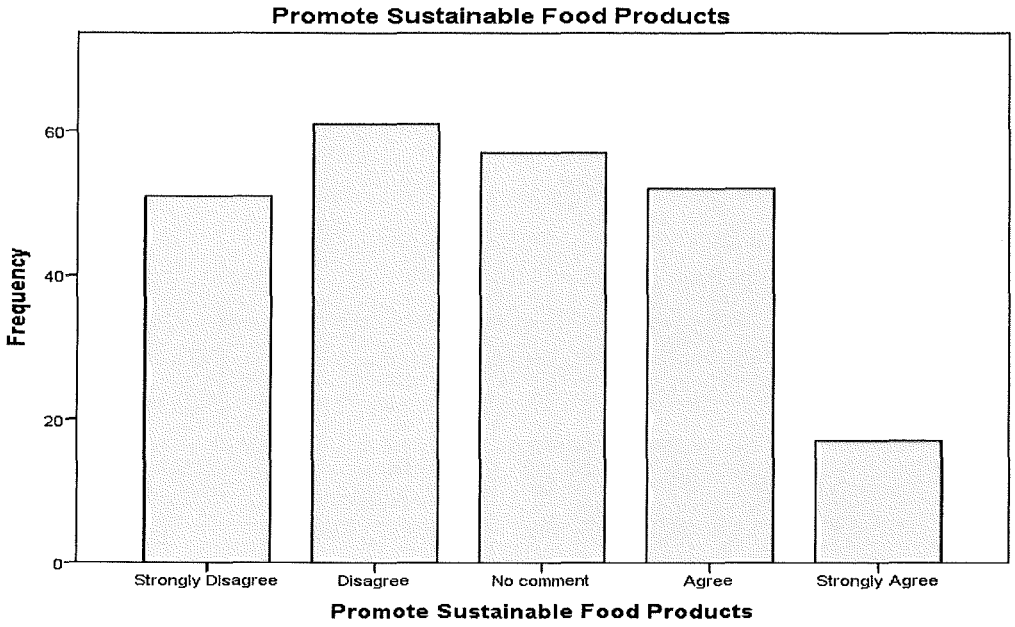

Figure 4.8: Promote Sustainable Food Products

In Figure 4.8 above majority of respondents 61 respondents disagreed that there was promotion of sustainable food products on the campus. Students who had no comment and agreed were following with 57 and 52 respondents respectively.

In the study by Mason, Oberender Brooking (2003) at the Turitea campus of Massey University, New Zealand it was found that most recyclables were from the kitchen in the form of food, paper, food and plastics and that food, glass and plastic contributed in the majority to cross contamination in the public area. They initially started a source separation system and continued to educate both the kitchen staff and the consumers with the kitchen staff as the major focus in the area of source separation and it became a huge success, which is proven in the analysis of this study. It must be borne that from this study that continuous improved ongoing education and training is required to both the kitchen staff and campus community to make this programme an effective one.

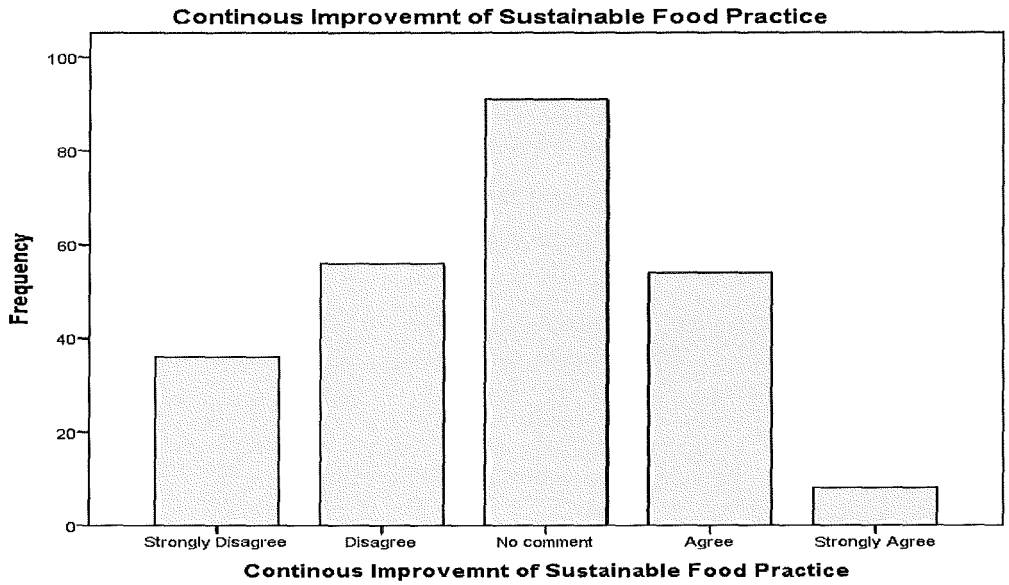

Figure 4.9: Continuous Improvement of Sustainable Food Practice

In Figure 4.9 above 92 of the students had no comment while 56 disagreed and 42 respondents disagreed on whether there was continuous improvement or promotion of sustainable food practices. In the very same study of Mason, Oberender Brooking (2003) it is noted that the observation was done during the first semester and the realisation came about that while much of the food that was delivered to the kitchen was pre-cooked, onsite leftovers came from items that were not pre-prepared. Also, there were deliveries in steel cans and glass and plastic bottles. The deliveries were also at any time during the month with the result that there were times when the leftovers increased. Once again, positive as well as negative areas were reflected in the attempts to continuous improvement of sustainable food practices hence there is ongoing education was observed to improve separation performance.

4.4 Correlations

The research findings are presented for statistical analysis purposes. The findings were presented as descriptive statistics mainly in the form of pie charts, frequency tables and histograms. The full correlation on the questionnaire will also be presented in the appendix section.

A series of questions needs to be answered in the presentation of research finding section in order to relate the findings to the research questions raised after inspection the literature name:

Is there a correlation between a respondents' faculty and his/ her awareness of green campus operations on the campus?

Table 4.13: Cross Tabulation – Faculty vs. Clear Objective for Green Research

		Faculty	Clear Objective for Green Research
Faculty	Pearson Correlation	1	-.070
	Sig. (2-tailed)		.510
	N	92	92
Clear Objective for Green Research	Pearson Correlation	-.070	1
	Sig. (2-tailed)	.510	
	N	92	246

The above table indicates a moderate level of significance at 0.510, which suggest that there is no linear relationship between the two variables. There is no significant correlation between faculty and clear green objective as the two variables are independent of each other. It is clear that even though the sample existed of 246 respondents, only 92 respondents completed the section of which faculty they were affiliated to.

Table 4.14: Research has Measurable Impact on Sustainable Societies vs. Projects dealing with Green Campus Promotions

		Research has Measurable Impact on Environmentally Sustainable Societies	Projects Dealing with Green Campus Promotions
Research has Measurable Impact on Environmentally Sustainable Societies	Pearson Correlation	1	.390**
	Sig. (2-tailed)		.000
	N	246	246
Projects Dealing with Green Campus Promotions	Pearson Correlation	.390**	1
	Sig. (2-tailed)	.000	
	N	246	246

**. Correlation is significant at the 0.01 level (2-tailed).

The above Table 4.14 has a correlation coefficient of 0.390 indicates that no relationship exists between the two variables. In other words, as one variable changes, one does not know what happens to the other variable.

Table 4.15: Campus Monitors Energy Consumption vs. Continuous Improvement of Sustainable Food Practices

		Campus Monitors Energy Consumption	The Continuous Improvement/ Promotion of Sustainable Food Practices
Campus Monitors Energy Consumption	Pearson Correlation	1	.562**
	Sig. (2-tailed)		.000
	N	246	245
The Continuous Improvement/ Promotion of Sustainable Food Practices	Pearson Correlation	.562**	1
	Sig. (2-tailed)	.000	
	N	245	245

**. Correlation is significant at the 0.01 level (2-tailed).

The above Table 4.15 has a level of significance of 0.000 indicating no or weak relationship between the two variables, even though the correlation is strong at 0.562

Table 4.16 Continuous Improvement of Innovative Green Buildings vs. New Methods of Waste Consumption

		Continuous Improvement of Innovative Green Buildings on Campus	New Methods on Waste Consumption are Promoted
Continuous Improvement of Innovative Green Buildings on Campus	Pearson Correlation	1	.539**
	Sig. (2-tailed)		.000
	N	246	246
New Methods on Waste Consumption are Promoted	Pearson Correlation	.539**	1
	Sig. (2-tailed)	.000	
	N	246	246

**. Correlation is significant at the 0.01 level (2-tailed).

The above Table 4.30 has a level of significance of 0.000 indicating no or weak relationship between the two variables, even though the correlation is strong at 0.539.

4.5 Conclusion

This chapter focused on the detailed result of the study by using statistical measures such as charts, frequency table, histograms and correlations. The majority of relationships in the finding proved insignificant and could not be taken into consideration. The studies could not conclusively find a link between higher education and the campus societies' awareness of global warming and how and where they fit into this vast, but well written on area as covered in chapter two.

The next chapter focuses on the conclusions made in the study with the aim of understanding the literature and making informed decisions regarding the study of green campus initiatives.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents conclusions drawn from the findings in the previous chapter, chapter four and aims to address green campus sustainability on the Mafikeng Campus. Green campus initiatives and environmental sustainability have over time, received substantial attention from both universities as well as society as a whole.

However, there are substantial environmental protection measures at some universities, a more systematic and sustainable approach is required to reduce the negative impacts of those activities and to make the campuses more sustainable. Universities is a large community and also has an intricate set ups that are involved in numerous and complex scientific (laboratory experiments, agricultural practical, workshop operations, etc.) and social and educational activities (teaching, learning and research), energy supply and usage, transport and interaction, sports and recreation etc. As such there is a need for a systematic and integrated approach to make the universities more liveable and sustainable. The university community must thus be challenged to reflect and reassess their environmental policies and practices in order to contribute to sustainable development at local, national and international levels (Alshuwaikhat and Abubakar, 2008).

This study serves to find whether the North West University, particularly Mafikeng Campus has green campus initiatives/ projects and whether staff and student have sufficient knowledge of such projects and seeking a basis for implementation of recovery, reduction and recycling of sustainability management programs at the campus. The study at the Mafikeng campus also seeks to contribute towards the current dialogue on green campus environmental sustainability (Sharp 2002),

while acknowledging progress that has been made at other Higher Education Institutions (HEIs).

5.2 Summary of the Study

The researcher seeks to answer four research questions that will be discussed in the following section of this chapter. The study focuses on green initiatives on the Mafikeng Campus

Much of the literature portrays higher education institutions as either small towns or then the size of small municipalities, resulting in the challenges being more complex to control and manage. The literature in chapter two was reviewed extensively to test the theories and models of green campus research and green campus projects and how they fit in with the current conditions at the Mafikeng Campus. The literature has proven a valuable means to address the various levels of institutional analysis and many of the suggestions presented in the current findings need to be examined more closely for possible further development.

In chapter four, based on the questionnaire that was distributed for this research, the findings were analysed and interpreted to provide clarity of the literature that was studied. The data was analysed by using the software package Statistical Package for the Social Sciences (SPSS).

5.3 Response to Research Questions

5.3.1 The campus has clear objectives with regard to the promoting and adapting of green operations on the campus?

Clear Objective to Promote Green a Campus

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	11	4.5	5.1	5.1
	Disagree	53	21.5	24.4	29.5
	No comment	89	36.2	41.0	70.5
	Agree	58	23.6	26.7	97.2
	Strongly Agree	6	2.4	2.8	100.0
	Total	217	88.2	100.0	
Missing	System	29	11.8		
Total		246	100.0		

Table 5.1: Clear Objective to Promote a Green Campus

In the above Table 5.1, out of 217 respondents on the clear objective to promote green campus, 89 respondents had no comment, while the 58 agree and 53 disagree. These amounts are almost equal along with the strongly agree 6 and strongly disagree 11. With the responses being so close to one another there cannot be a conclusion as to whether there is agreement or disagreement that the campus has clear objectives to promote a green campus.

The university community grows on an annual basis; therefore there is an ever increasing demand for land, water and other resources. Expansion of nature leads to increased disintegration of the natural ecosystems and erosion of life supporting systems that uphold human civilization according to Alshuwaikat and Abubakar (2008).

5.3.2 Research has a measureable impact on environmentally sustainable society?

Table 5.2: Research has Measurable Impact on Sustainable Societies Projects dealing with Green Campus Promotions

		Research has Measurable Im on Environmentally Sustain Societies	Projects Dealing Green Cam Promotions
Research Measurable Impact Environmentally Sustainable Societies	Pearson Correlation	1	.390**
	Sig. (2-tailed)		.000
	N	246	246
Projects Dealing Green Cam Promotions	Pearson Correlation	.390**	1
	Sig. (2-tailed)	.000	
	N	246	246

**. Correlation is significant at the 0.01 level (2-tailed).

It seems that students agree that there is a general consensus that research has a measureable impact on environmentally sustainable society but that there are no modules, that they are aware of that is offered to this effect, however, students also indicated that if there were any such modules available, they would be interested in attending such modules and effectively gaining education on green and environmental affairs.

Sharp (2002) suggests that environmental issues are now more complex and interconnected and environmental sustainability by its very nature requires an integrated and systematic approach to decisions making, investments and management. As a result, there is need for a professional and systematic environmental management approach to reducing the consumption of resources and negative impacts of the various campus operations and promoting campus sustainability. He then concludes that important measures need to undertaken to overcome barriers to greening and the most is important is campus environmental awareness

5.3.3 The campus continues to promote new methods of energy, water and waste consumption?

Practice to Reduce Energy Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	13	5.3	5.9	5.9
	Disagree	45	18.3	20.4	26.2
	No comment	82	33.3	37.1	63.3
	Agree	72	29.3	32.6	95.9
	Strongly Agree	9	3.7	4.1	100.0
	Total	221	89.8	100.0	
Missing	System	25	10.2		
Total		246	100.0		

Table 5.3: Practice to Reduce Energy Consumption

In Table 5.3 majority of the respondents reply to their knowledge of any Practice to Reduce Energy Consumption on the campus that they had no comment. Once again, the majority of the respondents have no comment on the questions of if the campus continues to promote new methods of energy, water and waste consumption on the campus.

One of the most cost-effective ways to save energy and according to Spirovski et al., (2012) is through changing energy consuming habits and behaviours. In their study in the Sustainable Campus of Claris has installed a captive cogeneration power plant which runs on biomass and hence saves use of coal or lignite which is green-house gas emitters (Patel and Patel 2012). There are always alternate methods and ways of reaching these objectives with the aim of new energy consumption methods and energy efficiency the development of energy efficiency. This initiative should ultimately be expanded across the campus by the campus management (Tan et al., 2014).

5.3.4 The campus implements environmental impact assessments for new and existing buildings?

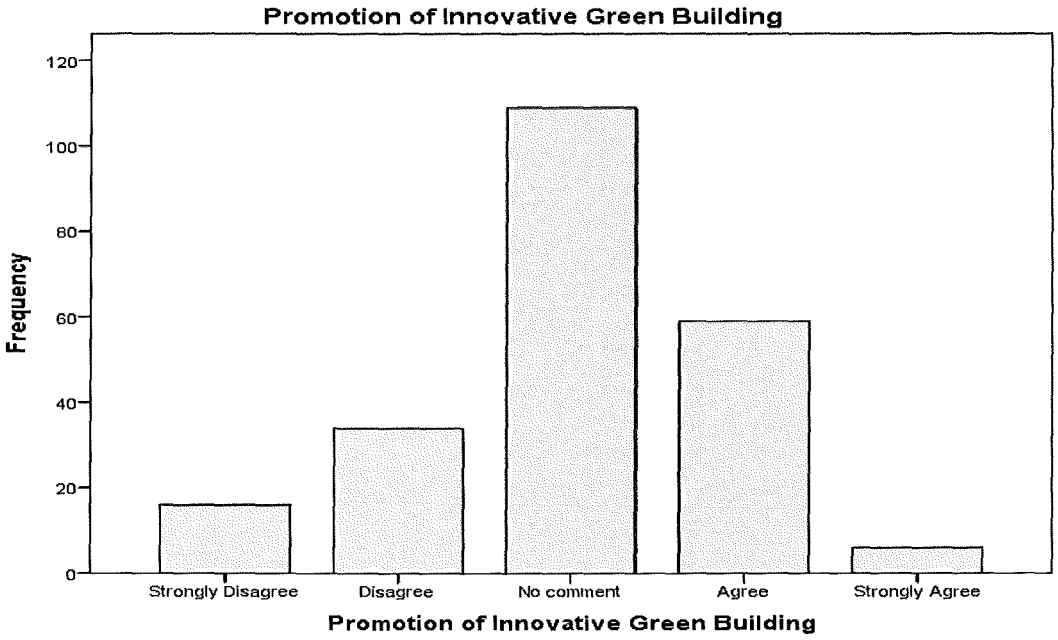

Figure 5.1: Promotion of Innovative Green Building

In Figure 5.1 above majority of respondents had no comment on whether there was continuous improvement or promotion of innovative green buildings on campus. Respondents seems not to commit to answering questions regarding whether the campus implements environmental impact assessments for new and existing buildings in any way but with no comment. One of the main objectives of a green building is to promote the construction of energy and resource efficient buildings.

Thus, the green buildings initiative is a set of projects designed to decrease production of waste and hazardous materials, reduce level of energy consumption and promote the design of energy efficient buildings and represent a sustainable design concept, because buildings have a significant impact on the environment, accounting for one-sixth of the world's freshwater withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy, leaving a large negative impact on the environment and health. It is clear that there are advantages of new buildings over traditional building design and that guarantees sustainability and

offers continuous campus quality improvement (Alshuwaikhat and Abubakar, 2008).

5.4 Recommendations

After careful study of the response to the research questions, the researcher found that the campus needs to create more awareness around green campus initiatives, if indeed there are any current projects on the campus.

It is up to both the staff (including management) and students to engage in this area as our students and student leaders today are the future of our country. In order to improve its sustainability, awareness among students and staff regarding green campus sustainability and an integrated green solution model is proposed at North West University (NWU) in order to address various dimensions (material/ energy/ water/ teaching/ research) in a systematic way.

Studies should be done at other universities to see how they integrated green campus into both their academics as well as everyday student lives. If at all, a collaborative should be formed with such universities who have successfully been running green campus projects. The campus can in this case, also form a collaborative with the local municipality and various other governmental departments, i.e. department of water affairs etc., thereby engaging the local community and making them aware of such projects. An initiative of such kind can allow the community to feel part and want to participate in projects that keep the area green and improve living conditions.

Seeing that the Mafikeng Campus is situated in a rather rural area, the institution should also look at ways of allowing students and staff access e-projects around greening the campus and not just the campus. As a whole, the campus should adopt policies that commits to reducing environmental impact and develop environmental performance

5.5 Limitations of Research

There is a general lack of awareness regarding green campus initiatives and environmental sustainability amongst the Mafikeng Campus community. There is very little and to a point no communication, between management and staff and management and students regarding the current status of environmental sustainability on the campus. The answering of the questions was very broad and probably not a true reflection of the current situation on the campus. The result of this study though is that there is no proper management of energy, water and waste consumption that could result in reducing this vicious cycle of waste.

5.6 Conclusion

In conclusion, collaboration and support from the management as well as the facilities department is required to make any initiative a success. A zero waste program should be established at grassroots level to address concerns over environmental management issues. It is suggested that the campus needs to establish an environmental committee that can expedite environmental communication matters between both the students and staff. The communication between the committee members can be formal as well as informal.

Obviously, any initiative requires funding, therefore new strategies in how to obtain such funding are very important. The funding is not the only thing to then guarantee a success of any initiative, there should be education and training offered to the campus community in order for them to assess and audit how they will reach sustainability and climate action projects on campus.

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Appendix A Matrix

References	Concept												
	Education Sector	Sustainability	Principles and Strategies of Developing a Sustainable Campus	Green Campus	Approaches of leading Green Campus initiatives	Energy Consumption	Water Consumption	Materials and Waste	Building Environment with a Focus on Energy	Natural lighting and ventilation	Trans portation	Services, Waste and Food	Integrated Model
Stephen et al. 2008		P318											
Brundtland Report of the World Commission on Environment and Development 1987													
Velazquez et al. 2006		P812											
Farrell and Hart 1998													
Saleh et al. 2011			P273 P276										
Rappaport 2008				P7									
Betts 2001				p199									
Nixon 2002				P2									
Ying 2010				P23									
Sharp 2002					P131								
Spirovski 2012						P4700							
Patel and Patel 201.						P4905 P4906							
Kwan and Hoffman 2010						P19 P228							
Solo 2007 2008													
Patel and Patel; 2102							P4906						
Alshuwaikhat and Abubakar 2008								P1777					
Evangelinos 2009								P1156					
Kaplowitz 2009								P615					
Zhang et. al 2011								P1607					
Patel and Patel 2012								P4903					
Smyth et al. 2010								P1401					
Alshuwaikhat and Abubakar 2008									P1779				
Pérez et.al 2011									P4858				
Patel and Patel 2012										P4906			
Tolley1996											P214 P215 P217		
Jalalkamali and Ghraei 2012											P935		
Vega et al., 2008												P54	
Smyth et al., 2010												P28	
Mason et. al. 2004												P155	
Baldwin and Dripps 2012												P107	
De Vega et. al 2008												P24	
Smyth et al.2010												P1008	
Geng et. al. 2012													P5

Appendix B Questionnaire

VOLUNTARY QUESTIONNAIRE FOR STUDENTS AND STAFF OF THE NORTHWEST UNIVERSITY MAFIKENG CAMPUS

Graduate School: **NWU**
Researcher **S Klink**
Supervisor: **Prof S Lubbe**

Note to the respondent

- We need your help to understand how people perceive green campus initiatives and promotions at Northwest University (NWU) Mafikeng Campus.
- Although we would like you to help us, you do not have to take part in this survey.
- If you do not want to take part, just hand in the blank questionnaire at the end of the survey session.
- What you say in this questionnaire will remain private and confidential. No one will be able to trace your opinions back to you as a person.

The questionnaire has six parts:

Part 1 asks permission to use your responses for academic research.
Part 2 asks general personal particulars like your age, gender and home language.
Part 3 asks about green research on NWU Mafikeng Campus
Part 4 - 6 asks about the green operations on the NWU Mafikeng Campus.

How to complete the questionnaire

1. Please answer the questions as truthfully as you can. Also, please be sure to read and follow the directions for each part. If you do not follow the directions, it will make it harder for us to do our project.

2. We are only asking you about things that you and your fellow researchers should feel comfortable telling us about. If you don't feel comfortable answering a question, you can indicate that you do not want to answer it. For those questions that you do answer, your responses will be kept confidential.

3. You can mark each response by making a tick or a cross, or encircling each appropriate response with a PEN (not a pencil), or by filling in the required words or numbers.

Thank you very much for filling in this questionnaire.

Part 1: Permission to use my responses for academic research

I hereby give permission that my responses may be used for research purposes provided that my identity is not revealed in the published records of the research.

Initials and surname **S. L Klink**

Postal address: **1457 Makhene Street, Unit 6, Mmabatho Postal code: 2735**

Contact numbers: Home: _____Cell: **078 349 0976**

No.	**PART2: GENERAL PERSONAL PARTICULARS** **Please tell us a little about yourself** Please mark only ONE option per question below.	23.	The campus continues to monitor energy consumption ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
1.	I am within this age group ☐21-30 yrs. ☐31-40 yrs. ☐41-50 yrs. ☐51-60yrs ☐Over 60 yrs.	24.	New methods of energy consumption are promoted ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
2.	I am a: ☐ Female ☐ Male	25.	**Part 4B: Water** The campus continues to monitor water consumption ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
3.	How long have you been studying presently? ☐ 1-2 years ☐ 3-4 years ☐ 5-6 years ☐ 7-8 years ☐ 9-10 years ☐ More than 10 years	26.	There is sharing of water consumption information on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
4.	How long have you been working presently? ☐ 1-2 years ☐ 3-4 years ☐ 5-6 years ☐ 7-8 years ☐ 9-10 years ☐ More than 10 years	27.	There is use/ promotion of alternative water resources on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
5.	Highest Qualification Achieved? ☐ Diploma ☐ Undergraduate Degree ☐ Honours ☐ Masters ☐ Phd	28.	There is additional infrastructure technology for water consumption reduction ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
	PART 3: GREEN RESEARCH EVALUATION Please mark only ONE option per question below	29.	Water efficiency practices outcomes on campus are measurable ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree

6.	A number of qualifications dealing with green teaching is offered ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	30.	**Part 4C: Waste** The campus continues to monitor waste consumption ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
7.	Integrated modules are offered around green campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	31.	There is sharing of waste consumption information on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
8.	Students are interested in green awareness modules ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	32.	There is use/ promotion of alternative waste resources on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
9.	Students are completing or have completed qualifications in integrated green matters ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	33.	There are implementation of practices to reduce waste consumption on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
10.	There are clear objectives with regards to green research ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	34.	New methods of waste consumption are promoted on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
11.	There is general awareness around green campus campaigns on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree		**Part 5:** Please mark only ONE option per question below. Please note that this section is divided into 2 subsections namely: **Buildings and Transport** **Part 5A: Buildings:**
12.	Students would like to complete green education modules ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	37.	There are a number of buildings that are considered green on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
13.	There are student projects dealing with promotion of green campus initiatives ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	36.	The implementation of environmental impact awareness (EIA's) for new and existing buildings exist ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
14.	Research can create new knowledge & new technology ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	37.	There is continuous improvement/ promotion of innovative green building practices on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
15.	Research has a measurable impact on environmentally sustainable society ☐ Strongly disagree ☐ Disagree	38.	**Part 5B: Transport** There is public transport available on campus ☐ Strongly disagree

	☐ No Comment ☐ Agree ☐ Strongly Agree		☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
16.	Any suggestion for the campus for green research/ promotion on the campus **Please specify:**	39.	Car pool or any other system on campus can reduce the number of vehicles on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
	PART 4: GREEN OPERATIONS EVALUATION Please mark only ONE option per question below. Please note that this section is divided into 3 subsections namely: **Energy, Water and Waste**		**Part 6: Sustainable Food Practices** Please mark only ONE option per question below
17.	There are clear objectives with regard to the promotion/ adapting of operations on campus to be green ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	40.	The campus makes available/ promotes sustainable food products on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
18.	**Part 4A: Energy** The campus continues to monitor energy consumption ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	41.	Sustainable food initiatives on campus are measurable outcomes ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
19.	There is sharing of energy consumption information on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	42.	There is implementation/ promotion of new innovative sustainable food practices ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
20.	There is use/ promotion of alternative energy resources on campus ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	43.	There is continuous improvement/ promotion of new innovative sustainable food practices ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
21.	There are implementation of practices to reduce energy consumption ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	44.	There continuous improvement/ promotion of sustainable food practices ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree
22.	Energy efficiency practices outcomes on campus are measurable ☐ Strongly disagree ☐ Disagree ☐ No Comment ☐ Agree ☐ Strongly Agree	45.	Any other green operation efforts/ suggestions for the campus. Please specify:

Appendix C Letter of Request

1457 Makhene Road
Unit 6
Mmabatho
2735

Dear Sir

Request for permission to run a survey

My name is Shirene Klink and I am carrying out my research for the completion of a Master's degree (MBA) at the North West University, Mafikeng Campus.

I hereby request permission to be used in my research from your offices as the survey rests entirely on the participation of staff and students on the campus along with relevant information provided by the maintenance department. Information gathered through the data collection will be kept confidential.

I urgently await your response to my humble request.

Sincerely,
Shirene Klink
078 349 0976