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# Exploring opportunities for job creation through waste value chain: Removal of alien invasive plants, Western Cape, South Africa

**Siyavuya Twetwa**

A mini-thesis submitted in partial fulfilment of the requirements for the degree of Master of Philosophy (MPhil) in the Department of Earth Sciences, Faculty of Natural Sciences, University of the Western Cape.

Supervisor: Dr Thokozani Kanyerere
Co-supervisor: Professor Catherina Schenck

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**ABSTRACT**

Alien invasive plants are often end up in landfills after they are removed, where they form part of organic waste. Wood contractors can utilise this organic waste as a source of informal employment, which is also a waste reduction method. The aim of this study was to explore opportunities for job creation through the removal of alien invasive plants, as the basis for developing a business structure that addresses unemployment. First, the impact of alien invasive plants on the environment and water resources was explored. Then, the impact of removed alien invasive plants on the socioeconomic status of people was assessed. Third, a business structure for alien invasive plant removal was formulated to promote environmental integrity and socioeconomic improvement. The study adopted a mixed methods research approach. The population of the study was wood contractors working in the Paarl Mountain Nature Reserve in the Western Cape Province. Convenient sampling was used to select the research sample of wood contractors. Data were gathered through observation, semi-structured one-on-one interviews and questionnaires. Data analysis involved the use of Excel spreadsheets to categorise information and present graphical representation of data. Relevant themes were identified using the Sustainable Livelihood Framework (SLF) and thematic analysis: vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes. After analysing the livelihoods of wood contractors, the main results of the study found that wood contractors were making a living by utilising the removed alien invasive plants, which confirms the results of previous literature. The wood contractors indicated that there is a gap between them and other corporations. Moreover, the results suggest that it is important that wood contactors are integrated with the municipality and with larger businesses, but not to formalise or regulate them, only as added support that could help the wood contractors expand their market.

**DECLARATION**

I declare that *Exploring opportunities for job creation through waste value chain: Removal of alien invasive plants, Western Cape, South Africa* is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Siyavuya Twetwa

Signed:

Date:

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# CHAPTER 1: INTRODUCTION

## 1.1 Study overview

This study explores opportunities for job creation in the waste value chain with a focus on the removal of alien plants. The Paarl Mountain Nature Reserve in the Western Cape is used as a study area to investigate the sustainability of the livelihoods of wood contractors in the nature reserve. Sustainability of jobs is measured by the availability of the product being sold (Sellitto et al., 2014). Currently, the organic waste generated after alien plant removal is sent to landfill, which undermines the job sustainability of wood contractors. This study argues that there are alternative methods that can reduce organic waste produced after alien plant removal, and that these alternatives are also potential job creation opportunities that can ultimately contribute to job sustainability. In other words, the study explores whether the removal of alien invasive plants can provide sustainable job opportunities and improve the socioeconomic status of those involved.



## 1.2 Background of the study

Alien invasive plants have a negative impact on water resources, consuming surface runoff. In addition, they are associated with high costs of removal. South Africa is under serious threat from these plant species, with invasive plants estimated to use almost 6.7% of the country's surface runoff and would cost an estimated R12.4 billion to clear over 20 years (Turpie et al., 2008). Alien invasive plants do not only affect surface runoff, but they can impact water catchment areas. For example, the Western Cape has been highly impacted by the presence of alien invasive plants in high-yielding subcatchments at the western end of the Sonderend River, which supplies the Theewaterskloof Dam (which has a capacity of 484 million $m^3$), an important source of water for the greater Cape Town metropolitan area and for the irrigation of deciduous fruit (Le Maitre et al.,1996). Therefore, to ensure that the overconsumption of water by alien plants is minimised, such plants must be removed.

A study by Prinsloo and Scott (1999) on alien invasive plant removal in the Western Cape Province found that streamflow increased by 8.8, 10,4 and 12 $m^3$/day per ha cleared in Du Toitskloof, Oaklands and Somerset West, respectively, after clearing Australian acacia and eucalyptus species from the area between the river and the riverbank. Additionally, Dye and Jarmain (2004) looked at net changes in total evaporation in the Western Cape and found

invasive alien trees increase evaporation by 1 570 $m^3$ to 4 240 $m^3$/annum per ha compared to natural vegetation. This suggests there is a significant amount of water loss through the atmosphere due to alien invasive plants.

South Africa has a high unemployment rate of 32.5% (Stats SA, 2021), and Godfrey et al. (2016) suggest that the waste economy might be a potential source of job opportunities. The use of organic waste can serve as a source of employment for unemployed individuals (Kawai.K and Tasaki.T, 2016). To combat unemployment, as well as remove alien invasive plants, the governmental programme known as Working for Water (WfW) was initiated in 1995 by the Department of Environmental Affairs (now called the Department of Fisheries, Forestry, and the Environment). Since 2000, the WfW programme has trained over 200 000 people, 52% of whom are underprivileged women, and the remaining majority of whom are youth, disabled individuals and those living with HIV/AIDS. Workers were initially (in 2000) paid R22.55 per day. Currently they are paid R102.00 per day, which is less than the minimum wage. The current minimum wage established by the Department of Labour is R160 per day (WRI, 2000–2001). Annually, the program provides jobs to approximately 18 000 previously unemployed individuals. In 2012, the Department of Environmental Affairs (DEA, 2012) indicated that the project would continue, and that more than 4 000 trainers would identify invasive species in order to configure laws pertaining to invasive species across South Africa between 2014 and 2018.



The employment opportunities for removed alien invasive plants can arise from different uses of biomass, as they are already used for different purposes in the WfW program. Participants have used the “waste” from extracted alien invasive plants to promote value–added industries, such as the production of furniture, wooden toys, firewood and fuel chips. This is an important and unique aspect of WfW, and should be considered in the development of similar projects (DWAF, 1996). Other uses of biomass include various wood products, such as timber and lumber, wood fuels, composite wood products, biochar, mulch, compost and bioenergy.

In order to ensure the success of an integrated approach to control the spread of alien invasive plants, the effects of these plants, their threat to the ecological environment and their impact on society need to be examined and understood. If properly managed, the programme to control alien invasive plants can provide the incentive needed for an active participatory

approach in the integrated management of catchments in South Africa to deal with water scarcity and to ensure sustainability of the environment and job security.

## 1.3 Problem statement

The potential of alien invasive plant removal in creating possible job opportunities and improving the socioeconomic circumstances of the unemployed has largely remained unexamined in the literature. This means that the positive economic influence that the use of removed alien plants could have, as well as its potential to create opportunities, remains overlooked. Because biomass can be used to produce a variety of energy sources, such as firewood, biochar and electricity, there is clearly a significant untapped market for selling it (Potgieter, 2016). The use of biomass for possible job opportunities must therefore be thoroughly investigated. This study first analyses the response of the environment to the removal of alien invasive plants, and then investigates the sustainability of the informal job opportunities created by the removal process.

## 1.4 Research question

To gain a deeper understanding of how biomass can contribute to creating job opportunities, this study puts forth the following research question: What sustainable job opportunities can be created by clearing alien invasive plants?



The study argues that there are ways of reducing organic waste after alien invasive plant removal, as such waste currently ends up in landfills, which are rapidly filling up.

## 1.5 Aim and objectives

The aim of the study is to explore opportunities for sustainable job creation through the removal of alien invasive plants.

The objectives of the study are to:

- Explore the impact of alien invasive plants on the environment and water resources.
- Explore the sustainability of job opportunities created by the removal of alien invasive plants.
- Establish a business structure for alien invasive plant removal that promotes

environmental integrity and the improvement of people's socioeconomic status.

## 1.6 Significance of the study

This study is of significance to multiple disciplines, as it combines aspects of social sciences, natural sciences and economics. It highlights formal and informal job opportunities in the removal of alien invasive plants and such informal job opportunities can help to uplift the local economy and contribute to sustainable development, livelihoods and inclusive green economic growth.

Three concepts are central to the study: water security, environmental maintenance and job sustainability. Alien invasive plants consume more water than endemic plants, and this causes strain to water users, including people and animals. It could lead to high water tariffs while additionally causing animals to die because of insufficient water. Alien invasive plants also intercept streamflow, especially when close to water resources (Turpie et al., 2008). It is therefore of crucial importance to manage alien invasive plants because of the significant effect they have on water resources.



Environmentally, alien invasive plants cause stress to native plants, negatively impacting their living conditions. For several decades, alien invasive plant species have posed threats to the local biodiversity, ecosystem services and environmental quality (Pejchar and Mooney, 2009; Bartz and Kowarik, 2019) and to human health (Pyšek and Richardson, 2010) This underscores the importance of ensuring that the environment is protected.

Alien invasive plants can be viewed as species that pose threats to the ecological environment, but they can be useful or valuable when removed, especially when creating employment opportunities. For example, the WfW programme that enables the removals of alien invasive plants creates thousands of jobs, with a strong emphasis on gender equity, and provides considerable benefits, such as skills training.

## 1.7 Conceptualisation of the study

The study covers three themes, which have also shaped its scope:

1. The effects of alien invasive plants on the environment, as explored in the literature

review.

2. The negative impact of alien invasive plants on water resources.

3. The sustainability of job opportunities created by the removal of alien invasive plants.

The study focuses on monitoring the environmental changes that occur after the clearing of the alien invasive plants has taken place. Alien invasive plants consume a lot more water than native plants, which causes a decline in the water table. However, the study does not measure how the water table has raised or declined after the removal of alien invasive plants. Instead, environmental change is observed. For example, if grass begins to grow in these areas it indicates that the ecological environment has responded positively to the alien invasive plants' removal.

Alien invasive plants have a negative impact on the ecological environment and water resources but when they are removed they can be used for something useful such as finding market for selling wood. Such actions create informal job opportunities, but such jobs must be sustainable. The study investigates how sustainable the jobs of the biomass contractors are. This is achieved by establishing when they first started collecting wood and by analysing whether the money, they make is sufficient to sustain themselves and their families.



The collected data are analysed using an Excel spreadsheet and categorised according to the questions asked in the questionnaire. Pictures are used as another source of data, and are discussed in Chapter 4, where the data collected are presented and analysed.

## 1.8 Thesis outline

The present study is separated into five chapters. Chapter 1 presents a general introduction and background to the study, the problem statement, research question, and aims and objectives of the study. Chapter 2, the literature review, provides an overview of the theoretical and conceptual background that guided the study. This chapter also provides an overview of the current literature on the removal of alien invasive plants in South Africa and internationally. Chapter 3 provides a description of the study area, with an emphasis on features that are likely to influence water intake by alien invasive plants in the area. It also describes the research design and methodology that was applied in collecting and analysing

the data, highlighting advantages and disadvantages of the chosen methodology. Chapter 4 presents and discusses the results of the study. Chapter 5 provides a conclusion and suggested recommendations based on the findings of the study. The appendices provide additional documentation in support of the findings of the study.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Introduction

This chapter focuses on the impact that alien invasive plants have on the environment as described in the literature. It also discusses the importance of removing alien invasive plants, and the positive impact that removal can have on people's livelihoods if biomass is utilised effectively, both in South Africa and globally.

Invasive plant species are species that can survive, reproduce and spread unaided, sometimes at alarming rates, across the landscape (Van Wilgen et al., 2001). In addition to the negative impacts of alien invasive plants, they also have some benefits (Van Wilgen.2001). These benefits include an improved river system service; flood control; the containment of erosion and a decrease in the siltation of dams; economic empowerment; social development and poverty alleviation; skills development; training through opportunities in small, medium and micro enterprises (SMMEs); job creation; and the development of careers in natural resources management (Van Wilgen.2001)

However, achieving these benefits requires effective partnerships and land-management plans to ensure that landscapes are restored following the clearing of alien invasive plants and that the long-term ecosystem service benefits are achieved (Van Wilgen and Scott, 2001; Van Wilgen and Forsyth, 2008).

## 2.2 General impact of alien invasive plants

Alien invasive plants are a global problem. The United Nation's Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) projects that about one fifth of the Earth's surface, including the global biodiversity hotspots, are at risk due to biotic invaders (Díaz al., 2019). High-income countries recorded 30 times greater numbers of invasive alien plants compared to low-income countries (Seebens.2018), One of the reasons for this difference is the deliberate movement of people and cargo for scientific exploration, industry and tourism, all of which may transport alien invaders of fungi, microbes, flora and fauna (Pyšek and Richardson, 2010).

Some parts of Canada that are semi-arid, for example, are faced with water quantity

challenges, mainly due to the overspreading of Australian eucalyptus trees. The intention behind promoting widespread eucalyptus plantations is to convert natural forests of low perceived value to improved timber productivity and to generate government revenue, with economic considerations focused on the yield of timber including pulpwood (Mathur et al., 1984). The initial idea was to produce high-quality furniture for governmental use, as provided by the eucalyptus trees, but the consequences and challenges that arose due to this initiative were not monitored.

Alien plants also affect ecological status. A study in Zambia indicated that biological invasions expand rapidly, and each major group of invasive species poses challenges to ecologists and ecosystem managers (Jama et al. 2000). Until recently, relatively few tree species featured prominently on lists of the most widespread and damaging invasive species, but the picture is changing rapidly (Richardson and Rejmanek, 2011).

As previously stated, alien invasive plants pose threats to the environment, mainly indigenous plants and water resources. This means that if alien invasive plants are not controlled, they will rapidly affect the environment in a way that causes local plants to die out, due to the competition for water and other resources. This will be discussed further in the next section.



### 2.3 Impact on the environment and water resources

The impact of alien invasive plants on water resources is one of a number of significant issues. It has been found that alien invasive plants' abstraction of groundwater from the transboundary Indo-Gangetic Basin, comprising 25% of global groundwater withdrawals and used to sustain agriculture in Pakistan, India, Nepal and Bangladesh, is not only unsustainable but also compromised by extensive contamination due to the presence of such alien invasive plants (MacDonald. 2016). Additionally, intensive, mechanised water management solutions, such as tube wells and dam-and-transfer schemes, have led to a decline in traditional, community-based stewardship and, consequently, to declining water security, compounded by centralised government control, economic pressures, and climate change (Everard.2013).

Alien invasive plants threaten biodiversity and the productive use of land. They also escalate the impact of fires and floods and increase soil erosion when they are removed (Richardson and Van Wilgen, 2004; De Lange and Van Wilgen, 2010). This means that, when removing

alien invasive plants, proper planning should be adopted to avoid the above issues after removal. Since alien invasive plants are a significant threat to biodiversity and water resources they must be removed or supplant with native plants to secure water and recover the ecological status of the region in question.

A study in India that controls alien invasive plants has supplanting the alien invasive trees that have the biggest impact on the environment with native trees that have less impact on the environment but have similar benefits, such as preventing flooding and soil erosion (Choi et al., 2020). These trees have been hailed as the wonder trees of India: leucaena leucocephala, pinus radiata and prosopis cineria (Bray et al. 1997). Among the reasons why these trees are admired are their exceptional adaptability to a wide range of sites, their rapid growth and the multiple uses for their various products (for example, leucaena leucocepbala can be used for fodder, firewood, building timber and erosion control).

South Africa is one of the countries in Africa that has been hardest hit by the presence of alien invasive plants (Cadotte et al., 2017). While South Africa is richly gifted with biodiversity, much of this lies outside of its protected area system, which only makes up approximately 6%. South Africa's biodiversity is therefore increasingly under threat (Turpie et al., 2008). The WfW program has done well over the years in removing these alien invasive plants and securing both water and environmental integrity, but there is still room for improvement.

The alien invasive plant species are highly invasive and have spread over an area of almost 2.5 million ha in South Africa (Versfeld et al.,1998), where it has significant negative impacts on biodiversity and the stability and integrity of riparian ecosystems, even though that the study is outdated is still relevant. Many alien invasive plants have substantial commercial value. These two features, commercial value on the one hand and an invasive, damaging ability on the other, give rise to a classic conflict of interests, where only a few people collect the rewards while society at large bears the external costs.

A study that replaced grassland in two small catchments in the KwaZulu-Natal Drakensberg with pines caused streamflow to be reduced over 20 years from 640 mm per annum to 115 mm per annum – a reduction of 82% under the same simulated rainfall conditions (Bosch,

1979). Replacing fynbos brushwood forest in the Western Cape Province with pines resulted in streamflow reductions of up to 50% (Van Wyk, 1987).

(Versfeld et al. 1998) estimated that alien invasive plants reduced South Africa's mean annual runoff by some 7%. However, many of these assessments did not focus on specific interventions and their impacts. (Marais et al. 2004) try to quantify the costs of removing alien invasive plants to some extent, but at that stage not enough data were available to do a focused assessment of specific interventions and these interventions' impacts on specific benefits. Before and since the WfW programme's beginning, several studies were done focusing on localised impacts of clearance on natural resources. (Dye and Poulter.1995) found a substantial increase in streamflow after clearing pinus patula and acacia mearnsii from riparian areas in Mpumalanga and the Western Cape.

The best way to deal with alien invasive plants is to remove them, which decreases the water stress on local plants. Therefore, options for utilising the biomass after removal need to be explored; this exploration is driven by the type of biomass available for use. Two common uses of biomass are for charcoal and furniture. These uses can establish businesses that remove alien invasive plants. This could have financial benefits such as selling wood for firewood, crafts, and furniture. However, most of the biomass is usually left in situ, which often results in a fire hazard (Eberhard and Joubert, 2002; Joubert et al., 2003; Cherni et al., 2007). The biomass is normally left in situ because removal in these areas is often difficult and requires expensive machinery.

In 1996, Le Maitre et al. found that the Western Cape Province is the most heavily invaded area, followed by Mpumalanga, KwaZulu-Natal, and Northern Cape. A detailed survey of the Western Cape Mountain catchments showed that around 60 500 out of 1 138 million ha (5% of the total surface area) had an invasion density of at least 25% (Marais et al., 2004). Initial estimates indicate that approximately 54% of all riparian areas also have an invasion density of at least 25%, or, effectively, some 460 000 ha. Given the fact that alien invasive plants cover an estimated one third of land, alien invasive species are a problem for the entire country. Additionally, given the fact that alien invasive plants utilise about 6.7% of the country's runoff, there is a significant water shortfall that must be dealt with. Since South Africa is a developing country, such water losses are not acceptable.

A South African study by (Schewe et al. 2014) aimed to improve water quality. Improving the local ecology and addressing unemployment are amongst the objectives addressed by the project, which can be achieved by removing alien invasive plants. The study estimated that, if alien invasive plants were not monitored, they could potentially reduce water supplies to the City of Cape Town in general by 30%. “The results show that biophysical and socioeconomic data can help to determine supply-use relationships for ecosystem services and demonstrate how integration of supply-use data can inform sustainable management of social ecological systems in the context of environmental change” (Schewe et al., 2014).

## 2.4 Impact on socioeconomic status

Since the removed alien invasive plants form part of organic waste, they can be a solution to unemployment. As an example, in Calabar, Nigeria, the value-added industries that use biomass feedstock are financially feasible,” while also contributing to job creation, skills development, inclusive socioeconomic development, biodiversity conservation and landscape restoration, and the biomass is used in creating electricity and other sources of energy like fire” (Youdeowei, 2012). This value-added industry plays a key part in providing employment and making sure that people make ends meet.



The Eco-Furniture Programme which is a public programme, run by South Africa’s Department of Environmental Affairs, makes use of alien invasive plants after they have been removed to manufacture furniture for governmental institutions, such as desks for schools (Ward,M . 2017). Nationally and regionally, the Eco-Furniture Programme adds value by creating cost-effective furniture for governmental institutions such as schools, as well as providing jobs and upscaling people’s skill sets.The Eco-Furniture Programme currently delivers 273 000 double-combination eco-desks to rural schools around the country, based on orders placed by the Department of Basic Education. Since April 2014, over 400 000 learners have been placed behind high-quality desks, most for the very first time in their careers. By the end of the August 2016, 546 000 learners were enjoying a much-improved learning experience. Should this Business Plan be fully implemented, a further 336 000 learners will be provided with eco-desks (Eco-Furniture Programme Business Plan, 2017). Recently, the geographical footprint of the project was expanded to increase job opportunities and be based closer to alien invasive biomass. This would also expand the scope and market of the products. An application was submitted by the Eco-Furniture programme to the Jobs Fund to

establish two factories in each province, which would be modelled on the eco-coffin factory at the Cedara Agricultural College in Howick, KwaZulu Natal, with similar structures replicated in the other provinces. The target of 3 006 beneficiaries were arrived at through the extrapolation of 167 beneficiaries in each of 18 factories around the country (Stafford, 2017).

WfW has also had significant value through the creation of jobs, the development of human capital and the protection and restoration of natural capital. It is seen as a success story for controlling alien invasive plants in South Africa while at the same time creating both formal and informal employment (Hobbs, 2004; Buch and Dixon, 2008; Turpie et al., 2008). For example, in Matatiele, an area in the Eastern Cape, people have been able to make ends meet with the discarded organic waste of alien invasive plants (Bennett, B.C., Prance, G.T .2000).

It is therefore evident that the use of biomass has a potential to lower the rate of unemployment. According to the (Department of Environmental Affairs .2017), both the WfW programme and the Eco-Furniture Programme have generated both formal and informal employment opportunities for thousands of people over the years. As such, the projects have not only contributed to reducing unemployment, but have also improved environmental integrity and water security ( Hughes et al. 2014.)



South Africa is faced with a longstanding issue of unemployment, which is a significant problem for the government. The removal of alien invasive plants is one way of providing informal employment and improving the socioeconomic status of people, especially as many people already work in the informal sector. The unemployment rate was 26.6% in 2016 and 32.5% in 2021, a massive increase, and the informal sector could potentially provide some employment opportunities (Stats SA, 2020).

There are many occasional miners who count amongst the unemployed; in 2012 there were approximately 90 000, compared to 46 600 in 2020 (StatsSA, 2021). Therefore, in eight years, about half of these miners lost their jobs, raising concerns about what the other half will do for employment as time goes on. It is therefore imperative to find ways of empowering and educating people like these and finding new ways of creating employment for them.

(Sindzingre .2004) describes the informal economy as non-observed, irregular, unofficial, informal, cash economy, black market, unmeasured, unrecorded, and untaxed. People in the informal sector are those who do not secure employment in the formal sector (Chen, 2004; Kutywayo, 2015). Alien invasive plant (biomass) collectors are one of the groups who make a living in the informal economy through collecting organic waste on the streets or at forestry sites throughout developing countries, including South Africa.

According to (Gallin .2001), "the informal economy should not be viewed as unusual. He states that 80% of low-income countries and 40% of medium-income countries and 15% of high-income countries have a growing informal sector ". This is a clear indication that the informal sector in developing countries is a major source of income, especially compared to developed countries, where there are more skilled jobs and fewer labour-intense jobs. For example, Ghana's informal sector makes up 80%, while South Africa's informal sector is relatively small. The figures indicate that sub-Saharan Africa's informal sector contributes between 20% (South Africa, Lesotho, Namibia) and 60% (Nigeria, Tanzania, Benin) to national GDPs (StatsSA.2020). This means that unemployment is generally higher in developing countries than in developed countries.

In summary, it is significant that the existence of alien invasive plants is a global issue which many countries worldwide have had to deal with. The use of biomass depends on certain factors such as wood type and grade of the wood, but most of the wood from alien invasive plants is used to generate energy.



## 2.5 Business structure to promote environmental integrity and socioeconomic

Alien invasive plants have long been a central problem in water and environmental disciplines. Removing these trees is often the best way to reduce the problem. The most common alien invasive plants in South Africa are pine trees, blue gums and black wattles. Such trees can produce wood fuel, building material, pulp and paper, poles, non-fibre product and bio-renewable energy (charcoal, biofuels, and furniture) (Stafford, W. 2017).) However, "the feasibility of the value-added industry depends on sharing the cost for alien invasive plant biomass supply between the bioenergy entrepreneur (R154,14/green tonne) and the government (R245,84/green tonne)" (Stafford, W. 2017). It is important to consider the relationship between those who remove the biomass and those they sell it to, who will use it

in the manufacturing process or in some other way.

When dealing with the biomass of alien invasive plants, the business model can be structured in two ways. First, there is the model dealing with energy product biomass, which manufactures heat and power, wood chips, firewood, lump charcoal, and electricity. The second type of model deals with biomass as a material product, manufacturing timber, biochar, wood poles and wood laths. The material products business model is a commonly used model, used in WfW and the Eco-Furniture Programme, and has been implemented and replicated across South Africa in most spaces were alien invasive plants exist. With the establishment of the Working for Value-Added Industries (VAI) programme in 2015, which was born from the WfW programme and the Department of Environmental Affairs' Natural Resource Management programme, a range of materials and energy products from alien invasive plants were developed, thereby merging the biomaterial and bioenergy opportunities of alien invasive plants (Stafford, 2017). The VAI programme encourages cost recovery of the cleared biomass by processing it into a wide range of products (Stafford, 2017). The type of product depends on the type, size, and grade of the plant. It is important to evaluate the efficiency, impact, and sustainability of the programme in addressing poverty, enhancing the value of assets, and creating jobs. The evaluation process revealed that issues of finance, manufacturing capacity, innovative approaches and products, networks and relationships, skills development and ecosystem services were crucial factors in determining a programme's success (Stafford, 2017). The data were collected through document analysis, interviews and site visits that generated both quantitative and qualitative information (Stafford, 2017).



## 2.6 Theoretical and conceptual framework

### *2.6.1 Conceptual framework*

"Sustainable development is the ability of maintaining a resource for the generations to come without compromising the resource at hand" (Koroneos, 2012). The word sustainability was established in 1980 by the International Union for Conservation of Nature and Natural Resources (Koroneos, 2012). The concept of sustainability continued to grow, and it was accepted in 1987 as stipulated by Brundtland Commission that the concept of sustainable development and many of its related concepts were manifested, emphasising

disadvantaged/vulnerable people and their needs, citizen participation, self-reliance emphasis and sustainability (Solesbury, 2003).

Sustainability was popularised by Chambers and Conway in a 1992 research paper (Solesbury, 2003) building up to Brundtland's work. Sustainability is a holistic approach which involves meeting our own needs without compromising the capacity of future generations to meet their needs (World Summit Outcome, 2005; Koroneos, 2012). To find lasting success, sustainability considers ecological, social, and economic dimensions (World Summit Outcome, 2005; Koroneos,2012). Sustainability for poor people is one of three significant policy aims, along with endorsing human development and preserving the environment (Huang et al., 2016)

*2.6.2 Theoretical framework*

The Sustainable Livelihood Framework (SLF) is a theoretical framework that guided this research programme. The SLF was developed to improve the understanding of the livelihoods of underprivileged people (Allison and Horemans, 2006), and provides a framework to identify the assets risks, organisational and institutional environment and vulnerabilities that may affect underprivileged ivelihoods. It also provides a comprehensive framework to collect a variety of data and provide an integrated analysis of complex and highly dynamic contexts and cases (Scoones, 2009).



The framework assists in assessing the sustainability and viability of the wood contractors' work, and the vulnerabilities that may impact their livelihoods (Kébé and Muir, 2006). (Chambers and Conway.1992) explained that the term "livelihood" incorporates the capabilities and assets which include both material and social resources and actions that are essential for living. "A livelihood is said to be sustainable when it can cope with and recover from stresses and shocks, maintain, or enhance its capabilities and assets while not undermining the natural resources" (Bechtsis et al.2018). In the case of wood contactors, the sustainability of their livelihoods refers to their access to the biomass as well as the continual availability of wood for their survival in the recycling sector itself (Nzeadibe and Mbah, 2015). The sustainability of their access to wood and income also affects their food security. In this case the structure of the wood contractors' work is of great importance to know because it is a direct indication of the type of life, they are able to afford. In addition,

knowing how many additional people are dependent on the wood contractors' income gives the researcher a clear picture of the figures they are left with after they have financed their expenses.

The following graph gives an overview of the SLF.

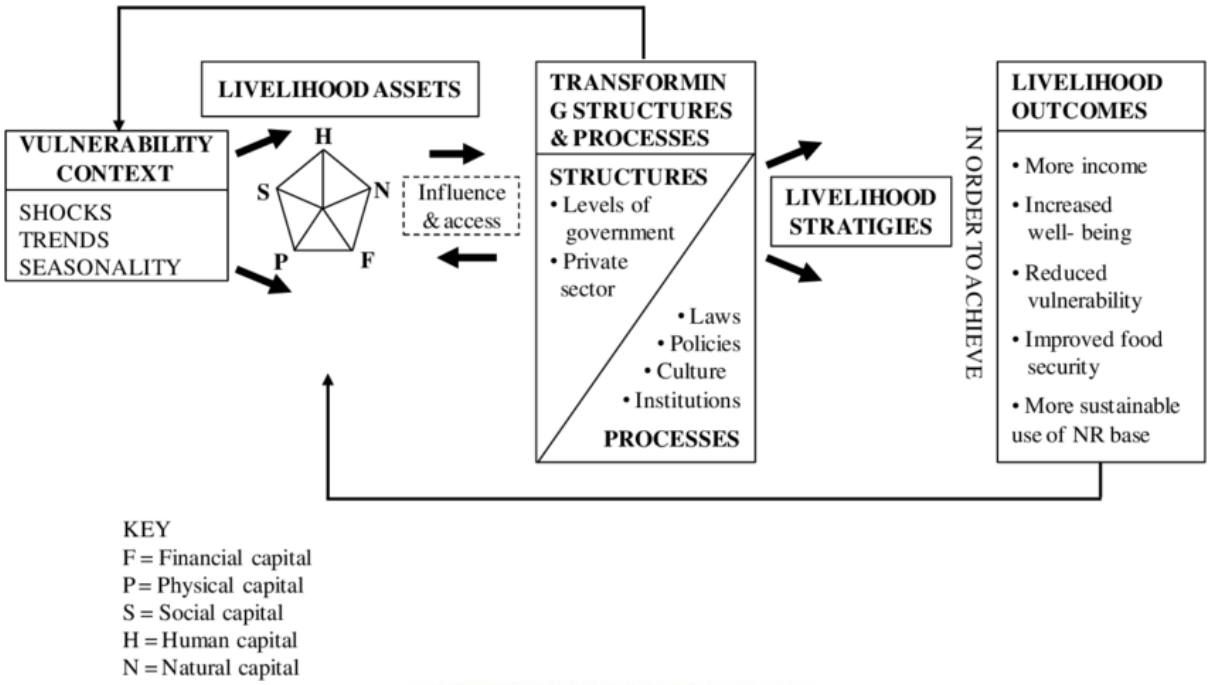




*Figure 1: The Sustainable Livelihood Framework*
(Source: IFAD, 2014)

Vulnerable contexts are measured by their ability to absorb stress. The vulnerability context is described in terms of "shocks/stresses/seasonality/trends" (Morse and McNamara, 2013), i.e., "circumstances over which people have limited or no control, and which require coping and adaptation". "Shock" tends to mean a more sudden pressure on the livelihood (Morse and McNamara,2013). The vulnerability context is guided by structures such as laws, policies, culture, and institutions, which then shape people's livelihood strategies and livelihood outcomes.

Livelihood assets are guided by five capitals. These are: human capital, social capital, natural capital, physical capital and economic or financial capital. For this framework to be properly

used, it must fit in all five of these capitals, which are also referred to as livelihood assets.

Human capital involves the expertise, understanding, capacity to work, good health and physical ability important for the successful pursuit of different livelihood strategies (Kollmair and Gamper, 2002; Allison and Horemans, 2006; Morse and McNamara, 2013). This capital is based on the understanding of the basic human need for access to safety and good working conditions.

"Social capital refers to social bonds and social norms that are an important part of the basis for sustainable livelihoods" (DFID, 1999). Social capital is vital, as it has a strong influence on people's sense of wellbeing through identity, honour and belonging, and acts as an informal safety net to safeguard survival during times of intense insecurity (Kollmair and Gamper, 2002). Social capital is formed through systems and connectedness, involvements of additional formal groups, affiliation of trust, mutuality, and exchanges (Isakson, 2015). It focuses on the culture and beliefs of people and is also driven by languages and environment.

Natural capital includes resources such as water and access to land (Krantz, 2001; Ruben et al., 2007). This is especially vital in agricultural settings, but also at landfill sites, where access to drinking water is a priority since it is a basic human need for survival.



Physical capital consists of basic infrastructure equipment, vehicles, houses, and producer goods needed to support livelihoods (Seratti, 2008). It is important to measure this dimension because the absence of it leads to difficulties in achieving sustainable livelihoods. For example, improved infrastructure in a community like roads would reduce transaction costs, which could decrease the need for self-provisioning (Winters et al., 2006).

Financial or economic capital refers to the funds created or access to funds which are needed to search for any livelihood strategy, for example cash, debit, savings, and other economic assets (Dheressa, 2013). It is of great importance because it can be used for direct achievement of livelihood outcomes, for example when food is bought to reduce food insecurity (Krantz, 2001). In this study, this type of capital focuses on the amount of money that individuals involved in wood construction make during good and bad months, and also looks at the funds that might help them in support of their work, such as for acquiring new equipment.

Transforming structures and processes are an important in representing external factors that influence the range of livelihood options open to different categories of people and they also influence access to assets and vulnerability to shocks (Seratti, 2008). “They comprise institutions and organisations together with their policies, legislation and regulations that affect and influence people’s livelihood, and provide the commercial contexts in which economic outputs are realised” (Seratti, 2008; Morse and McNamara, 2013). A permitting policy and institutional environment make it easier for people who are underprivileged to make up access to assets they need for their livelihoods (Morse and McNamara, 2013).

Livelihood strategies are the variety and union of activities and choices that people make to accomplish their livelihood goals (Krantz, 2001; Ruben et al., 2007; Nzeadibe and Mbah, 2015). This is dependent on an individual’s understanding of the choices available to them in their surroundings and on their socioeconomic status. “These strategies will include short-term and long-term coping tactics to earn a living, to manage shocks and risks as well as goals for their families’ future “(Krantz, 2001; Morse and McNamara, 2013; Schenck et al., 2017).



## 2.7 Summary

The clearing of alien invasive plants has a positive impact on the upliftment of South Africa’s economy, reducing unemployment and contributing positively to the informal sector while also creating thousands of job opportunities for marginalised members of societies. The products created through alien invasive plant remove have the benefit of uplifting and providing incomes in predominantly rural areas, where this is much needed (Vundla et al., 2016).

The use of alien invasive plants for energy purposes has the potential to reduce both the negative externalities caused by coal-fired electricity generation and their harmful effects on the environment. In addition, the use of alien invasive plants for bioenergy production will contribute to reducing alien invasive plants and restoring the invaded ecosystems, while enabling increased clearing and eradication of alien invasive plants through cost recovery. Other benefits include social development; poverty alleviation; job creation; economic empowerment; training for small, medium, and micro enterprises; and a reduction in fire

protection costs.

# CHAPTER 3: RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter describes the study area, including its physiographic features and the socioeconomic context. The study area, Paarl, is a city in the Drakenstein Municipality of the Western Cape Province. The chapter also details the methodologies implemented in this study. The research design, data collection methods, data analysis methods, data quality assurance, ethical consideration and limitations of the study are presented. The sample criteria, sample size and saturation point are also discussed.

## 3.2 Location of the study area

The town of Paarl is located in the Western Cape Province of South Africa. It is the fourth-oldest town and European settlement in South Africa and the biggest town in the Cape Winelands district. It is situated about 60 km northeast of Cape Town. Paarl is renowned for its fruit-growing heritage (Drakenstein Municipality, 2021). The study area includes the Paarl Mountain Nature Reserve.

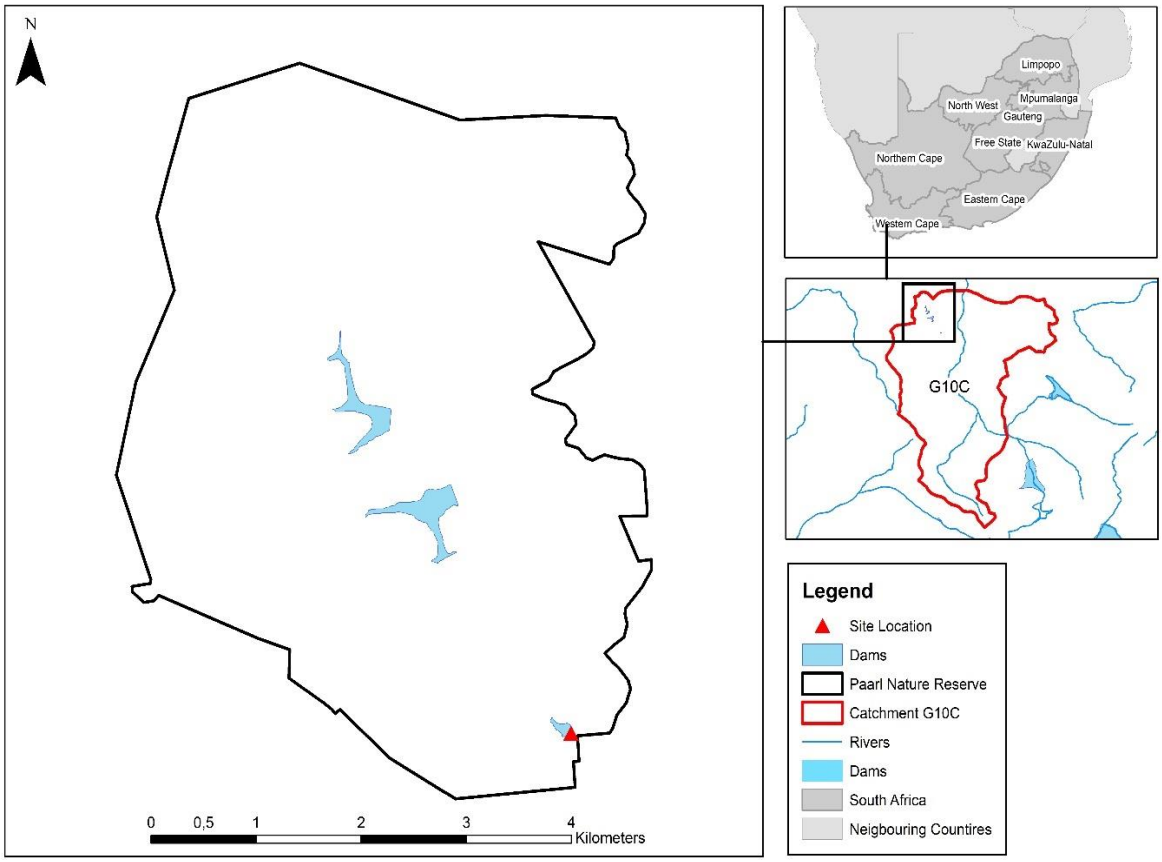

*Figure 2: Map of the study area*
(Source:Twetwa,S, 2021)

### 3.3 Motivation for the study area

The study area is one of the most biodiverse towns in the Western Cape Province, after Cape town (Drakenstein Municipality, 2021). Paarl also has one of the lowest unemployment rates in the country, since it is surrounded by farms and vineyards which provide formal and informal employment opportunities to the residents. The choice to use the Paarl Mountain Nature Reserve as a study area was since it captures all the elements that are required to make sure the three research objectives are fulfilled, such as the active presence of alien invasive plant removers and wood contractors who work for themselves. Drakenstein Municipality is also one of the local municipalities selected as a study area under the DSI/NRF/CSIR Chair in Waste and Society.

### 3.4 Physiographic features of the study area

*3.4.1 Rivers and drainage pattern*

Paarl is nestled in the district known as Drakenstein and was named Paarl when a village was founded at the foot of Paarl Rock. The town is built alongside the Berg River, which traverses the valley created by the mountainous outcrops to the east and west.



The Drakenstein Municipality includes portions of three major catchments: the Molenaars/Breede Rivers, the Mosselbank/Diep Rivers and the Berg River. These are located within the Berg, Mosselbank/Diep catchments and Breede (Breede/Molenaars) Water Management Areas. Of these catchments, by far the largest portion of the Drakenstein Municipality is located within the Berg River catchment (some 54 000 ha), with the Mosselbank/Diep accounting for a relatively small area on the southwest of the municipal area (some 2 080 ha), and the Molenaars River being fed by an even smaller area (1 600 ha) to the east of the Klein Drakenstein Mountains (Drakenstein Municipality, 2021).The water from the Berg River is directed to the Paarl Mountain Nature Reserve, where the study took place. The water is used for irrigation purposes and for personal use by the residents in the nature reserve.

The catchments are subdivided into subcatchment for management purposes relating to the river. Despite the relatively small areas represented by the catchments within the study area, they nevertheless include important rivers from the upper reaches of these systems, indicating that their management within the Drakenstein area could have implications for the greater systems downstream (Drakenstein Municipality, 2021). The subcatchments are located at the nature reserve and reserve water from the Berg River Dam. The water is directed from the Berg River and stored in the subcatchments, namely Nantes Dam and Bethel Dam.

*3.4.2 Topography*

The Drakenstein Municipality has steep mountainous slopes in the southeast and along the eastern border and a small area in the southwest. The mountain range along the eastern boundary of the municipality continues northwards beyond the northern border. It is characterised by steep lateral valleys, topped by approximately 1 700 m-high mountain peaks. The land to the east of the Berg River rises in terraces to the slopes of the mountain range before reaching the steep sides of the mountains. “There are three valleys in the area: a narrow, closed valley in the Franschhoek area which widens towards the northern point of Simonsberg, the valley between Paarl Mountain and the Drakenstein range and an open valley between Perdeberg and the continuation of the Drakenstein range” (Drakenstein Municipality, 2021).



*3.4.3 Geology*

The Drakenstein Municipality consists of a sequence of rocks from the Malmesbury Group, the Cape Granite Suite, the Table Mountain Group, and younger Cenozoic sediments. The Table Mountain Group consists predominantly of erosion-resistant quartzitic sandstones which result in the formation of steep rugged topography. Such topography is evident in the higher altitudes within the southern reaches and along much of the eastern edge of the municipality (Drakenstein Municipality, 2021).

Towards the lower-lying western areas of the municipality, the TMG erodes down to underlying Phyllite and Greywacke shales from the Malmesbury Group (Drakenstein Municipality, 2021). These shales are interspersed with lenses of quartzite schist as well as limestone. Essentially, the Malmesbury Group is comprised of soft, highly erodible rocks surrounded mostly by shales that form undulating plains in low-lying areas. Large outcrops of

erosion-resistant granite from the Cape Granite Suite are present within the southern reaches of the municipality in the form of Paarl Mountain, Perdeberg and an area extending from the Klein Drakenstein Mountains to Groenberg. Fine to medium and coarse-grained alluvial deposits are present in river channels extending throughout the municipality (Drakenstein Municipality, 2021).

### 3.5 Socioeconomic setting of the study area

Drakenstein Municipality has one of the highest average incomes per household in the country, with most households (57.6 %) in the middle-income category. Despite this relative wealth, the socioeconomic statistics show extreme deprivation and poverty amidst the wealth. Nearly one quarter of households in the Drakenstein area earn less than R1 000 per month and 42% of households earn below the household subsistence level (Drakenstein Municipality, 2021).

Given the importance of the Drakenstein Municipal area in the Western Cape's wine and fruit belt, economic activities concentrated in the towns of Paarl and Wellington are dominated by the agro-processing industry for the fruit, wine, brandy, juice concentrate and dried fruit sectors. The trade, services and financial sectors also play a significant role, as the towns in the area act as service centres for the surrounding region. The major industries in the Berg River catchment are agriculturally based (wheat, grapes, and deciduous fruit) and include wineries, canneries, and other food-processing factories. Winelands tourism provides another major source of income. Dryland grain farming and stock faming (sheep and cattle) dominate much of the area between Wellington and the northern and western boundaries of the Drakenstein area, extending as far as Veldrif at the coast. Pine and gum plantations occur near Franschoek (Drakenstein Municipality, 2021).

### 3.6 Management of water resources in the study area

Paarl, the largest town within the Drakenstein Municipality, purchases the bulk of its water supply – approximately 95% – from the City of Cape Town. While it is good quality, the water is relatively expensive (Drakenstein Municipality, 2021).

An existing water supply scheme in the Paarl Mountain Nature Reserve includes the Nantes and Bethel bulk storage dams sited on Paarl Mountain, which has the infrastructure to

supplement the natural runoff to the dams with the municipality's allocation of water from the Berg River. In addition, reservoirs and pipelines existed to feed the water into the town's distribution network. This scheme could provide up to 25% of the town's annual water requirements, substantially reducing water supply costs. However, apart from basic disinfection, no treatment facilities existed, and the infrastructure still continuous to be wasted (Drakenstein Municipality, 2021).

"Based on the cost of water, the nature reserve has initiated the building of water-sensible design buildings to capture rainfall. This design is regarded as an innovative treatment process that uses direct filtration to minimise the plant footprint. The filters are equipped with a dual-parallel lateral under-drainage system, the first plant in South Africa to incorporate this design. This system is part of an overall design to enhance the filter performance through the incorporation of optimised collapse-pulsing backwashing" (Drakenstein Municipality, 2021.

## 3.7 Methodology

### *3.7.1 Study design*

This study followed an exploratory design, using Paarl Mountain Nature Reserve as a study area. The main aim of exploratory research is to identify the gaps in the study, and the feasible factors or variables of relevance to the research. Moreover, exploratory study is designed to bring out the details from the participants (Yin, 2017). Exploratory research is the process of investigating a problem that has not been studied or thoroughly investigated in the past. It is conducted to gain a better understanding of the existing problem but does not always lead to a conclusive result. Researchers use exploratory research when trying to gain familiarity with an existing phenomenon and acquire new insight into it to form a more precise problem. It begins based on a general idea and the outcomes of the research are used to discover related issues within the broader area of research (Yin, 2017).

### *3.7.2 Study population*

The population participating in the study was comprised of people from a diverse range of ethnicities, such as coloured, Shona and Xhosa. In total there are about 120 contractors who work in the nature reserve. The research included people of all races and ethnicities, although the participants all have the common characteristic of their work (Graziano and Raulin, 2010; Wyon and Gordon, 2013). The population for this study was comprised of wood contractors

working in the Paarl Mountain Nature Reserve site as well as municipal officials.

The wood constructors have a specific structure to their operation. Namely, there are 20 wood contractors, and those representatives have about five workers each who work for them. This makes the total number of people working in wood construction in the nature reserve to be 120. The wood contractors work for themselves and do not pay the municipality. For wood contractors to work in the nature reserve they need to get permission from the manager of the nature reserve, and the manager will then assign the area that the contractor will be working on.

*3.7.3 Sampling design and sample size*

Convenience sampling was used to select the participants. Convenience sampling design is a non-random sampling where members of the target population who met specific criteria were willing to participate (Dörnyei, 2007). The criteria that qualified the contractors were that they had to be wood contractors who are permitted to work in the nature reserve.

The wood contractors were approached by the manager of the nature reserve to participate in a meeting for the renewal of their contracts, as they require contracts to work in the nature reserve. These meetings are held once every three months. The interviews for this study took place at one of these meetings. It must be noted that the wood contractors are not related to the WfW programme. The researcher communicated with the manager of the nature reserve via email, and the researcher asked to visit the site.

The sample size was limited to a maximum of 20 participants. These participants consist only of the representatives of the groups; each representative has five or more workers working for them. These representatives are the once who fire and employ the workers in their teams; they also pay the contractors daily while the workers do not sign contracts for them to work in the site. The representatives were interviewed because they are the ones who employ the workers in teams. They generally also have more experience than the people that they employ, and the equipment for cutting the trees belongs to them. This also means that they are the ones who are registered with the municipality.

*3.7.4 Data collection*

Quantitative research focuses on gathering numerical data and generalising them across groups of people or to explain a phenomenon with the goal of defining the connection between one thing and another within a population (Punch, M.1986). “Quantitative methods are used primarily to examine relationships between numerically measured variables with the application of statistical methods, grounded on random sampling and structured data collection tools “(Rasinger, 2011).

In contrast, the qualitative approach to data collection uses unstructured or semi -structured interviews, participation and observations. Data collection is dependent on human experience, which often makes it more captivating than quantitative data (Creswell, J.W., and Plano-Clark, 2011).

A mixed method combines qualitative and quantitative methods and enriches the skills of researchers, as it is able to illustrate different perspectives within the issues being studied (Creswell and Plano-Clark, 2011). Using both methods is also referred to as triangulation (Hughes. 2014).



This study made use of a mixed methods research design, with a qualitative approach as the main methodology.

It is advantageous to use both approaches in one study, as this provides additional evidence and support for the findings (Creswell and Plano-Clark, 2011). The use of both methodologies allows the researcher to be flexible on how the data is collected. Additionally, a mixed methods approach blends inductive thinking (Andrew and Halcomb, 2012). Researchers can also use various research tools available to them and collect more comprehensive data (Creswell and Plano-Clark, 2011; Wisdom and Creswell, 2013). Using a mixed methods approach also allow the researcher to use triangulation to identify parts of a phenomenon more precisely by approaching it from various points using different methods and techniques (Hughes.,Houwer,., & Barnes-Holmes, D., 2014)

There are some disadvantages to using a mixed methods research design. First, the study may require more resources to collect both types of data (Andrew and Halcomb, 2012). When

using both methods, the study requires measurement tools as well as qualitative tools such as interviews. Additionally, it is more time-consuming to collect both quantitative and qualitative data (Creswell and Plano-Clark, 2011). Instead of focusing on one method, the researcher must focus on both qualitative and qualitative. Moreover, translating data using the mixed methods framework can be time-consuming, given that the data and interpretations are often conceptual (Hughes, 2014).

## 3.8 Data collection methods

The gaps identified in this exploratory design will be addressed by means of conducting semi-structured interviews, observation, questionnaires and analysing existing studies with similar interests.

The study attempted to answer the objectives systematically from objective one to three. Objective one, exploring the impact of alien invasive plants on the environment and water resources, was met through environmental observations. Site inspections were done on a weekly basis. This was the initial step in determining why alien invasive plants are being removed. After the site inspections, the results were related to the answers from the semi-structured interviews that were answered by the manager of the nature reserve. The second objective, determining the availability of job opportunities and their sustainability, was addressed by the data collected using questionnaires. Objective three was achieved by formulating a business structure that determines how scalable the wood contractors' market is, and that promotes environmental integrity and the improvement of people's socioeconomic status.

### *3.8.1 Phase 1: Impact on the environment and water resources*

The first phase of the study examined the impact of alien invasive plants on the environment and water resources. The parameter that was measured was the recovery of the environment after the removal of alien invasive plants, which was done by observing and taking photos of the environment every Friday until significant recovery was observed. The first observation took place on 2 July 2020 and significant change was visible on 31 October 2020. Grass was used as an indicator on the basis that it takes 7 to 30 days to germinate.

*3.8.2 Phase 2: Impact on socioeconomic status*

The study made use of twenty questionnaires and semi-structured interviews, conducted with the manager of the nature reserve and the wood contractors. The questionnaires and interviews determined the wood collectors' income on good and bad days. The reason for measuring these units was to determine whether wood collection is a sustainable type of informal employment or not. Initially, the researcher collected data by travelling around the site and trying to find contractors. This was time-consuming and ineffective, however. After two weeks, the manager of the nature reserve gave the researcher the contact details of some of the wood contractors. Three interviews were conducted telephonically, and soon after this the manager of the nature reserve organised a meeting, which is where the researcher could distribute the questionnaires to more wood contractors.

An interview guide is a tool for collecting data between two or more people (Levine, 2014). A semi-structured interview was formulated and was used to interview the manager of the nature reserve. He was asked about the impact that the alien invasive plants have on the environment, which is the key element of objective two. He was also asked about the sustainability of the wood contractors' jobs, which is also important to objective two.

A questionnaire is a tool designed for collecting quantitative data and is widely used in research as it is a good research instrument for collecting standardised quantitative data and generalising. Questionnaires provide quick responses, but adequate care must be taken when developing questionnaires to ensure that the researcher does not influence the responses received. Questionnaires were directed to the wood contractors, who were first asked for their permission before participating.

*3.8.3 Phase 3: Formulation of business structure*

The business structure was formulated by understanding the process of the wood collectors' work, such as who cuts the biomass, who delivers the biomass, who buys the biomass, how much biomass there is, what activities are done with the biomass, etc. All these parameters were measured by interviews and observations that helped in establishing a business model.

## 3.9 Data analysis

They are several methods that are used in analysing data; such methods differ based on what

the researcher wants to achieve. Common methods are content analysis, narrative analysis, discourse analyses and ground theory. This research project made use of narrative analysis. A narrative method is used to analyse content from various sources. For instance, two images were taken to analyse the change in the ecological environment over a period of three months.

Computer software makes analysing the data much easier (Jones,2016). Microsoft Excel was used in analysing and categorising the biographical data and to log the income of the wood contractors. The data in the Excel spreadsheet was used to create graphs to evaluate the relationships between income and other variables such as happiness.

*3.9.1 Phase 1: Impact on the environment and water resources*

The data were analysed by comparing two sets of photographs, which will indicate how the environment has recovered over a period of three months. Grass was used as an indicator of the recovered environment.

*3.9.2 Phase 2: Impact on socioeconomic status*



The data were analysed by means of Excel spreadsheets where graphs are used to organise the data. Such graphs will be related to the sustainability of the informal jobs of the wood contractors. Data were presented with descriptive statistics.

*3.9.3 Phase 3: Formulation of business structure*

The data assisted in determining the business structures of the wood contractors. Formulating such structures involves determining the expenses and income of the contractors and the type of products that are being sold.

### 3.10 Quality assurance

When collecting data, it is important to use measures that ensure that the data collection is controlled so that errors are minimised. In this case, the triangulation method was employed to make sure that the research is of a high standard. When using the triangulation method, it is important to note that there are different types of triangulations, such as data triangulation,

methodological triangulation, investigator triangulation, theory triangulation and environmental triangulation (Pelto,2017). Triangulation is a way of integrating different data sources, which can consist of observations, questionnaires, or field notes (Pelto,2017).

Data triangulation involves using diverse sources of information to increase the validity of a study (Pelto, 2017). This type of triangulation, where the researchers use different sources, is perhaps the most popular (Pelto,2017). Additionally, this approach is also known for the practice of using multiple sources of data or multiple approaches to analyse data to enhance the credibility of a research study." Originating in navigational and surveying contexts, triangulation aligns multiple perspectives and leads to a more comprehensive understanding of the phenomenon of interest" (Shih, 1998).

### 3.11 Research ethics

Ethical considerations are always important when conducting research. This project was conducted under the ethical approval of the CSIR-funded Clean Cities Project in the DSI/NRF/CSIR Chair in Waste and Society at the University of the Western Cape. Ethical clearance was provided by the Senate Research Committee of the University of the Western Cape. Before the data were collected, the ethical procedures were explained by the Waste and Society Chair together with the Department of Earth Sciences. Before the interviews were conducted, the purpose of the research was explained to the participants. Participants were also assured that their response would remain both confidential and anonymous. Moreover, the participants were required to sign a consent form to confirm that they have agreed to take part in the research. No identifying information was included when the interviews were conducted, meaning data transcription was not included.

In research it is vital to take note of self-reflexivity. This involves having an ongoing "chat" with your whole self around what you are experiencing as you are experiencing it (Nagata, 2005). The researcher was always mindful to separate emotional attachments and personal thoughts from the research participants; therefore, the interviews were carried out in a professional and ethical way, as the researcher aimed to be non-judgmental and respectful of the respondents' self-worth and dignity.

Confidentiality, privacy and anonymity are also essential. To maintain participants' self-

respect, identity and dignity, they were assured that the information would be used by the researcher and the supervisors for study purposes only (Babbie and Mouton, 2007). Participants were assured that any identifying information would be removed after coding and pseudonyms would be assigned to them to protect their identity.

### 3.12 Study limitations

One of the major issues faced by the researcher was to find a study area that suits the study. This was overcome by contacting various departments such Environmental affairs, Working for water until a suitable study area was identified.

When conducting research, it is of great importance to look at possible factors that contributed negatively to the progress of the research. It has been extremely tough to conduct the research in 2020, given the effects of the Covid-19 lockdown regulations.

The Covid-19 pandemic also affected the attendance of the wood contactors to the site as their working hours became unpredictable. It was therefore a challenge for the researcher to know when they were available to be interviewed. This challenge was largely overcome when the manager of the nature reserve called a meeting for the renewal of their contracts.



### 3.13 Chapter summary

This chapter examined the study setting and the features of the study area, the Paarl Mountain Nature Reserve, in detail. The data were collected in this study setting using a mixed methods research approach, which combines qualitative and quantitative research. The data were collected by means of questionnaires, semi-structured interviews, and observation. The data were then analysed using graphic representation by looking at the relationships of the wood contractors' income to other findings such as happiness. The ethical dimensions of the study were also briefly discussed in the chapter.

# CHAPTER 4: RESULTS

## 4.1 Introduction

This chapter highlights the results of the study. The first part of the results is based on how the environment recovered after the removal of the alien invasive plants which is based on objective one. Then results for objective two about the impact that the alien invasive plants have on the livelihood of the wood contractors, that will then help in building up objective three in formulating the business structure. The SLF is used to present the data collected.

## 4.2 Phase 1: Recovery of the environment and water resources

The first research objective was to investigate the impact of alien invasive plants on the environment and water resources. The data for this objective were collected by means of observation, which included monitoring the ecological environmental change immediately after the removal of alien invasive plants such as black wattle, pine, blue gum, and sting beam.



The environment was given up to three months to recover after the clearing took place. This allows the researcher to monitor how the environment will respond to the removal of alien invasive plants. The growth of grass was used as an indicator in this scenario because grass takes more than ten days to germinate (Moody and Martin, 2009). A semi-structured interview was then used to compare the literature to the understanding of the wood contractors and the manager of the nature reserve.

Photographs were taken to illustrate the environmental response after alien invasive plants have been removed. The photos were taken every Friday. Observations started on 20 July 2020 and concluded on 31 October 2020. The photographs were compared to see how the environment has changed over time, as shown in Figure 4. The alien invasive plants were removed for two reasons: first, they have a huge negative impact on the ecological environment, such as distorting the environment presence of the native plants; second, they consume more water than native plants, contributing to South Africa's water insecurity.

The image shown in Figure 3 illustrates the environment two days after clearing has taken place. The environment had pale grass patches, which possibly indicates that the alien

invasive plants were the biggest consumers of water. The lack of available water affects the growth of any plant. In this case, the indigenous plants suffer because the alien invasive plants require a lot more from the environment to survive than the local plants.

*Figure 3: Environment two days after clearing*



The image was taken during the winter season, on 2 July 2020. During this time the land is

supposed to be greener because it rained often, with an average precipitation rate of 60% in July. The Paarl area receives plenty of rainfall in winter. However, the area still appeared dry during this period. The area was monitored every week until a significant change was seen.

Figure 4 indicates the environmental change in three months after the removal of alien invasive plants has taken place. Within three months of monitoring there were significant changes in the environment, and as the weeks progressed a positive change was noted.

*Figure 4: Response of environment after three months*



The image was taken during the spring season, on 31 October 2020, 90 days after the clearing has taken place. There was no significant rainfall in October, with an average daily temperature of 25 °C. It was hot during this month, and one would expect the grass to dry out somewhat as it was nearing summer; instead, the grass was growing. The grass started to grow as the weeks progressed, which indicated that the removal of the alien invasive plants yielded positive results to the environment. Additionally, the soil was moist, and the colour of the soil turned black, which was also an indication of soil nourishment.

As seen in in Figure 3 and Figure 4, alien invasive plants do affect the environment and water resources. Under normal circumstances in winter, the environment was supposed to be grassy but that was not the case. The grass was visible during the summer season when it was supposed to be less green.

Alien invasive plants have a clear negative impact on the environment. As the results

indicated, after the alien invasive plants were removed a positive change in the environment was noted. Similar studies have reported significant impacts of clearance on the recovery of the odonata species originating from Siberia (Samways.2004). The study found that odonata species populations recover rapidly after the clearance of dense stands of black wattle. The black wattle is one of the alien plants that were cleared in this research.

It was further evident that the alien invasive plants affect the water resources in the area. If the alien invasive plants are given the opportunity to grow, they will have an impact on water resources. It was noted during the study that the ground's surface was dry two days after the clearing of the alien invasive plants took place, though it soon recovered as the months progressed, with grass beginning to appear. Additionally, an increase in the water table was noted by the change in the soil colour together with the visibility of grass. As previously mentioned, Prinsloo and Scott's study indicated that the clearing of alien invasive plants increased the streamflow by 9 $m^3$, 10 $m^3$ and 12 $m^3$/day per ha cleared in in Du Toitskloof, Oaklands and Somerset West, respectively (Prinsloo and Scott, 1999). A similar study found a substantial increase in streamflow after clearing pinus patula and acacia mearnsii from riparian areas in Mpumalanga (Dye and Poulter, 1995).

A study conducted in the desert climate of the Arabian Gulf indicated that grass species germinate and develop into seedlings between November and February (winter) when the chances of rainfall are high. This means that grass mostly grows when the area has high rainfall and the soil is moist (El-Keblawy et al., 2009). Such results are an indication that during July the area was supposed to be greener, which it was not. During the winter season the water table was supposed to be closer to the surface, making the surface grassy, but that was not the case. In summer, the surface was supposed to be less green because there was less rainfall, but the area was grassier than expected. A grass seedling study indicated that during summer the grass does not grow as much due to high temperatures and less rainfall while in winter the grass grows at a higher rate due to precipitation and conducive temperatures (Marques et al., 2015). The results of this study are an indication that water resources are negatively impacted by the alien invasive plants in a way that such plants consume more water as compared to the native plants.

The manager of the nature reserve confirmed that clearing the alien invasive plants present benefits to the environment, such as:

- Increased water levels.
- Reduced fire during the fire season.
- Rehabilitation of the indigenous plants.

The manager further added that after the removal has taken place, they apply a chemical or burn the stems to avoid regrowth of the alien invasive plants. He indicated that the contractors are being educated on the type of plants that they must remove. The manager added that removing the alien invasive plants is to the benefit of the nature reserve, but is also to the benefit of the wood contractors, who make a living from selling the wood, as will be discussed in the next section

### 4.3 Phase 2: The socioeconomic status of wood contractors

This section evaluates the impact of removed alien invasive plants on the socioeconomic status of the people involved in the removal. The data for this objective were collected by means of questionnaires, observation and semi-structured interviews. The biographical information of the wood contractors is found in Table 1.



The results of this section stem from the questionnaires of the 20 contractors. First the biographical details of the respondents will be shared and then the data will be described according to the SLF. Please note that the names in the table are pseudonyms.

*Table 1: Biographical data*

| **Participant (pseudonym)** | **Gender** | **Age** | **Language** | **Highest schooling (Grade)** | **Place of origin** | **Cultural group** | **No. of dependants** |
|---|---|---|---|---|---|---|---|
| 1. Kepa | M | 40 | Afrikaans | 7 | Botswana | White | 3 |
| 2. Rudiger | F | 47 | Afrikaans | 12 | SA, Western Cape | African | 3 |
| 3. Alonso | M | 68 | Afrikaans | 8 | SA, Western | White | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Cape | | |
| 4. Andreas | M | 57 | Afrikaans | 7 | SA, Western Cape | Coloured | 3 |
| 5. Joginho | M | 30 | Afrikaans | 12 | SA, Western Cape | Coloured | 4 |
| 6. Silva | M | 30 | Shona | 12 | Zimbabwe | African | 2 |
| 7. Kante | M | 42 | Afrikaans | 8 | SA, Western Cape | Coloured | 3 |
| 8. Ross | M | 67 | Afrikaans | 9 | SA, Western Cape | Coloured | 10 |
| 9. Tammy | M | 34 | Afrikaans | 12 | SA, Limpopo | African | 4 |
| 10. Pulisic | M | 26 | Afrikaans | 10 | SA, Western Cape | Coloured | 1 |
| 11. Timo | M | 28 | Afrikaans | 10 | SA, Western Cape | Coloured | 3 |
| 12. Loftus | M | 68 | Afrikaans | 9 | SA, Western Cape | Coloured | 1 |
| 13. Willy | M | 37 | Afrikaans | 5 | SA, Western Cape | Coloured | 5 |
| 14. Blue | M | 66 | Afrikaans | 10 | SA, Western Cape | Coloured | 1 |
| 15. Chelsea | M | 47 | Afrikaans | 8 | SA, Western Cape | Coloured | 3 |
| 16. Mendy | M | 61 | Afrikaans | 8 | SA, Western Cape | Coloured | 3 |
| 17. Kova | M | 47 | Afrikaans | 6 | SA, | Coloured | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Western Cape | | |
| 18. Olivie | M | 40 | Afrikaans | 12 | SA, Western Cape | Coloured | 4 |
| 19. Mason | M | 32 | Afrikaans | 12 | SA, Western Cape | Coloured | 2 |
| 20. Calum | M | N/A | Afrikaans | 12 (tertiary qualifications) | SA, Western Cape | Coloured | 1 |

Source: Research data

Biographical data is personal data that differentiates one individual from another (Czyżewski, 2013). The full biographical data is found in Appendix E, Table 2.

Wood contractors' workers constitute people from various ages ranging from 20 to 70 years. This demonstrates that unemployment affects people of all ages, as some contractors stated that they have been doing the job from a very young age because they were forced to leave school and become breadwinners for their households, based on the circumstances at home. Most of the contractors who participated in the study are coloured South Africans who are also Afrikaans speakers who were born in the Western Cape. Only two black South Africans participated – one from Limpopo and one from the Western Cape. One person from Zimbabwe and one from Botswana participated in the study. The wood contractors have never gone to sleep without food and stated that they have decent sleeping structures.

As previously mentioned, the Sustainable Livelihood Framework (SLF) was a useful theoretical framework for guiding this study. It was useful to apply some of its concepts to the data collected during the study.

Vulnerability is an important part of the SLF. Vulnerability refers to external environmental factors such as natural disasters and economic downturns that affect wellbeing, but over which people have no control (Chambers,1989). In this study, the contractors are dependent

on the wood from the nature reserve. The three major factors which can affect their livelihood and make them vulnerable are the following: they can run out of alien invasive trees (the source of their livelihoods); fires; and changes in the market. Fires during the dry summer season, fire is one of the biggest threats which can destroy the livelihoods of the contractors (Brandt, 2020). The market might also change, and the demand of innovative technology likely means using wood-generated power will soon be replaced by other technology. Even though wood is the primary way of generating energy, it can be replaced.

Livelihood assets are significant in the SLF. These cover human, social, financial, physical, and natural capital. Aspects such as being poor, unskilled, and uneducated and having ill health lessen a person's ability to cope with environmental hazards and material hardship (Chambers, 1989).

Human capital refers to the skills, knowledge, ability to work and good health that enable people to follow livelihood strategies and achieve their livelihood objectives (DFID, 1999). As can be seen in Table 1, only six of the contractors completed high school (Grade 12), and only one has a tertiary qualification. Removal of alien invasive plants is informal work which provides an income opportunity for people who will have difficulty to access formal employment. However, all the wood contractors that were interviewed had substantial skills and knowledge about alien invasive plants. They know what plants they must remove, as the manager of the nature reserve has helped educate them in this regard.



In the SLF, natural capital refers to the natural resources (Neves and Du Toit, 2013). There is plenty of wood available to the contractors. They were asked if they are not afraid that the wood can be depleted. Their response was that wood has been available since the beginning of time. If the wood runs out at the nature reserve, they will move to another place.

Financial capital refers to the money that the contractors make to make sure they can pay their bills and put food on the table. The contractors make a sufficient amount of money for this basic purpose. Even though some contractors are not happy with their work and wish they can get new jobs, they continue because it pays relatively well.

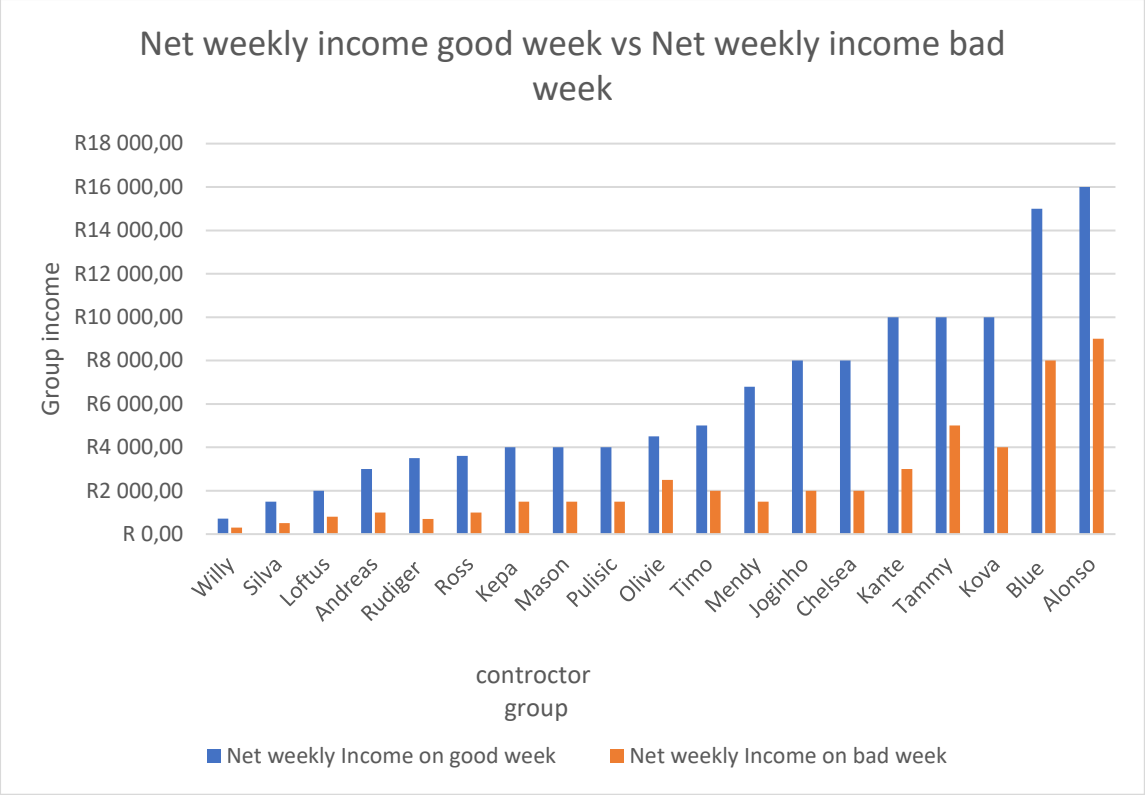


*Figure 5: -Comparison of net weekly income in a good and bad week*

Figure 5 depicts the contractors' net weekly income in a bad and good week. The graph indicates that there is a huge difference between the incomes. The net income in a bad week is nearly half of that in a good week. The mean income on a good week is R6 295, with a median income of R4 500.The mean income on a bad week is R2 515 with a median income of R1 500. The reason for such steep differences is that in the middle of the month people do not buy wood as much as towards the end of the month, because people usually have more money towards the end of the month. That means that the contractors' income declines as the month progresses.

Figure 6 indicates that there is no correlation between the number of employees and the net income of the group (the total money income that each group makes before the money is split). In other words, having more employees does not mean an increase in net income. For example, Alonso's group had fewer employees with a higher net income recoded, while Mason's group had more employees but recorded a lower net income than Alonso's group.

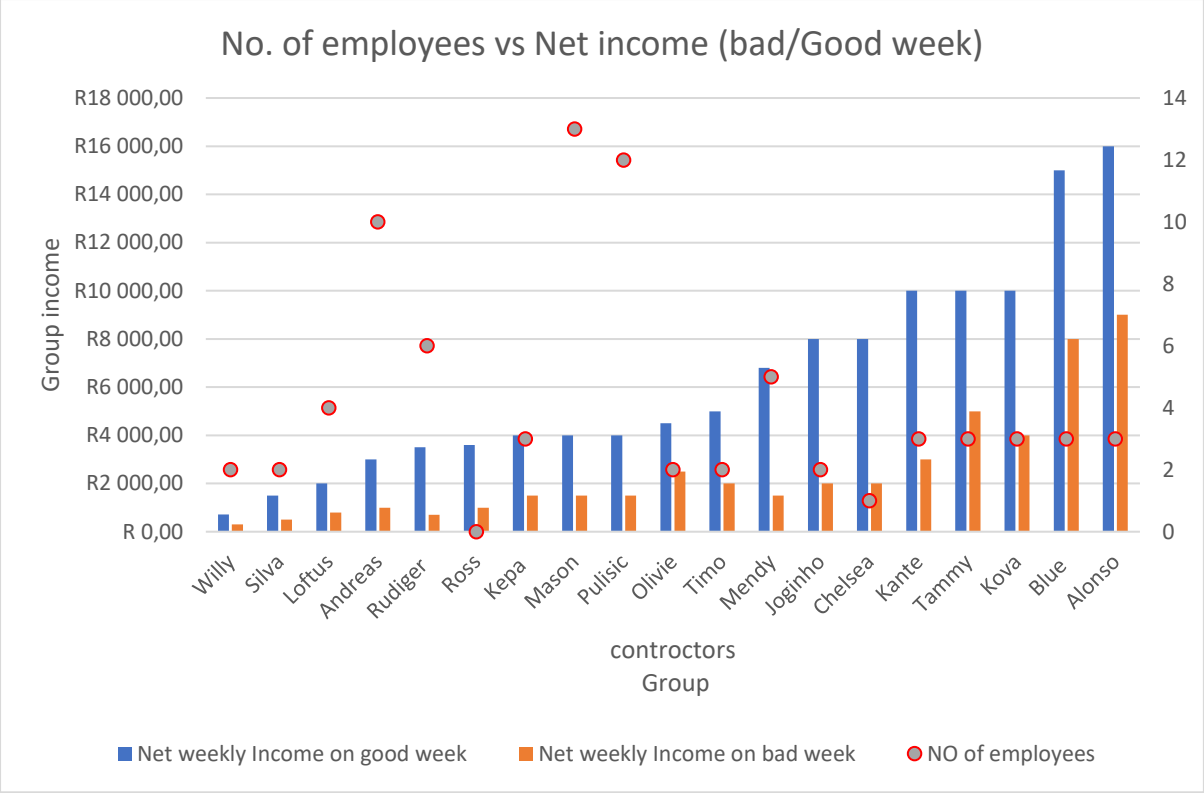


*Figure 6: Number of employees vs net weekly income in good week amd bad week*

The graph in Figure 7 indicates the relationship between the weekly wage per contractor in a good and bad week. The results indicate that in a good week the contractors make a decent amount of money to sustain themselves and that they make more than the national minimum wage. The South African minimum wage is R21 an hour, with a weekly wage of R840(Employment &labour, 2021). In a bad week they make nearly half of what they make in a good week. Some people earn less than the minimum wage and they sustain their families with this income and, even though it might not be enough, they are able to have a small income at the end of the week.

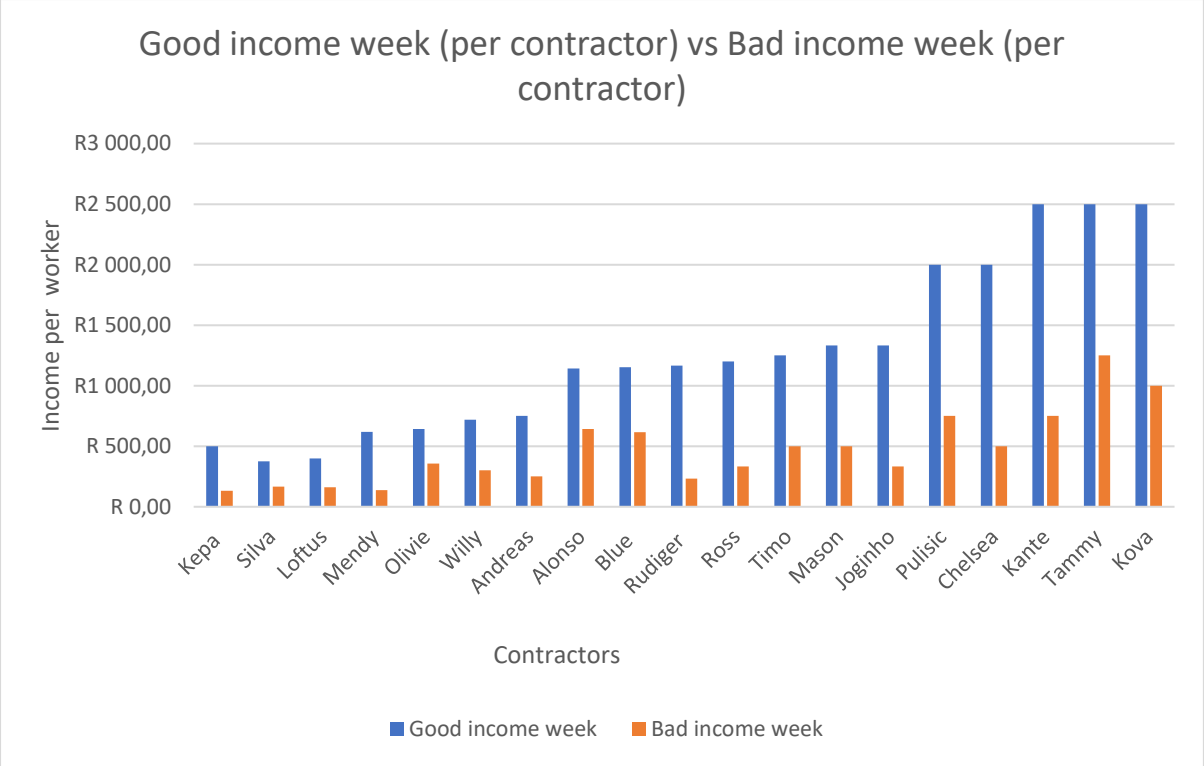


*Figure 7: Comparison of good income week and bad income week (per contractor)*

Figure 8 indicates the relationship between happiness and weekly income per contractor. It demonstrates that people's happiness cannot be measured by the amount of money that they make. Some contractors seem to be happy even if they make less money than others, and those who earn more are often less happy than them.

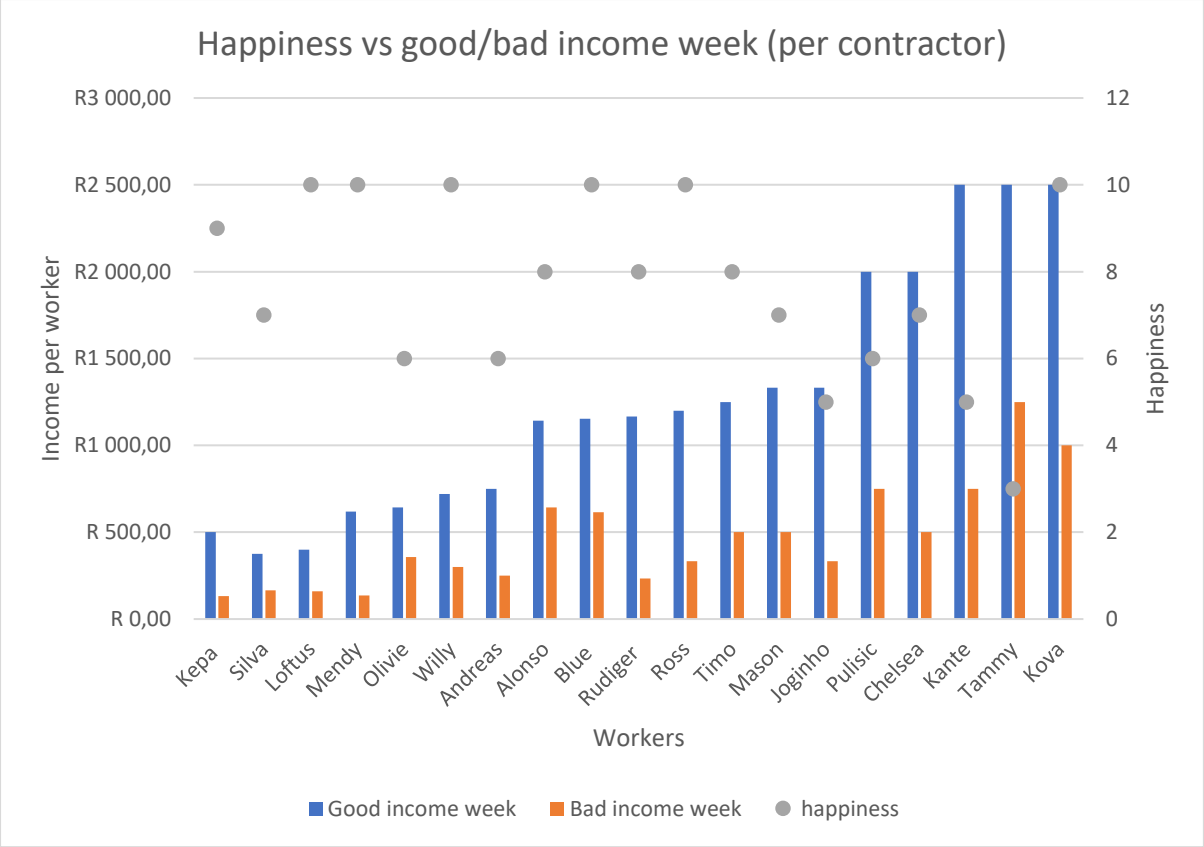


*Figure 8: Comparison of Happiness and good/bad income week (per contractor)*



Physical assets refer to the infrastructure, transport, shelter, and energy that are available (DFID, 1999). The wood contractors have certain physical assets at their disposal, such as the machinery that they use to remove the alien invasive trees. All the equipment that the contractors use belongs to them. Each team of contractors also has its own means of transport. Those who have encountered problems with transport arrange with other contractors to help them. The contractors mostly stay in liveable standard shelter.

Within the context of the SLF, social capital refers to the availability of various social resources upon which people can draw (DFID, 1999; Nzeadibe and Mbah, 2015). The contractors can always speak with one another when they need advice or guidance, while the nature reserve's manager is also available to help them. The contractors have families that depend on them for food, and some also pay school fees for their children. All these expenses have to be covered by the money that they make from selling wood as they do not have any other means of income.

Livelihood strategies refer to the activities and decisions people engage in and make to

achieve their livelihood goals (Chambers, 1989). The manager of the nature reserve has regular meetings with the contractors where they make collective decisions as to how they operate on the site and share solutions to the challenges that they face on the site, such as wood piracy. Wood piracy refers to the theft that happens when some contractors steal wood from other contractors. The contractors also make individual decisions as well; each contractor decides on their prices and how they want to structure their business. The contractors compete with one another for customers.

The contractors do not view themselves only as wood contractors but also as contributing to the environment. Many stated that the alien invasive plants are water enemies, and that they regard themselves as environmentalists because they deal with the plants that cause harm to the environment. They regard themselves as knowledgeable in knowing which plants to remove, as the municipality sometimes organises meetings to educate them about such matters.

When removing the alien invasive plants, there must be a clear structure in place to avoid an increase in organic waste. Alien plants are often removed without a clear process in place for what to do with the by-product after clearing. In the case of the wood contractors in the study, the group representatives are the ones who determines the process. The clearing process is illustrated in figures 9–12.



The first stage of the clearing process is to assess the area. Because much of the biomass is found on mountainous areas, it is recommended that the area is assessed before clearing starts (Figure 9).

During the second stage, the alien invasive plants are cut and prepared for customers Figure 10).

In the third stage, some of the remains of the wood are stacked on the ground surface to avoid soil erosion. This is also good for the nourishment of the soil (Figure 11).

The final stage is germination control by the municipality, which is also known as basal buck treatment (Figure 12). This is done by applying a chemical to avoid germination. If this is not done, the remaining stem is burned.

The wood contractors organise themselves according to the four stages to maximise the production of biomass. The wood contractors indicated that it is important to follow such stages because it saves them time. The working stages also help to avoid the duplication of the work and helps for everyone to know their duties.

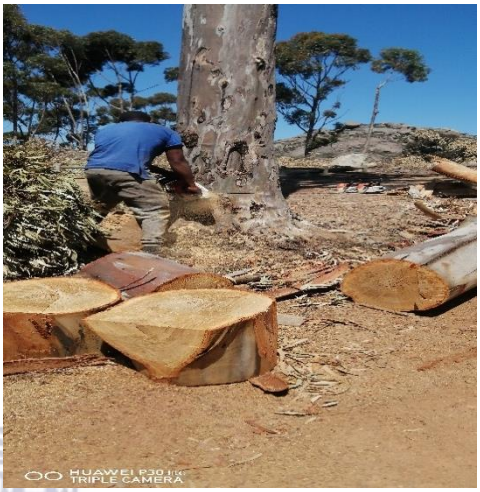


*Figure 9 (left): Stage 1: Alien invasive plants*

*Figure 10 (right): Stage 2: Cutting and preparation*

*Figure 11 (left): Stage 3: Stacking to avoid erosion*

*Figure 12 (right): Stage 4: Germination control*

The preparation of biomass in stage 2 of the removal phase is what ensures the economic significance of the biomass and creates products such as bags of wood, blocks of wood, loads or bakkies full of wood, big logs and small logs, as indicated in figures 13–17.

After the wood is prepared, they are valued according to the prices shown under figures 13–

17. The products are sold by the wood contractors for an income. The price of biomass is not weighed by the amount of processing that the wood has gone through. The quantity of wood determines the price.

The contractors indicated that there is a big market for selling wood. The market includes street vendors that sell meat, restaurants, medium corporations, and individuals who buy wood for braais or to make firewood. The demand for wood means that the contractors must work long hours to meet the demand of the market, reportedly working more than eight hours a day.

Figures 13 to 17 show products from removed alien invasive plants.

*Figure 13 (left): A bag of wood, valued at R35*
*Figure 14 (right): One piece of wood, valued at R1.50*

*Figure 15 (left): A load of wood in a bakkie, valued at R900*
*Figure 16 (right): Big log, valued at R8 000*

*Figure 17: Small logs, valued at R6*

Transforming structures and processes include the institutions, policies and legislation that impact livelihoods (Chambers,1989). The wood contractors have principles and guidelines that are set in place by the manager of the nature reserve. The contractors are required to sign contracts that have rules and regulations. Their regularly scheduled meetings also allow them to discuss their challenges and what is expected of them in the nature reserve.

The researcher attended some of the meetings during the research period. During the meeting, the nature reserve manager explained what contractors are allowed to do and also reminded them of the nature reserve's rules, such as not to litter or steal, and the penalties they will face if they break the rules, this happened on the meetings that the researcher attended. Figure 18 depicts a typical meeting where workers are educated about alien invasive plants and their impact on the environment. The meetings also serve as team building meetings.

*Figure 18: Education site meeting*

The manager was asked about the sustainability of the wood contractors' jobs. He indicated that the jobs of the wood contractors are sustainable because many have been working in that nature reserve for more than 30 years and there are no signs that the wood will run out. The manager indicated that there are more than 150 people in the reserve making a living from cutting wood, either as a contractor or worker. The manager is of the opinion that this number is expected to increase over time, as more people will be seeking employment because of the country's high unemployment rate.



Additionally, the manger mentioned that for the contractors to increase their work efficiency they need proper machines. He has been trying to contact the municipality for funds but they have not responded. He mentioned that they worked with the WfW programme years ago, but WfW left because they did not have the financial backing to continue working in the nature reserve. He concluded by mentioning that the contractors work for themselves. It is important for the workers' job sustainability that they work for themselves, because then they can operate according to their own rules, which makes them work without fear.

### 4.4 Phase 3: Business structure

The business structure for wood contractors starts at stage 2 of the clearing process. At stage 2 the wood contractors must remove the alien invasive plants and cut them into the customers' desired size or style. The different types of cutting give rise to the different products that are sold, as indicated in Section 4.3. The products are then priced according to the volume of wood. After pricing, the wood is transported to the customer, as the contractors

do not normally charge the transport fee to the customers. The contractors must cater for the expense of petrol for the transport and the chainsaw. The contractors do not have to pay any fee to the nature reserve as they must pay themselves with the money that they have made.

The graph in Figure 19 indicates the relationship between happiness, number of dependents and weekly income. The results indicated that there is no strong correlation between these variables. Job satisfaction is more complex than income because the people earning less with a greater number of dependants are often happier than those with fewer dependants who earn more.

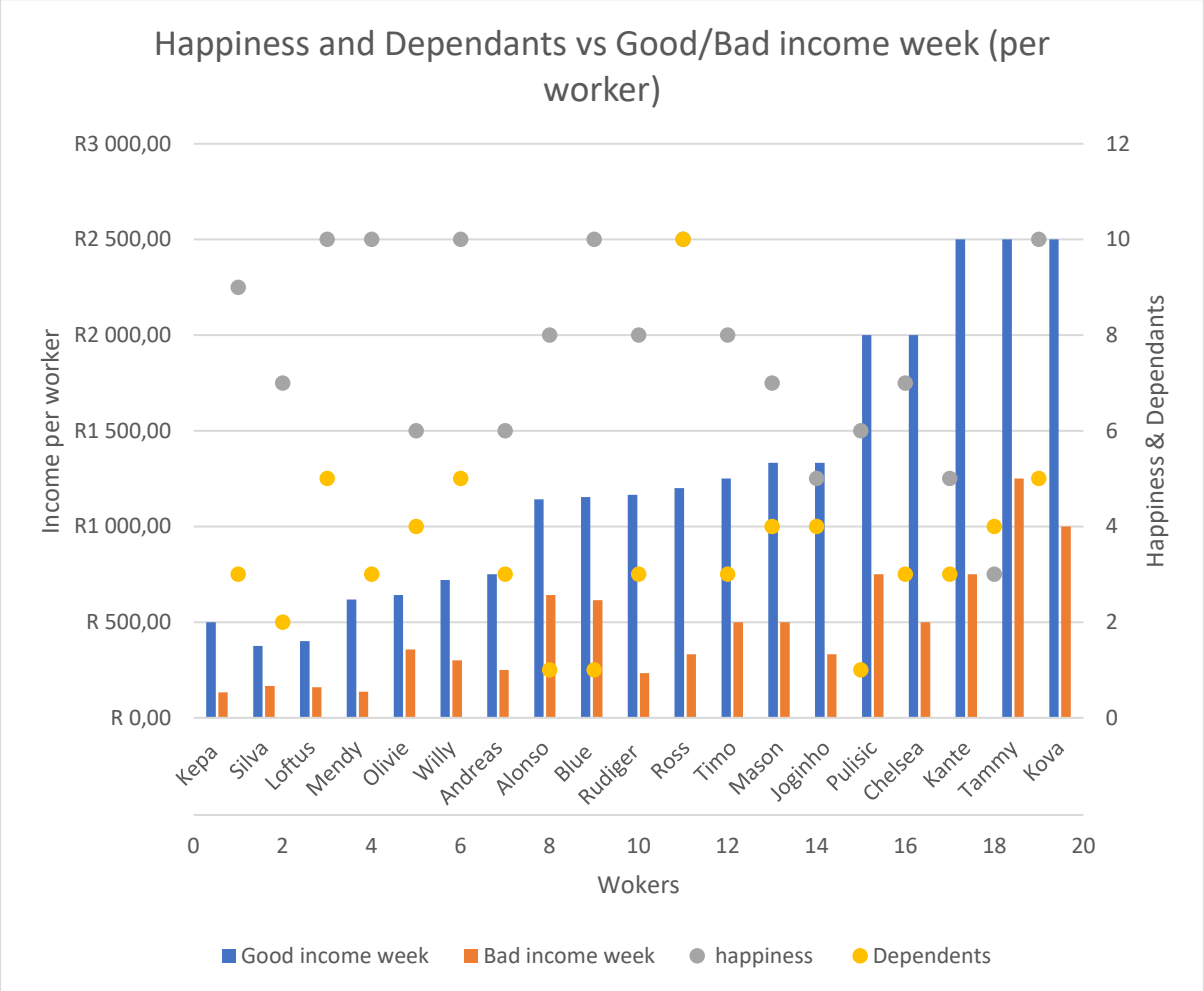


*Figure 19: Comparison of Happiness, dependants, and good/bad income week*

## 4.5 Conclusion

A study conducted by Dondofema et al. (2017) in South Africa suggested that organic waste was one of the largest contributors to total waste in landfills, making up 56.3% of landfill waste in 2017. The organic waste formed after alien invasive plants have been removed can be diverted to reduce the amount of waste in landfills. It has been shown in this study that the organic waste generated from alien plants can be used for economic benefit by forming small businesses such as selling wood. WfW has conducted a study like this research that focuses on the use of organic waste. The study suggested that the use of alien invasive plants has financial benefits even though it has been limited to use of the wood for firewood, crafts, and furniture (Buch and Dixon, 2008). The WfW programme is seen as a success story in controlling alien invasive plants in South Africa while at the same time creating both formal and informal employment (Hobbs, 2004; Buch and Dixon, 2008; Turpie et al., 2008).

The business models can be structured in two ways when dealing with the biomass. The first is energy product biomass, which is responsible for the manufacturing of heat and power, wood chips, firewood, lump charcoal and electricity. The second model is a material product, which manufactures timber, biochar, wood poles and wood laths.

## CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

The first objective of the study was to investigate the impact of alien invasive plants on the environment and water resources, and the possible ecological improvement when the alien invasive plants are removed. The results indicated that alien invasive plants do affect the ecological environment, which was evident by comparing the ecological environment days before the removal of alien invasive plants to the ecological environment three months after the alien invasive plants were removed.

The study's second objective was to evaluate the impact of removed alien invasive plants on the socioeconomic status and livelihoods of people. The SLF framework was used to analyse the results from the study. Given the fact that South Africa has an oversupply of alien invasive plants, the related income opportunities can be seen as sustainable, although there are possible threats, such as more people moving into the nature reserve, fires, and market fluctuations. The study promotes inclusion by allowing people to create small businesses for employment. The results show that removing alien invasive plants can provide a sustainable income.



The third objective of the research was to formulate a business plan for the removal of alien invasive plants to promote environmental integrity and improve people's socioeconomic status.

The results of the study indicate that the wood contractors' work is sustainable and provides a modest though steady income that is often above the national minimum wage. The results of the study ultimately demonstrate that the removal of alien invasive plants provides important income opportunities as well as having a positive effect on the ecological environment, and that this is therefore an industry that has significant potential for growth.

### 5.2 Recommendations

The working conditions of wood contractors can improve and become more dignified. It is also suggested that wood contractors could enter into partnerships with established businesses that sell wood. Integration of some big businesses with wood contractors will help the wood

contractors in increasing their market and learn from those business on how larger businesses are run. The wood contractors can partner with established businesses by supplying them with wood.

Site security should be provided to reduce illegal activities such as wood theft. In conclusion, the use of removed alien invasive plants can provide a sustainable way forward for socioeconomic improvement and positive environmental change.

The results of this study lacked numerical measurements that would prove the scientific evidence of environmental recovery. The results are only based on observations, whereas the underlying factors that might have caused the ecological environment to recover might include other factors in addition to the removal of alien invasive plants.

The wood contractors sell wood at a micro or small level, so there is a huge gap between the big businesses and the small businesses. Future studies must look at the factors that limit the wood contractors from reaching the level of big businesses. Such studies could explore ways to integrate small and big businesses.

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**APPENDIX A**

**English questionnaire**

**WOOD COLLECTORS SURVEY IN SOUTH AFRICA, 2020 Department of Earth Sciences – University of the Western Cape**

**SURVEY DETAILS**

(Can be completed after the interview)

Interviewer: Complete the following questions after the interview.

Date of interview: ..... Time of interview: .....

Fieldworker name: .....

Street Address (of site): .....

City/Town/Suburb: .....

| Questionnaire | Completed | Not Completed |
|---|---|---|

**SECTION A**

This set of questions relates to the personal background of the respondent you are interviewing.

1. Respondent's gender:

| | |
|---|---|
| Male | 1 |
| Female | 2 |

2. With which cultural group do you associate yourself with?

| | |
|---|---|
| African/Black | 1 |
| Coloured | 2 |
| White | 3 |
| Indian/Asian | 4 |
| Other | 5 |
| If other, please specify. ..... | |

3. Language predominantly spoken by respondent. Mark ONE only

| | |
|---|---|
| English | 1 |
| Sesotho | 2 |
| Sepedi | 3 |
| Isizulu | 4 |
| IsiNdebele | 5 |
| Xitsonga | 6 |
| Afrikaans | 7 |
| Setswana | 8 |
| IsiXhosa | 9 |
| Tshivenda | 10 |
| SiSwati | 11 |
| Shona | 12 |
| Other | 13 |
| If other, please specify. ..... | |

4. From which country do you originate from?

| | |
|---|---|
| South Africa | 1 |
| Zimbabwe | 2 |
| Namibia | 3 |
| Swaziland | 4 |
| Mozambique | 5 |
| Botswana | 6 |
| Lesotho | 7 |
| Other | 8 |
| If other, please specify.<br>..... | |

5. If from South Africa, in which province where you born?

| | |
|---|---|
| Gauteng | 1 |
| Mpumalanga | 2 |
| KwaZulu-Natal | 3 |
| Eastern Cape | 4 |
| Limpopo | 5 |
| Northwest | 6 |
| Free State | 7 |
| Northern Cape | 8 |
| Western Cape | 9 |



6. How old are you?

| | |
|---|---|
| | |

7. Which of the following describes your current marital status?

| | |
|---|---|
| Never married / Single | 1 |
| Separated / Divorced | 2 |
| Married (Traditional or Western) | 3 |
| Widowed | 4 |
| Living with a partner | 5 |
| Other | 6 |
| Other, specify.<br>..... | |

**SECTION B**

This set of questions relates to the respondent's education.

8. What is the highest school or tertiary qualification you have passed?

Grade

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Post School Qualification | | | | | | | | | | | | 13 |
| Post School Qualification. Please mention the qualification<br>..... | | | | | | | | | | | | |

Ask question 9 only if the waste pickers left school before passing Gr. 12.

9. Why did you leave school before completing Gr. 12?

.....

10. Do you have any other training or skills that you might be able to use in another job?

| | |
|---|---|
| Yes | 1 Go to question 11 |
| No | 2 Go to question 12 |

11. If your answer in question 10 is Yes, please specify what training and skills you have, where you obtained the training and skills and whether it was formal or informal training. (field worker needs to probe)

| 1 | 2 | 3 |
|---|---|---|
| Type of training/skill | Where obtained | Formal or informal |
| | | |
| | | |

12. How well can you understand English? (Field workers ask the question in English)

| | |
|---|---|
| Not at all | 1 |
| Somewhat | 2 |
| Well | 3 |

13. How well can you speak English?

| | |
|---|---|
| Not at all | 1 |
| Somewhat | 2 |
| Well | 3 |

14. Hoe goed kan jy Afrikaans verstaan? (Ask the question in Afrikaans)

| | |
|---|---|
| Not at all | 1 |
| Somewhat | 2 |
| Well | 3 |

15. Hoe goed kan jy Afrikaans praat?

| | |
|---|---|
| Not at all | 1 |
| Somewhat | 2 |
| Well | 3 |

**SECTION C**

This set of questions relates to the respondent's employment history.

16. Have you ever worked where you received a payslip?

| | |
|---|---|
| Yes | 1 Go to Question 17 |
| No | 2 Go to Question 20 |

17. If YES, what was your last full-time job? (field worker needs to probe)

Job title:

.....



18. How long did you have the last full-time job?

| | | | | | |
|---|---|---|---|---|---|
| Years | | | Months | | |

19. Why did you leave your last job?

| | |
|---|---|
| Laid off business/mine/factory closed | 1 |
| Laid off business moved | 2 |
| Laid off business downsizing | 3 |
| Disciplinary reasons | 4 |
| Quit the job because wage was too low | 5 |
| Quit the job because of medical reasons | 6 |
| Quit because of bad treatment from employer | 7 |
| Other, specify | 8 |
| Refused to answer | 9 |

20. Are you currently looking for a full-time job?

| | |
|---|---|
| Yes | 1 |
| No | 2 |

21. If not, why not?

.....

22. What other job/s have you done before becoming a wood collector or while being a wood collector?

.....

.....

.....

**SECTION D**

This set of questions relates to the respondent's work as a wood collector.

23. What do you like about your work as wood collector? (fieldworker needs to probe)

.....

.....

.....



24. What about your work as wood collector don't you like? (field worker needs to probe)

.....

.....

.....

25. Why did you decide to collect wood? (field worker needs to probe)

.....

.....

.....

26. How long have you been doing this job?

| | | | | | |
|---|---|---|---|---|---|
| Years | | | Months | | |

27. To whom do you sell the wood to? Mark all applicable.

| | |
|---|---|
| Private individuals | 1 |
| shops centres/depots | 2 |
| Other sellers | 3 |
| If other buyers, please specify.<br>..... | |

28. Indicate whether buyers collect the wood products from you or whether you must take (deliver) it to them?

| | |
|---|---|
| They collect | 1 |
| I must deliver to them | 2 |

29. What does it cost you to get the wood from the site to the buyer?

| |
|---|
| Rand |

30. Is there wood material that you collect for personal use?

| | |
|---|---|
| No | 1 |
| Yes | 2 |
| If yes, please specify.<br>.....<br>.....<br>..... | |

**SECTION E**

This set of questions relates to the income patterns of the respondents.

31. How much income did you earn last week for the wood you have collected?

| |
|---|
| Rand..... |

32. How much income do you earn from the wood collected during a good week and during a bad week?

| | | |
|---|---|---|
| 1 | Good week | R |
| 2 | Bad week | R |

(Round off to the nearest Rand)



33. Is your income as wood collector as good as expected?

| | |
|---|---|
| Better | 1 |
| Worse than expected | 2 |
| As good as expected | 3 |

34. What are the other sources of income available to you?

| | Sources of income | You (Rand) | Other household members (Rand) |
|---|---|---|---|
| 1 | Another job | | |
| 2 | Child support grant? | | |
| 3 | Disability grant? | | |
| 4 | Old age grant? | | |
| 5 | Pension from a previous job? | | |
| 6 | Other | | |

| If other, please specify. |
|---|
| ..... |
| ..... |
| ..... |

35. How many people (excluding yourself) depend on your income?

| Number of people | | |
|---|---|---|

36. How many children do you have?

| Number of children | | |
|---|---|---|

| Number of children under 18 | | |
|---|---|---|



37. How many people are employed under you as representative of the group?

| | |
|---|---|

38.How many females are working in your group?

| | |
|---|---|

39. Do you send money away to relatives that do not live with you?

| | |
|---|---|
| Yes | 1 |
| No | 2 |

40. If your answer is yes to question 45, how often do you send them money?

.....

**SECTION F**

This set of questions relates to the respondent's access to basic needs.

41. In what type of structure do you usually sleep?

| | |
|---|---|
| Construction Site | 1 |
| Backyard room with sleep in domestic worker | 2 |
| Backyard room | 3 |
| Veld/bushes | 4 |
| On the street | 5 |
| Backyard shack | 6 |
| Shack | 7 |
| Hostel/shelter | 8 |
| House (bricks/reeds etc) | 9 |
| Buy-back centre/ depot | 10 |
| Other | 11 |
| If other, please specify. ..... | |

42. How many times in the last month was there no food to eat of any kind in your household because of lack of resources to get food?

43. How many times in the last month did you go to sleep at night hungry because there was not enough food?

44. How many times in the last month did anyone in your household go to sleep at night hungry because there was not enough food?

45. How many times in the last month did you go for a whole day and night without eating anything at all because there was not enough food?

46.How many times in the last month did anyone in your household go for a whole day and night without eating anything at all because there was not enough food?

| |
|---|
| |

47. Where do you get your food? (Mark all applicable)

| | |
|---|---|
| Prepare food at home | 1 |
| Buy ready-made food | 2 |
| From other waste pickers | 4 |
| Somebody else, e.g., church/individuals/restaurants etc | 5 |

48. If you receive food from somebody else, e.g., church/ individuals, specify from whom

.....

49. Do you have access to the following while collecting wood? Please specify?

| | Basic Needs | No | Yes, specify |
|---|---|---|---|
| 1 | Drinking water | | |
| 2 | Food | | |
| 3 | Toilet | | |
| 4 | Place to wash yourself | | |



**SECTION G**

This set of questions relates to the respondent's relationship with the municipality, buyers of wood and co-wood collectors.

50 How do the municipal workers treat you on the reserve?

.....

.....

.....

51. Do you work together with other wood pickers to help one another?

| | |
|---|---|
| Yes | 1 Go to question 53 |
| No | 2 Go to question 54 |

52. If yes, in what way do you help each other? Mark all applicable.

| | |
|---|---|
| Transport/getting lifts | 1 |

| | |
|---|---|
| Loans | 2 |
| Food | 3 |
| Shelter to sleep/housing | 4 |
| Care when sick | 5 |
| Personal care products | 6 |
| Help to collect/share what they have collected | 7 |
| Selling for each other | 8 |
| Clothing | 9 |
| Other | 10 |
| If other, please specify.<br>..... | |

**SECTION H**

This question relates to work related injuries and health risks.

53. What are the health and injury risks when collecting wood?

.....

.....

54. On a scale of 1-10 (10 being very happy and 1 very unhappy) how happy are you with life now?



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|



55. Would you like to tell us anything else that concerns you or that you think we should know?

Specify

.....

.....

Interviewer: Thank the respondent for his participation.

For more information contact:

Dr Kanyerere: 0719031722

Prof. Schenck: 082 864 0600

**APPENDIX B**

**English consent form**


# UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa
***Tel: +27 21-959 2277, Fax: 27 21-959 2845***
**E-mail: cschenck@uwc.ac.za**


Tittle of research project: **Exploring opportunities for job creation through waste value chain.**

The study has been described to me in language that I understand. My questions about the study have been answered. I understand what my participation will involve and I agree to participate of my own choice and free will. I understand that my identity will not be disclosed to anyone. I understand that I may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.



**Participant's name……..**

**Participant's signature…….**

**Date……**

**APPENDIX C**

**Semi-structured interview**

**Questions guidance**

Questions to the manager of the reserve

(1) What are the benefits of clearing alien invasive plants?

……

(2) What do the contractors do with the removed alien plants?

……

(3) Do you think the job for wood contractors is sustainable if yes, why?

……

(4) What do you think can improve in increasing the efficiency of their work?



……

(5) How many contractors do you have in the reserve?

……

(6) How do you manage the contractors?

……

(7) How do you make sure that gemination is controlled?

……

(8) Do the wood contractors know the type of plants that they have to remove?

……

(9) What is the relationship between the contractors and the manager?

……

**APPENDIX D**

**Ethical clearance**

Ethical clearance application form (Humanities and Social Sciences Research Ethics Committee)

UNIVERSITY *of the* WESTERN CAPE

60 YEARS *of hope, action & knowledge*

01 September 2020

Prof C Schenck
Social Work
**Faculty of Community and Health Science**

| | |
|---|---|
| **Ethics Reference Number:** | HS19/5/5 |
| **Project Title:** | Clean cities and towns: Understanding societal behaviour in order to reduce and divert waste going to landfills. |
| **Approval Period:** | 27 August 2020 – 27 August 2023 |

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

**Please remember to submit a progress report by 30 November each year for the duration of the project.**

*The permission to conduct the study must be submitted to HSSREC for record keeping purposes.*

The Committee must be informed of any serious adverse event and/or termination of the study.

*Ms Patricia Josias*
*Research Ethics Committee Officer*
*University of the Western Cape*

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

*NHREC Registration Number: HSSREC-130416-049*

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

**APPENDIX E**

**Results information sheet**

*Table 2: Full biographical data*

| **Participants** | **Gender** | **Age** | **Language** | **Highest schooling (Grade)** | **Place of origin** | **Cultural group** | **Dependants** | **Days without food** | **Sleeping structure** |
|---|---|---|---|---|---|---|---|---|---|
| 1.Kepa | M | 40 | Afrikaans | 7 | Botswana | White | 3 | 0 | Hostel |
| 2.Rudiger | F | 47 | Afrikaans | 12 | SA, Western cape | African/Black | 3 | 0 | House |
| 3.Alonso | M | 68 | Afrikaans | 8 | SA, Western cape | White | 1 | 0 | House |
| 4.Andreas | M | 57 | Afrikaans | 7 | S.A Western cape | Coloured | 3 | 0 | House |
| 5.Joginho | M | 30 | Afrikaans | 12 | SA, Western cape | Coloured | 4 | 0 | House |
| 6.Silva | M | 30 | Shona | 12 | Zimbabwe | Shona | 2 | 0 | Back yard room |
| 7.Kante | M | 42 | Afrikaans | 8 | SA, Western cape | Coloured | 3 | 0 | House |
| 8.Ross | M | 67 | Afrikaans | 9 | SA, Western cape | Coloured | 10 | 0 | house |
| 9.Tammy | M | 34 | Afrikaans | 12 | SA, Limpopo | Black | 4 | 0 | house |
| 10.Pulisic | M | 26 | Afrikaans | 10 | SA, Wester | Coloured | 1 | 0 | house |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | n cape | | | | |
| 11.Timo | M | 28 | Afrikaans | 10 | SA, Western cape | Coloured | 3 | 0 | house |
| 12.Loftus | M | 68 | Afrikaans | 9 | SA, Western cape | Coloured | 1 | 0 | house |
| 13.Willy | M | 37 | Afrikaans | 5 | SA, Western cape | Coloured | 5 | 0 | house |
| 14.Blue | M | 66 | Afrikaans | 10 | SA, Western cape | Coloured | 1 | 0 | house |
| 15.Chelsea | M | 47 | Afrikaans | 8 | SA, Western cape | Coloured | 3 | 0 | house |
| 16.Mendy | M | 61 | Afrikaans | 8 | SA Western cape | Coloured | 3 | 0 | house |
| 17.Kova | M | 47 | Afrikaans | 6 | SA, Western cape | Coloured | 5 | 0 | house |
| 18.Olivie | M | 40 | Afrikaans | 12 | SA, Western cape | Coloured | 4 | 0 | House |
| 19.Mason | M | 32 | Afrikaans | 12 | SA, Western cape | Coloured | 2 | 0 | House |
| 20. Calum | M | N/A | Afrikaans | 12 tertiary qualification | SA, Western cape | Coloured | 1 | 0 | House |

*Table 3: Income-based data*

| **Participants** | **Worked and had pay slip** | **How long** | **Why collecting wood** | **Who do you sell to** | **Income on good week** | **Income on bad week** | **No. of employees** | **No. of years as a wood contractor** | **How happy are you with your work out of 10** |
|---|---|---|---|---|---|---|---|---|---|
| 1.Kepa | yes | 6 years | Pays well | Everyone | R4000 | R1500 | 2 males | months | 9 |
| 2.Rudiger | yes | 5 years | Pays well | Everyone | R3500 | R700 | 2 males | 6 months | 8 |
| 3.Alonso | N/A | N/A | Pays well | Everyone | R16 000 | R9000 | 13 males | 50 Years | 8 |
| 4.Andreas | N/A | N/A | Pays well | Everyone | R3000 | R1000 | 3 males | 13 Years | 6 |
| 5.Joginho | yes | 3 years | Pays well | Everyone | R8000 | R2000 | 5 males | 10 Years | 5 |
| 6.Silva | N/A | 2 years | Unemployed | Private individual | R1500 | R500 | 2 males | 6 months | 7 |
| 7.Kante | yes | 8 years | Pays well | Private individuals | R10000 | R3000 | 3 males | 3 years | 5 |
| 8.Ross | yes | 24 years | Pays well | Everyone | R3600 | R1000 | 2 males | 13 years | 10 |
| 9.Tammy | yes | 10 years | Pays well | Everyone | R10000 | R5000 | 3 males | 2 years | 3 |
| 10.Pulisic | N/A | N/A | Unemploy | Private | R4000 | R150 | 1 male | 3 years | 6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ed | individuals | | 0 | | | |
| 11.Timo | N/A | N/A | Unemployed | Private individuals | R5000 | R2000 | 3 males | 2 years | 8 |
| 12.Loftus | yes | 16 Years | Extra income | Everyone | R2000 | R800 | 4 males | 18 years | 10 |
| 13.Willy | yes | NA | Unemployed | Everyone | R720 | R300 | 0 | 17 years | 10 |
| 14.Blue | yes | 10 Years | Unemployed | Everyone | R15000 | R8000 | 12 males | 43 years | 10 |
| 15.Chelsea | yes | 15 years | Extra income | Everyone | R8000 | R2000 | 3 males | 5 years | 7 |
| 16.Mendy | N/A | N/A | Unemployed | Everyone | R6800 | R1500 | 10 males | 40 years | 10 |
| 17.Kova | N/A | N/A | Financial difficulties | Everyone | R10000 | R4000 | 3 males | 29 years | 10 |
| 18.Olivie | Yes | 4 years | Company moved | Everyone | R4500 | R2500 | 6 males | 15 years | 6 |
| 19.Mason | Yes | 2 Years | Unemployed | Everyone | R4000 | R1500 | 2 males | 2 years | 7 |
| 20. Calum | yes | 14 years | Pays well | Everyone | NA | NA | 14 males | 5 years | 10 |