



University of Venda

CONTROL OF INVASIVE ALIEN PLANT SPECIES AT WOLKBERG  
PROJECT IN LIMPOPO PROVINCE

By

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## DECLARATION

I hereby declare that the dissertation for the Master Degree in Environmental Sciences in the School of Environmental Sciences, Department of Ecology and Resource Management, University of Venda, is my own independent work and that it has not been previously submitted to this or any other university.

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Matsila Sydwell Nyadzani

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Date

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## ABSTRACT

Invasive alien plants refer to plant species that show a tendency to escape from human control, go beyond the intended physical boundaries and cause environmental damage.

The issue of letting the Invasive alien plant species grow and spread, with no attempts made to control the spread of the species beyond the limits of plantations, is not sustainable. All the attempted methods that the Department of Environmental Affairs used seemed to have failed in yielding the expected results. The main objective of the study was to determine the Wolkberg Working for Water programme's level of success in terms of clearing invasive alien plant species. Wolkberg Project was used as a case study as it is one of the Working for Water Programme. The data were collected using random sampling methods on the worked areas, where work is in progress and those where no work has been done. Primary data were collected from land owners through field observations and questionnaires from the participants whilst secondary data were collected from the Department of Environmental Affairs.

The study adopted a mixed methods approach which is both quantitative and qualitative. The data were analyzed using Statistical Package for the Social Sciences (SPSS) package. The research determined the level of success in terms of clearing invasive alien plant species, employment opportunities, tools/materials that have been used to clear the plants and the advice on the possible strategies that can be employed in the invasive alien plant species management.

It was found out that the Invasive alien plant species require constant maintenance in order for them to be controlled. The Wolkberg project is mainly dominated by male workers compared to females. Each team comprised 3% underage workers. The study recommends that the project should make sure that the follow-ups are done at the correct time and stage. Looking at the statistics of males and females, the study revealed that transformation is not adhered to in this project.

## ACRONYMS

**AIS-** Alien and Invasive Species

**APO-** Annual Plan of Operation

**CARA** - Conservation of Agricultural Resources Act

**CBD** - Conservation of Biological Diversity

**DEA** - Department of Environmental Affairs

**DWAF** - Department of Water Affairs and Forestry

**EWP-** Expanded Public Works Programme

**GDP** - Gross Domestic Product

**GISP-** Global Invasive Species Programme

**FROHG** -Friends of the Haenertsburg Grasslands

**IAPs** – Invasive Alien Plants species

**IPPC** - International Plant Protection Convention

**KZN** - Kwa-Zulu Natal

**L.D.F.E.D** - Limpopo Department of Finance and Economic Development

**LUIs-** Land use Incentives

**MS** – Microsoft

**NEMA-** National Environmental Management Act

**NEMBA-** National Environmental Management: Biodiversity Act

**SA** - South Africa

**SPP** – Species

**SPS Agreement** - Sanitary and Phytosanitary Measures

**WfW** - Working for Water

**WIMS** - Working for Water Information Management System

## CHAPTER ONE: INTRODUCTION

### 1.1 Background of the study

Invasive alien plants are plant species that show a tendency to escape from human control, go beyond the intended physical boundaries and cause environmental damage (Shine *et al.*, 2000:1). This means that the alien species are the species occurring outside their normal distribution. These species are considered native in their past or present natural range or within their natural dispersal potential (Shine *et al.*, 2000:1). These invasive alien plant species are posing a global problem or challenge that is causing countries to spend huge amount of money (billions) every year in trying to clear or control them (Van Wilgen *et al.*, 2000:18).

Panetta (1999:144) asserts that weed invasion is posing a threat in the ecosystems. He further posits that the threats that are posed by these invasive alien plants are ranked second in habitat destruction in the whole world. The key point in managing weeds lies in determining where to start clearing the invasive alien plants species and to what extent. According to Panetta (1999:144), the most effective control methods of invasive alien plants is to focus on entry point of the country, even though it does not assist the land managers in their attempts to deal with widespread serious weeds.

In Zimbabwe, the problem posed by these invasive alien plant species has been realized by the Nyanga National Park back in the 1980s, and it was difficult to determine their extent since there was no survey done. Nyoka (2003:12) found out that the major sources of these invasive alien plant species are the commercial plantations. Since then, no institutional research has been done on the invasive alien plant species despite the awareness that took place. The research that has been done was only conducted by few individuals. Unlike South Africa where sizeable amount of work and research were done to identify the major invasive alien plant species and their distribution, only less amount of work has been done in Zimbabwe (Nyoka, 2003: 12).

South Africa has a long history of problems with invasive alien species, researching about them and also management of their biological invasions. The Working for Water Programme was started in 1995 to conduct and coordinate alien plant management throughout South Africa (Richardson *et al.*, 2004:45). The programme initially worked

only in watersheds and riparian areas, but now it has been expanded to the terrestrial ecosystems. It has grown into one of the world's biggest programmes dealing with invasive alien species. The enterprise's success has been attributed to its multi-faceted and cross-disciplinary nature that has enabled it to leverage local and international funding and continuing political support (Richardson *et al.*, 2004:45).

Van Wilgen *et al.* (2004:113) reported on the invasive alien species being significant and growing threat in the ecosystems of the world. They can spread at alarming rates, and where they land and establish, they displace native vegetation, disrupt important ecosystem processes, and such leads to serious environmental changes.

In South Africa, land managers are becoming increasingly concerned about the occurrence of invasive alien plant species, and are seeking cost-effective ways of combating the spread of invasive species. One of the remarkable characteristics of invasive alien plants is that few, if not all are not invasive in their countries of origin. Their ability to grow vigorously and produce copious amounts of seeds is kept in check by a host of co-evolved invertebrates and pathogens. These plant species are transported to new countries without the attendant enemies. This allows the introduced species to multiply rapidly in the absence of a host of attendant invertebrates and diseases, with associated tendencies to spread rapidly and to out-compete native species (Van Wilgen *et al.*, 2004, 113).

The natural trees or indigenous trees in South Africa could not meet the demand for timber, mine supports poles, charcoal and tannin because of being slow growers, therefore, the commercial forestry decided to grow exotic trees which are known as fast growing trees to meet the demand (Nyoka, 2003:1).

According to Van Wilgen *et al.* (2004:113), bio-control has been practiced since 1910 to date in South Africa. About 103 bio-control agents have been released against 47 weed species, making South Africa the third most active country in biological control after the USA and Australia. The bio-control scientists of South Africa form a relatively small, united and committed community.

The Working for Water Programme by government is involving a huge amount of resources to control these plants. It is therefore, on this background that the

researcher realized the need to determine the level of success in clearing the invasive alien plant species.

## **1.2 Problem statement**

The main objective of the Department of Environmental Affairs was to enhance water security, reduce invasive alien plant species infestation and alleviate poverty in the disadvantaged areas through the empowerment programme such as contracting, training and skills development. Due to the tendency of invasive alien plants to spread vigorously and extensively, the government of South Africa initiated a programme that deals with the control of these plants in 1995 (Nyoka, 2003:8). Since then, the government never ceased to clear these alien plants. Notwithstanding the attempt by government to control the populations of these plants, there was no reduction in their abundance and diversity, instead their number and diversity is increasing unabated. Attempting to control or to get rid of invasive alien plant species usually appears to be a futile exercise to date. Since the implementation of Working for Water Programme in the Limpopo Province, there has been no attempt to determine the level of its success. The continuous use of non-effective methods in the programmes necessitates the study to determine the level of success in clearing invasive alien plant species.

## **1.3 Research questions**

- What are the current infestation statuses by invasive alien plant species in some parts of the Wolkberg Project?
- How far has the government gone in attempting to control the spread of invasive alien plant species in Wolkberg Project?
- Is there sustainability in the livelihood of the surrounding communities of Wolkberg Project?
- What strategies could be employed to adopt and use invasive alien plant species profitably in South Africa?

## **1.4 Objectives**

### **1.4.1 Main objective**

To determine “Wolkberg Working for Water Project’s” level of success in clearing invasive alien plant species.

### **1.4.2 Specific objectives**

- To establish the latest extent of infestation by invasive alien plant species in some parts of Wolkberg Project
- To determine if there has been successes in clearing invasive alien plant species at Wolkberg Project
- To assess the contribution of “Working for Water Project” in community livelihood
- To recommend feasible strategies for identifying invasive alien species for adoption to enhance community livelihood

## **1.5 Hypothesis**

The Working for Water Programme in the Wolkberg Project has been active since 2003. On the surface, it does not seem to have made much progress in containing the spread of invasive alien plant species and continuous clearing of these plant species seems never to reach a level where they will disappear forever.

## 1.6 Delimitation of Study area

The study is based at Wolkberg which is in Greater Tzaneen municipality under Mopani district Limpopo province. The area is highlighted below (Figure 1.1).

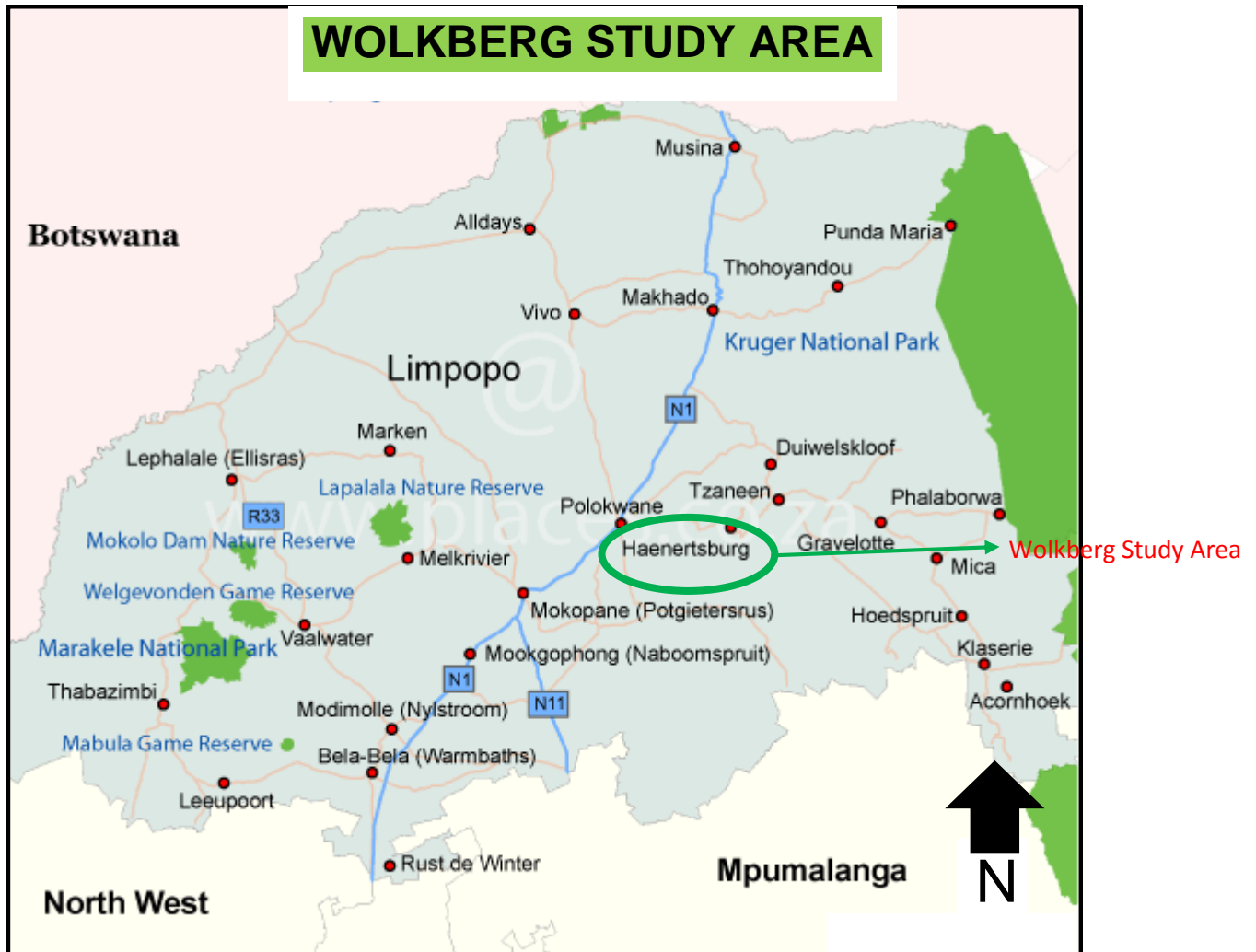
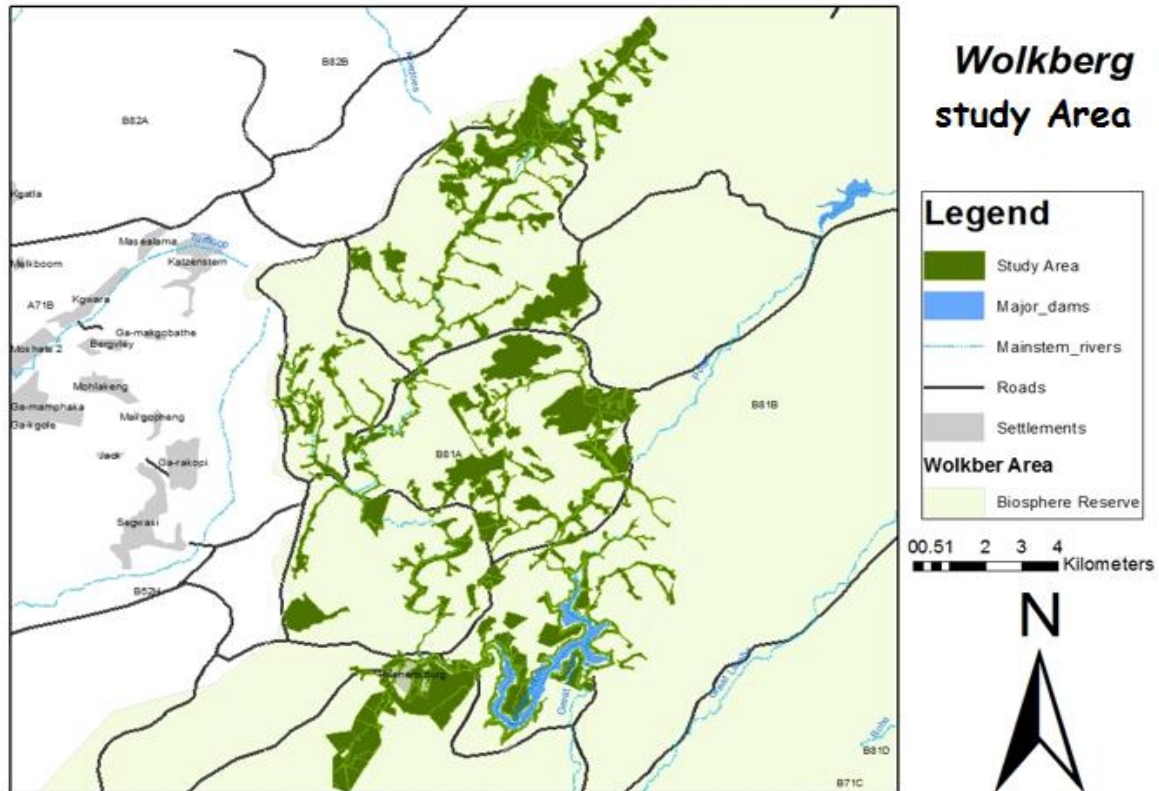


Figure 1.1 A map showing the study area in the province

### 1.6.1 Location

The study area is in Wolkberg which is commonly known as Makgoebaskloof Mountain and Haenertsburg village. The area is in Mopani district under Greater Tzaneen municipality in Limpopo province. It is located between Tzaneen and Polokwane towns, which is 60 km in the eastern side of Polokwane and 40 km in the Western side of Tzaneen respectively (Van Oudtshoorn, 2014: 4). The area is situated in 23°56'20"S and 29°59'11"E around the Ebenezer Dam.

The important landmarks near the Haenertsburg town are the Ebenezer Dam, and the Iron Crown Mountain Peak which is 2126 m above sea level and it is regarded as the highest peak in the Limpopo Province. The Iron Crown is known as the old miners' road (Van Oudtshoorn, 2014: 4).



**Figure. 1.2 Wolkberg Project study area: WIMS Map**

The area is mainly characterized by commercial plantations and it covers the mountainous areas in Wolkberg. *Aloe lettyae* and *Indigofera rehmannii* are endemic to this high-rainfall, granitic area. The Pedi refer to the Haenertsburg area as Byatladi, which means a place with plenty of roots that are used as source of food (Dzerefos, 2004: 19).

The vegetation of the Wolkberg is broadly classified as the North-Eastern Mountain Grassland, characteristic of high-altitudes and high-rainfall escarpment regions. The predominantly Montana grassland is interspersed with pockets of Afromontane Forest confined to the slopes of the main escarpment and fynbos on some of the highest peaks. Sparse to dense savanna develops in the warmer lowland areas (Limpopo D.F.E.D, 2004: 38).

In Haenertsburg, indigenous vegetation represents a habitat that is rapidly disappearing under the threat of agriculture, commercial forestry and the invasion of alien plant species. The Afromontane grassland in Haenertsburg is known to be home to over 340 plant species as well as several rare or endangered reptiles, mammals, insects or birds (Moreroa, 2014: 10).

Wolkberg dolomite grassland is characterized by the grassland which is rich in herbaceous plants and grass species with dominant small trees that include *Acacia davyi* and *Vitex rehmannii*. The endemic plants include *Aloe dolomitica* and *Euphorbia restricta* which are succulent shrubs and some herbaceous plants include *Barleria dolomnitica*, *Becium citriodorum*, *Beciumcodii* and *Lotonis pariflora* (Mokganya *et al.*, unpublished: 20).

The animals that are found within the Wolkberg area include Samango monkeys, wild dogs, baboons, wild buck and many mammals distributed within the Wolkberg Nature Reserve. There are different bird species which are recognised by Birdlife South Africa which include white Backed Night Heron, Martial Eagles, Striped Flufftail, African Finfoot, Cape Parrot and Blue Swallows which are regarded as threatened bird species (Mokganya *et al.*, unpublished: 22).

### **1.6.2 Climatic condition**

Wolkberg offers a pleasant climate for most of the year. Wolkberg is the northern most area and bisected by the Tropic of Capricorn, with long summer afternoons and moist, cool winds. With almost all year-round sunshine, it can get rather very hot in the summer months (October to March) ranging between 27°C and 30°C. It receives more rain in summer than its surrounding areas and it is also characterized by heavy fog which can obstruct vision, particularly for the drivers on the road. During winter months which is from April to July, Wolkberg experiences fairly very cold temperatures ranging from 2°C to 20°C, early morning fog is prevalent all over the area (Dzerefos, 2004: 18 -19).

The long-term average rainfall ranges from 800mm to 1200 mm per annum and mainly occurs during summer which is from November to March. The area is commonly affected by mist and sometimes frost during winter (Van Oudtshoorn, 2014: 6).

The monthly average maximum temperature ranges from 19°C in July to 26°C in December. Temperature can rise up to 31°C in the height of summer. The temperatures can drop to 6°C during July which is winter (Mokganya *et al.*, unpublished: 16).

### **1.6.3 Hydrology**

Limpopo Department of Finance and Economic Development (Limpopo D.F.E.D), (2004: 38) reports that the river systems in the north and east are characterized by a number of prominent northeast flowing, high flow river systems from the high rainfall Drakensberg escarpment.

The Letaba river catchment area is about 13670 km<sup>2</sup>. It includes the Groot Letaba, Letsitele, Thabina, Debengeni and Makgoebaskloof rivers that rise in the great escarpment mountains and Klein Letaba, Nsama and Molotsi Rivers as typical sandy Lowveld Rivers (Limpopo D.F.E.D, 2004: 38).

### **1.6.4 Geology and topography**

The Haenertsburg grassland occurs on a granitic portion of the Drakensberg escarpment which extends north from the Wolkberg and is geologically distinct. Granitic soils tend to be deeper and are favoured for planting crops or plantations (Dzerefos, 2004: 19).

The Drakensberg mountain range meets the Strydpoort Mountains in the Wolkberg Wilderness area with great, vertical quartzite krantzies, countless kloofs, cool, deep and densely forested ravines, massive buttresses and folded and interlocking spurs. The reserve extends for almost 22,000 hectares consisting of extensive indigenous forests and pristine grasslands. The range forms a high plateau reaching up to 2126 m in height at the Iron Crown above Haenertsburg (Mokganya *et al.*, unpublished: 216).

Other conspicuous peaks are Serala which is 2050 m in height, Maake 1824 m, Mutagumetse 1825 m, Mamotswiri 1838 m in height, Magopalone 1667 m in height and Selemole which is 1611 m in height. Access to the reserve entrance at Serala Forest station requires a high clearance vehicle (Mokganya *et al.*, unpublished: 16). The Wolkberg Nature Reserve is well known for its vertical quartzite krantzies, countless kloofs, cool, deep and densely forested ravines, massive buttresses and folded interlocking spurs (Mokganya *et al.*, unpublished: 216).

The geology of the area consists of biotite granite which results in deep red loamy soil from the hutom form. Soil on the slopes are generally shallow from the Mispah and Glenrosa forms. Soil in the lower laying areas is high in clay and mainly consists of the Oakleaf form (Van Oudtshoorn, 2014: 6).

### **1.6.5 Other activities**

The Wolkberg Caves are located next to Wolkberg Nature Reserve. The cave system provides a record of human development from Hominid *Australopithecus africanus*, to Stone Age and Iron Age humans. It is believed that the Boers were residing in this area and surrounded by the Langa and Kekena tribes. Members of the local communities have historically utilized and still to this day, utilize the so called holy water from the Wolkberg Nature reserve for a variety of traditional ceremonies and rituals (Mokganya *et al.*, unpublished: 216).

### **1.7 Rationale of the study**

The observation made on different areas infested with invasive alien plant species so far makes this study most important. Few years ago, Working for Water employed participants to manage projects on invasive alien plant species removals. Years later, after work started, participants somehow managed to get rid of alien invasive plant species but few years later, following their handing over of the areas back to the owners, that is, farmers, the alien invasive plant species re-grew vigorously; they are seen completely reclaiming “their” areas and even extending beyond their original boundaries.

A study to determine the level of success in clearing invasive alien plant species by Working for Water Programme was therefore initiated. This was to give an indication on how many hectares have been cleared, and their infestation statuses.

## 1.8 Definition of key concepts

- **Alien plant species** are the species occurring outside their normal distribution and established in natural or semi-natural ecosystems and threaten native biological diversity (Shine *et al.*, 2000: 1- 2).
- **Biological control** is a science that deals with the role that natural enemies play in the regulation of their hosts, especially as it applies to animal or plant pests (Hufferker, 2012: 4).
- **Ecology** is the scientific study of the relationship of living organisms with each other and their immediate environment (Cockerham & Shane, 1993: 3).
- **Ecosystem** is a system of abiotic, biotic and social components and their interactions that, by virtue of human influence, differ from those that prevailed historically, having a tendency to self-organize and manifest new qualities without intensive human management (Morse *et al.*, 2014: 12).
- **Environment** is the surrounding in which physical and biological organisms are found (Sharma, 2005: 16).
- **Environmental impact** is a measurable change to the properties of an ecosystem by an alien species (Blackburn *et al.*, 2014: 12).
- **Escarpment** refers to a steep cliff or slope formed by a fault or by erosion (Moreroa, 2014: 10).
- **Pest** is referred to as any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (McNeely, 2001: 6).
- **Wolkberg Project** is a project that was established to deal with the clearing of alien invasive plant species in the Wolkberg Area.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1 Introduction

One of the remarkable characteristics of invasive alien plant species is that few of them are invasive in their countries of origin. They have the ability to grow very fast and produce numerous amount of seeds. This is due to the fact that when invasive alien plants were transported to other countries, they were transported without their natural enemies (Van Wilgen *et al.*, 2004: 113).

Clout and Veitch (2002: 2) observed that the introduction of invasive alien species beyond their natural range is rising due to increased transport, trade, travel and tourism and the unprecedented accessibility of goods resulting from globalization. These activities provide the vectors and pathways for live plants, animals and biological materials to cross biogeographical barriers that would usually block their ways. Most alien species do not become invasive or cause problems in their new location, rather, many have considerable benefits to society, for example, plantation and horticulture. However, the subset of alien invasive species that are invasive can have significant environmental, economic and public health impacts and present significant risks of the wholesale homogenization of ecosystems.

The invasive species are now considered as the second cause of global biodiversity loss after direct habitat destruction and have adverse environmental, economic and social impacts from the local level upwards.

According to Nel *et al.* (2004: 53), there are more than 117 invasive alien plant species that are well established and already have substantial impact identified, and approximately 84 species are identified as emerging and having less impact, but have attributes and potential suitable habitat that could increase their future impact. Out of these major invasive alien plants identified, 29 species are considered to be aggressive transformers, which means that they are able to change the character, condition, form or nature of ecosystems over a substantial area relative to the extent of that ecosystem. These means that there are no invasive alien plants that cause less damage to the environment since all of them get aggressive if they get a favourable condition and tend to destroy the natural habitat.

It is therefore, not a surprise that the late Kader Asmal, in his capacity as Minister of Water Affairs, outlined the challenge facing Working for Water at its inception in 1996. He stated that the programme was the world's most comprehensive initiative to clear invasive alien plants, and that it needed to clear approximately 750 000 hectares each year to bring invasive alien plants under control within 20 years in South Africa (Van Wilgen *et al.*, 2012: 1).

Even after 20 years of trying to get rid of this IAPs, the rate at which these plant species are growing is very fast while there are other IAPs that are emerging every year and requiring special attention. He went further and indicated that the Department of Environmental Affairs had set some goals and objectives that they were aiming to achieve between 2012 and 2017 on clearing invasive alien plants in South Africa.

The objectives of the Department was to contribute in the restoration and maintenance of vegetation structure and function. This was done in order to contribute to ecosystem services and sustainable development, livelihoods, greening and inclusive economic growth through facilitating skills development, employment creation and infrastructure development. Some of the objectives that were set by the DEA were met but there is still a struggle to restore the vegetation and enhancing water security since some of the rivers and dams are losing water carrying capacity every year. This is the problem occurring not only in South Africa, but also in other parts of the world.

## **2.2 Perspective on invasive alien species**

There are different perspectives about the invasive alien plant species ranging from global, national and local. These perspective are either negative or positive towards these invasive alien plant species. All these lead us to check how the IAPs are being handled in different sphere of the universe.

### **2.2.1 Invasive alien plants at global level**

The global magnitude of the invasive alien plants problem is highlighted by the fact that 23% of the plant species in the United States and 47% in New Zealand are aliens (Samways & Taylor, 2004: 78). This means that only 67% of the plant species in United States and 54% in New Zealand are indigenous plants. Therefore, it will take only a

few years for New Zealand to have 50% alien species and 50% or less indigenous species if there are no measures in place to control invasive alien plants.

Richardson *et al.* (2011: 791) confirm that six regions including Australia, Southern Africa, North America, Pacific Islands, Europe and New Zealand have over 100 species of invasive alien woody plants. Regions also differ considerably in terms of the uniqueness of their invasive woody floras. In the four regions which include North America, Europe, Asia and the Pacific Islands, over 25% of their invasive woody species are known to be invasive. (Richardson *et al.*, 2011: 791). South America, the continent with both temperate and tropical climates, is positioned in the centre, reflecting the fact that alien flora of this continent share invasive species with many other areas (Europe, North America, Australia and the Palaeotropics). This is because invasive woody floras of these areas are to a large extent, subsets of the exotic woody flora of southern Africa (Richardson *et al.*, 2011: 791).

Panetta (1999: 146) posits that it was discovered in North America that initial treatment saves greater than the maintenance costs and further suggests that early control of the invasive alien plants will save huge amount of money. This was discovered in the area where clearing had been done and followed-up. If the treatment can be neglected for 2 years, the area would be seen going back to the original stage, therefore, it was necessary to check the infestation level of invasive alien plant species from the national and local levels. This was done in order to reduce the chances of generalizing the impacts. This means that the area that is infested by the invasive alien plant species should be given continuous maintenance. If this can be done in the global scale, it will be easy to continuously maintain alien plant species on the national level.

### **2.2.2 Invasive alien plants at a national level**

Van Wilgen *et al.* (2011: 1061) articulate that South Africa is a good place to explore the invasive alien plants due the long history of plant introductions and range of interventions that have been implemented to deal with these plants in recent decades. The country has a vast number of IAPs from different countries that employ different methods of growth and adaptation.

Marais and Wannenburg (2008: 536) state that the Department of Forestry launched the successful clearing programme during the 1970s and the early 1980s that led to

the control of invasive alien plant species mostly in the mountain catchment areas. After that, there were serious budget cuts in the late 1980s until the inception of the Working for Water Programme. The budget cuts which became an obstacle in the 1980 are still posing the very same problem that delayed winning the battle against IAPs in the 21st century. They further opine that as much as the country's water yield can be lost if the invasive alien plant species in the mountain catchments and riparian areas are left unchecked, there is a need to assess the value of early detection and rapid response to invasive alien plant species.

The problem of alien infestation is country-wide, and alien vegetation is estimated to be responsible for massive losses of water as well as losses of biodiversity. Alien vegetation is seen as the single greatest threat to the biodiversity of the Cape Floral Kingdom, the world's smallest and richest floristic kingdom. The success of the Working for Water (WFW) Programme is widely acknowledged, and given the extent of the invasive alien plant species problem in South Africa, its services are in demand throughout the country. Thus, the programme managers are in a position where they have to prioritize the potential projects, which usually operate at a quaternary catchment-level for implementation (Marais *et al.*, 2001: 2). The acknowledgement of the success of WfW programme does not mean the objective of DEA is met.

Sykes and Jooste (2014: 10) maintain that of equal concern to South Africa, Invasive Alien Plant species (IAPs) invade grazing lands, reducing their value to stock farmers by replacing palatable plants in a country where raising livestock on natural pastures is still the most widespread form of land-use. Sykes and Jooste (2014: 10) estimated that in South Africa, 9.6 million hectares in the Department of Water Affairs and Forestry (DWAF) priority licensing catchment areas and 7.5 million hectares of land-based conservation priority areas are infested with IAPs. They further indicated that IAPs invade at an annual rate of 5%, doubling their impact every 15 years.

South Africa's natural ecosystems such as rangelands are under threat from invasive alien plants, the scale of the problem facing managers of invasive alien plant species in South Africa is huge, and thus, about 10 million hectares have been invaded (Lesoli *et al.*, 2013: 261). There is somehow cosmopolitan concern about the effects of bush encroachment and invasion on rangeland ecosystem productivity and sustainability. Thus, human communities and natural ecosystems worldwide are under restriction

from a growing number of destructive invasive alien species. These species erode natural capital, compromise ecosystem stability, and threaten economic productivity of rangeland ecosystems (Lesoli *et al.*, 2013: 261).

Le Maitre *et al.* (2000: 365) state that in the Fynbos biome alone, R855 million has been spent on clearing invasive trees and shrubs. Despite this substantial investment, Working for Water was able to reach only a relatively small proportion of the invasions, which continue to spread, although less rapidly. They further indicate that it also appears that the initial estimates of rates of spread of about 5% per year were too low. Thus, while there has been progress in some areas in the Fynbos biome, these successes have been localized, and many areas remain under considerable threat from invasions.

Marais and Wannenburg (2008: 527) reported that while WfW was 12 years in 2007, Working for Water Programme has made a huge impact in terms of sustainable management, alien control and containment through the Expanded Public Works Programme (EPWP), biological control programme as well as establishment of the sound legislation for managing invasive alien plant species. He emphasized this by indicating that R3.2 billion was spent on the programme, created job opportunity for 30 000 people and cleared more than 1.6 million hectares of the land infested with IAPs.

The success of the programme can be measured in terms of quality of work done and not quantity of hectares cleared. It is therefore essential that quality is safeguarded in order to attain the objective of the department.

Marais *et al.* (2004: 97) reported that the WfW Programme was launched in 1995; with the aim of protecting water resources and creating jobs for disadvantaged people. It was found out that there is a need for training large number of beneficiaries, managers, and such was accomplished. In 2002/2003, the programme managed to support over 300 projects countrywide. The programme realized the need to assess the consequences of the programme in different regions and the effect on different invasive alien species. These led the programme to the assessment of the effect on the status of alien invasive plants in South Africa. It was found that data costs are necessary for budgeting and planning. Therefore the programme launched the GIS

based project information system which assists greatly in assessing the costs associated with clearing and follow-up operations at a scale, accuracy and resolution that were not possible before. It is good that DEA established the WIMS system that enables the official to understand and know the amount of work that has been done, but the system also requires monitoring and assessment for the work that has been done on the ground to verify the accuracy.

Beater *et al.* (2008: 503) argued that the main focus of WfW Programme was mainly to focus on the cutting of the woody invasive alien plant species in both savanna and grasslands biomes. They managed to clear the large IAPs that were dominating the Sabie River in the mid-90s. The main aim was therefore, to increase the water yield of those catchments, which were initially achieved. After that, the structure of the vegetation changed dramatically over the years in the grassland rich with the reduction in tall trees and an increase in the trees and shrubs. This indicates that the IAPs regeneration is not well controlled. These changes resulted in the suppression of indigenous trees by invasive alien plants. All these bring us to conclude that there is less information on the regeneration requirements of plants in the savanna and grassland biomes including the riparian trees.

In South Africa, the situation is not any better, with some species dominating entire ecosystems to the effect that hydrology has been adversely affected (Samways & Taylor, 2004: 78).

Van Wilgen *et al.* (2012: 812) state that like all environmental management programmes, Working for Water has to operate in complex socio-ecological environments, in which it is continually necessary to monitor outcomes, learn from experience, and adapt new approaches. The use of the LUIs models within WfW programme serve no purpose since the focus has shifted from the catchments and indigenous vegetation to private land and commercial plantation.

### **2.2.3 Invasive alien plants at a local level**

In 1984, it was recorded for the first time in Transvaal that a small infestation was located near Tzaneen. By 1987, Erasmus and Goodall (unpublished data) recorded a large infestation around Tzaneen. Phalaborwa has one of the most arid climates in the region and is frost-free throughout the year. The fact that *Chromoleana odorata* has

established and is spreading along riparian zones at this locality indicates that all woody communities in the 'none to light frost' zone, especially in riverine areas, have the potential to be invaded (Goodall & Erasmus, 1996:153).

Frequently disturbed by minor floods, and periodically by major flood events, riverbanks and floodplains provide ideal habitats for the establishment of invasive plants. Dense stands of species such as *Lantana camara* cover very large areas in the Kruger National Park (KNP). Problems associated with alien plant invasions in riparian zones of the KNP include direct competition for resources, with many alien plants being able to germinate and establish quicker than indigenous species after floods (Foxcroft & Richardson, 2003: 389).

There is a complex pattern of land ownership in the catchment areas of the major rivers and the KNP has no control over land use in these areas that serve as the main source of alien plant propagules for riparian systems of the KNP. In the Sabie - Sand River catchment, which covers about 6,500 km<sup>2</sup> where only the bottom third lies within the Park, at least 40 invasive species have been recorded in the upper catchment and about 23% of the catchment was mapped as invaded by alien plants in the late 1990s (Foxcroft & Richardson, 2003: 389).

The upper reaches support *Pinus spp* and *Eucalyptus spp* plantations, many of them highly invaded with *Solanum mauritianum*, *Caesalpinia decapetala* and other alien species. The middle reaches consist mainly of commercial agriculture of sub-tropical fruit, and in the lower reaches, subsistence farming in densely populated communally owned rural areas. These areas are sources of many alien plant species for the KNP. Regular dispersal of propagules in the Park is a major challenge for management (Foxcroft & Richardson, 2003: 390).

Villages and rest camps in the KNP contain many species known to be invasive in other areas such as *Hedychium spp.* and species of Commelinaceae and Crassulaceae. Many alien species are used for hedging and beautification, with resistance to their removal being met with by personnel who have been living in the KNP and tending to the gardens for a long time. These may pose a threat to the surrounding areas and with time, may invade the riparian fringes of the rivers on which the camps are situated (Foxcroft & Richardson, 2003: 393).

### 2.3 Types and characteristics of invasive alien plants

Henderson (2001: 2) maintains that in terms of the amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of invasive alien plants on their properties. The 198 alien species listed as declared weeds and invaders have been divided into three categories:

- Category 1 plants are prohibited and must be controlled.
- Category 2 plants (commercially used plants) may be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

Invasive species are controlled by the National Environmental Management Biodiversity Act (NEMBA), 2004 (Act No. 10 of 2004). It is Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. The AIS Regulations list 4 different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa.

Invasive species are species that are introduced into an area, and are able to outcompete and displace indigenous or useful alien species. They may be plants, animals or microbes, and are widely regarded as among the biggest threats to the productive use of land and water, to the ecological functioning of natural systems, to health and to the economy.

The National List of Invasive Species which need to be controlled inside South Africa is as follows: Plants (383), mammals (41), birds (24), reptiles (35), amphibians (7), fresh-water fish (15), terrestrial invertebrates (23), fresh-water invertebrates (8), marine invertebrates (16) and microbial species (7), resulting in a total of 559 species.

NEMBA invasive species are divided into four categories:

- Category 1a: Invasive species which must be combatted and eradicated. Any form of trade or planting is strictly prohibited.
- Category 1b: Invasive species which must be controlled and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited.
- Category 2: Invasive species, or species deemed to be potentially invasive, in that a permit is required to carry out a restricted activity. Category 2 species include commercially important species such as pine, wattle and gum trees. These plants are regarded as Category 1b in riparian areas.
- Category 3: Invasive species which may remain in prescribed areas or provinces. Further planting, propagation or trade, is however prohibited. These plants are regarded as Category 1b in riparian areas.

According to De Wit *et al.* (2001: 168) *Acacia mearnsii* (black wattle) is native to Australia, and was imported to South Africa in the mid- nineteenth century. It has been widely planted in South Africa, and now forms the basis of a small, but significant industry. The species is also highly invasive and has spread over an area of almost 2.5 million ha in South Africa where it has significant negative impacts on water resources, biodiversity, and the stability and integrity of riparian ecosystems. These two features, a commercial value on the one hand, and an invasive, damaging ability on the other, give rise to a classic conflict of interests, where the benefits accrue to a number of people, while society at large bears the external costs (De Wit *et al.*, 2001: 168).

## **2.4 The impact of invasive alien plant species**

Invasive alien species are now recognized as one of the greatest biological threats to our planet's environmental and economic well-being. A plant or animal transported beyond the ecosystem in which it occurs naturally may multiply out of control, endangering native species in the invaded ecosystem, undermining agriculture, threatening public health, or creating other unwanted and often irreversible disruptions (McNeely, 2001: 5).

### 2.4.1 Environmental impacts of invasive alien plants

Global reviews of the effects of plant invasions suggest that the most damaging species transform ecosystems by using excessive amounts of resources which include water, light and oxygen, by adding resources such as nitrogen, by promoting or suppressing fire, by stabilizing sand movement and/or promoting erosion, and by accumulating litter or by accumulating or redistributing salt. Such changes potentially alter the flow, availability or quality of nutrient resources in biogeochemical cycles; they modify trophic resources within food webs; and they alter physical resources such as living space or habitat, sediment, light and water (Richardson *et al.*, 2004: 47).

One of the remarkable characteristics of invasive alien plants is that few, if any, of them are invasive in their countries of origin. In their land of origin, their ability to grow vigorously and produce copious amounts of seeds is kept in check by a host of co-evolved invertebrates and pathogens. Some of these plant species, when transported to a new continent without the attendant enemies, exhibit ecological release. This phenomenon allows the introduced species to multiply rapidly in the absence of a host of attendant invertebrates and diseases, with associated tendencies to spread rapidly and to out-compete native species (Van Wilgen *et al.*, 2004: 113).

It has been estimated that invading alien plants cover 10 million hectares in South Africa, and, annually use 3.3 billion m<sup>3</sup> of water in excess of that used by native vegetation which is about 6.7% of the water runoff in the entire country, with the losses being concentrated in invaded parts of the fynbos and grassland biomes, and along invaded riparian zones (Van Wilgen *et al.*, 2011: 505).

Beater *et al.* (2008: 504) observed that the ground cover in the savanna and grassland displayed difference in response to variation in invasion intensity and with WfW clearing in 1996/7. Litter cover increased with the intensity of invasion. The more heavily invaded areas contributed to the development of thick litter layer of branches, leaves and twigs from the cleared alien invasive plant species. This litter may greatly impede germination, seedling establishment and growth of juveniles. Beater *et al.* (2008: 504) reported that the situation worsened from 1996/7 to 2005 as herbaceous and grass cover decreased significantly and resulted in the bare soil that reduced the stability of the surface.

#### 2.4.2 Economic impacts of invasive alien plants

The invasion by invasive alien plant species can lead to the loss in agricultural potential, biodiversity, and water quality and quantity. Globally, invasive alien plants continue to invade and cause havoc not only in pristine ecosystems, but also in disturbed environments. This invasion has been rated as the biggest second threat to the survival of ecosystems, after habitat loss (Sykes & Jooste, 2014: 10).

Of equal concern to South Africa is that invasive alien plants (IAPs) invade grazing lands, reducing their value to stock farmers in a country where raising livestock on natural pastures is still the most widespread form of land use (Sykes & Jooste, 2014: 10).

Funding for Working for Water increased from R25 million in 1995 and 1996 to R250 million in 1997 and 1998, at which stage it was estimated that R600 million per year would be needed over the next 20 years to reduce the problem to a level where the invasive species could be contained at a relatively low cost. This proposed level of spending was justified principally on the basis of the predicted economic consequences of lost water if invasive alien plants were to occupy all of the land suitable for invasion (McConnachie *et al.*, 2012: 128).

Working for Water collectively has a 3-year budget of R7.8 billion. Although Working for Water operated for 16 years under the administration of the Department of Water Affairs, its recent transfer to the Department of Environmental Affairs, its consolidation with other initiatives substantially increased funding offer opportunities to the scientific community to inform improvements in ecosystem management (Van Wilgen *et al.*, 2012: 11).

McConnachie *et al.* (2012: 128) hold that subsequent studies have estimated the value of potential ecosystem services that include water, grazing and biodiversity in South Africa at R152 billion annually. Although an estimated R6.5 billion of this amount is lost every year as a result of invading alien plants, the loss would have been an estimated additional R41.7 billion had no control measures been carried out. These values indicate a saving of R35.2 billion every year (approximately 4.8% of South Africa's annual GDP); about one third of this saving was as a consequence of biological control (McConnachie *et al.*, 2012: 128).

Invasive alien species have many negative impacts on human economic interests. Weeds reduce crop yields, increase control costs, and decrease water supply by degrading catchment areas and freshwater ecosystems. Tourists unwittingly introduce alien plants into national parks, where they degrade protected ecosystems and drive up management costs. Pests and pathogens of crops, livestock and trees destroy plants outright, or reduce yields and increase pest control costs (Pimentel *et al.*, 2000: 53).

### 2.4.3 Social impacts of invasive alien plants

Problems arising from invasive ornamental plants lead to conflicts of interest between horticulturalists, landowners and conservationists. Various initiatives in different parts of the world aim to reduce the use of known invasive species in horticulture for example, the St. Louis Declaration on Invasive Plant Species in North America (Foxcroft *et al.*, 2008: 33).

Very little information is available regarding the impacts of invasive alien plant species on human and animal health. However, negative effects can be significant, for example Parthenium weed *Parthenium hysterophorus*. These species cause severe dermatitis, allergy and toxicity in humans, and its toxicity affects stock and crop production, resulting in direct economic losses (Van Wilgen *et al.*, 2011: 506).

The disruption of ecosystem services as a result of biological invasions is known to have adverse socio-economic and cultural impacts. There are a number of human health problems which are caused by invasive alien plants, for example plant species such as giant hogweed (*Heracleum mantegazzianum*), common ragweed (*Ambrosia artemisiifolia*) and silver wattle (*Acacia dealbata*). Health problems such as allergies and skin damages. Invasive alien plants can reduce yields from agriculture, forestry and fisheries or obstruct transportation by blocking waterways or clog industrial water intakes of, for example, power plants. Certain invasions of alien species, such as Azolla water fern (*Azolla filiculoides*) and Eastern white pine (*Pinus strobes*), have led to declines in recreational or cultural heritage values associated with different landscapes and water bodies (Kettunen *et al.*, 2009: 3).

Significant amount of evidence exists on the negative effects of invasive alien plant species on human health. The analysis of invasive alien plant species impacts on

ecosystem services shows that almost 30 of the total of 125 studied species can negatively affect human health either by functioning as disease vectors or causing allergies. Furthermore, the existing data on the costs of human epidemic diseases clearly also reflects the importance of these alien pathogens to a broader wellbeing. One of the positive sides known is that several species have high social value, for example a range of non-native pets and ornamental form an integral part of our culture and everyday lives. These species can also play an important role in individual's wellbeing, including maintaining mental health (Kettunen *et al.*, 2009: 26).

## **2.5 Strategies for addressing invasive alien plants.**

Clout and Veitch (2002: 2) indicated that there are many international instruments or technical guidelines that already dealt with invasive alien species issues from various perspectives that include plants and animal health, biodiversity conservation, aquatic ecosystems and some sectorial pathways. These binding or voluntary instruments provide the baseline from which state and regional economic integration organizations, such as community development policy, legal and management frameworks address the invasive alien species issues. Because invasive alien species are a global problem, unilateral actions by few states can never be enough to prevent unwanted introduction. Co-operation at international, regional, transboundary and local levels is essential to develop compatible approaches to common problems (Clout & Veitch, 2002: 3).

### **2.5.1 International (global) strategies.**

In recent years, IAPs have become a high-profile policy topic for the international community which has emphasized the need for cross sectorial coordination between competent institutions and stakeholders at all levels. New programmes and tools have been developed, notably the Global Invasive Species Programme (GISP) which actively promotes practical regional co-operation. Global Invasive Species Programme has established a Global Strategy on invasive alien species and toolkit of Best Prevention and Management Practice (Clout & Veitch, 2002: 2).

The Conservation of Biological Diversity (CBD) has identified IAPs as a major cross cutting theme. This global treaty requires parties as far as possible and appropriate to prevent the introduction of alien species, control or eradicate those alien species which

threaten ecosystems, habitat or species. In 2002, the CBD conference of the parties adopted a specific decision and guiding principles to help parties implement this requirement. The decision urge all parties to develop the invasive alien species strategies and action plans at national and regional level and to promote and implement CBD guidelines (Clout and Veitch, 2002: 2). The Conservation of Biological Diversity suggests that strategies should focus on prevention, early detection and rapid response or action and containment and long-term control measures.

The International Plant Protection Convention (IPPC) is a multilateral treaty in force since 1952. With 111 governments as Contracting Parties, the purpose of the Convention is to secure common and effective action to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control. The implementation of the Convention has applied mainly to crops, but it also extends to the protection of natural flora. Thus, the scope of the IPPC covers any invasive alien species that may be considered to be a plant pest. The standards developed under IPPC are recognized by the World Trade Organization under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) (McNeely, 2001: 6).

The Global Invasive Species Programme (GISP) was developed from January 1996 and established in 1997 to address the global threats caused by alien invasive species and to support to implement the Convention on Biological Diversity. The Global Invasive Species Programme (GISP) seeks to improve the scientific basis for decision making on invasive species; develop capacities to employ early warning and rapid assessment and response systems; enhance the ability to manage invasive; reduce the economic impacts of invasive and control methods; develop better risk assessment methods; and strengthen international agreements. The Global Invasive Species Programme strives to develop public education about invasive species, improve understanding of the ecology of invasive, examine legal and institutional frameworks for controlling invasive species, develop new codes of conduct for the movement of species, and develop new tools for quantifying the impact of invasive species. The Global Invasive Species Programme work involves dozens of scientists, lawyers, and managers from all parts of the world (McNeely, 2001: 7).

## 2.5.2 National strategies

The Department of Water Affairs and Forestry (DWAF) has initiated the Working for Water Programme to remove invasive alien tree species from catchments in South Africa. Through the modification of the vegetation in various catchments, where water-thirsty vegetation with high transpiration rates have reduced the stream flow, the available water supply can be increased. Invading alien plants have covered some 10 million hectares, about 8% of South Africa (Mukheibir & Sparks, 2003: 12).

According to Van Wilgen *et al.* (2012: 8-11), Guy Preston stressed the need for more effective legislation that would require land-users to take responsibility for managing invasive species, hold growers accountable for seed pollution, and require compulsory clearing of invasive species prior to the transfer of land. He further emphasises the issues of vigilance and compliance at our borders, to expand the capacity to respond rapidly to the threat of new invasive species as they arise, to broaden the scope of projects to include all species other than plants, and to find innovative ways to utilize the biomass provided by invasive species without creating dependency, focus on priority areas so that available funds can be more effectively utilized, paying attention on planning, monitoring and evaluation, funding the biological control buy-in from the private land owner and improving the qualifications of field managers.

The government through the DWAF which is now known as DEA in the Working for Water programme, started to implement the following strategies:-

- **Clearing strategies**

Van Wilgen *et al.* (2011: 1061) argues that mechanical clearing strategies were employed in order to address the issue of poverty alleviation and available management capacity without considering ecology due to the fact that there were no clear targets for assessing the progress that have been set.

He further indicated that when the programme began, they started clearing the alien plant species using the following methods:

Mechanical methods which include using machines such as chainsaw, slasher, cane knife and physical power to do cut-stump, ring-barking, frilling, hand-pulling, felling and strip-barking

Application of herbicides which is regarded as a chemical method. This chemical is either applied through foliar spraying (on leaves), stump treatment or injection in succulent plants.

These are methods that are still used today to clear the invasive alien plant species. These methods are sometimes combined to work together so that they can work effectively.

- **Biological control strategy**

Investments by Working for Water into biological control, combined with these mechanical clearing, are nonetheless paying substantial dividends. In particular, a gall-forming fly recently released on *Acacia mearnsii* has virtually stopped pod production in some areas, offering encouraging prospects for gaining control through a combination of mechanical clearing and seed reduction through biological control. There are also prospects for the release of a biological control against pines, which would be the only sustainable long-term option for keeping these aggressive invaders in check (McConnachie *et al.*, 2012: 128).

Van Wilgen *et al.* (2011: 1061) opines that the biological control agent for Australian acacia was introduced to reduce seed production, not targeting the non-reproductive parts so that it does not jeopardize the yield in the cultivators. He further indicates that nine insect species and fungus have been introduced as biological control agents into ten *Acacia* species in South Africa. Of these, five species feed on seeds and are called seed weevils or flower-galls that form gall in the flower. All these disturb the production of the seeds and seedlings. Reduction in seed production can reduce the costs of follow-up control.

- **Legislation framework**

Van Wilgen *et al.* (2011: 1061) argue that according to South African legislation, permits can be issued to allow invasive alien plant species to be cultivated in the demarcated areas while on the other hand, requiring the other control for the spread of the same species.

According to NEMBA (10: 2004), Section 65, a person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7.

A permit referred to in Chapter 7, subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out. Section 65 indicates that should an alien species establish itself in nature as an invasive species because of the actions of a specific person, a competent authority may hold that person liable for any costs incurred in the control and eradication of that species.

Chapter 7 of NEMBA, Section 70, subsection 1 states that the Minister must within 24 months of the date on which this section takes effect, by notice in the Government Gazette, publish a national list of invasive species in respect of which this Chapter 7 must be applied nationally.

Section 73, subsection 1 indicates that a person authorized by permit in terms of Section 71 (1) to carry out a restricted activity involving a specimen of a listed invasive specimens must take all the required steps to prevent or minimize harm to biodiversity.

The National Environmental Management Act (NEMA) No 107 of 1998, as amended in 2004 under Section 28, states the duty of care and remediation of environmental damage. Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimize and rectify such pollution or degradation of the environment.

The National Water Act No 36 of 1998 under section 36(1) states that the following are stream flow reduction activities:

- (a) The use of land for afforestation which has been or is being established for commercial purposes.
- (b) An activity which has been declared as such under subsection (2).

Subsection 2 of section 36 states that the Minister may, by notice in the Government Gazette, in relation to a particular area specified in that notice, declare any activity

(including the cultivation of any particular crop or other vegetation) to be a stream flow reduction activity if that activity is likely to reduce the availability of water in a watercourse to the Reserve, to meet international obligations, or to other water users significantly.

- **Policy**

According to Simberloff *et al.* (2005:13), from the accumulation of experiences from different countries, states, and local municipalities, it was found that there are many different ways to tackle invasive species. For example, comparative policy analysis can be used to elucidate which policy approaches result in ineffective outcomes, both for regulating new introductions and for responding to ongoing invasions. Similarly, comparative field studies and sharing of information across continents and among agencies is a vital part of improving management of invasive species on the ground. Here we focus on some of the most pressing issues in invasive species policy and management, and suggest how research could improve our current practices.

The Working for Water programme (WfW) has taken a policy decision to phase out managing working directly on private land, and rather to use incentives and disincentives to get private land-owners to manage invasive alien plants on their property themselves (WfW unpublished policy, 2008:)

McGeoch *et al.* (2010:104) indicate that the international policy indicator, even if an indirect measure of control and management response, shows that the majority of countries have signed their 'intention' to address the threat from IAS. They further indicated that the national policy adoption indicator, however, demonstrates that only about half (55%) of the countries have taken the step of implementing appropriate national legislation on IAS towards meeting these international commitments. It is also apparent that even countries with legislation often have inadequate IAS strategies, insufficient IAS management plans and ineffective implementation of such plans. Numerous reasons such as lack of capacity underpin these deficiencies

There are also currently insufficient data on sub targets in terms of controlled pathways and species management plans in place at national level to determine whether these have been met. The responsibility for addressing this lies with countries party to the CBD, where after data may be collated across countries to express a global indicator

that more closely reflects these sub-targets for IAS in the CBD framework (McGeoch et al., 2010:104).

## 2.6 Conclusions

Like all environmental management programmes, Working for Water has to operate in complex socio-ecological environments in which it is continually necessary to monitor outcomes, learn from experience, and adapt new approaches. Every day, the programme as well as the country are developing policies that can assist in fighting the invasive alien plant species. Even though there are some challenges in implementation of the law, regarding the landowners, there should be strategies that will help the land owners and other affected parties to realize the importance of the strategies as well as the policies that are in place.

Marais and Wannenburg (2008: 527) maintain that even though the programme has been seen as work in progress, there were some challenges of data base for capturing the information. Van Wilgen *et al.* (2011: 1061) posit that South Africa's approach to the management of invasive alien plant species to date can be regarded as the strategy of hope since most of them were carried out in isolation and without the formal protocols for adopting tactics as new information becomes available and as conditions change.

## CHAPTER THREE: RESEARCH METHODOLOGY

### 3.1 Introduction

The study adopted the mixed methods approach which involves both the qualitative and quantitative approaches. The convergent parallel mixed methods was the design that was used since it was a form of mixed methods design in which a researcher converges or merges both qualitative and quantitative data in order to provide a comprehensive analysis in the research problem. Data collection was done through observations, interviews, questionnaires and secondary data from the Department of Environmental Affairs.

### 3.2 Research approach

There are three different approaches that a researcher can choose from. These include qualitative, quantitative and mixed methods. Often, the distinction between qualitative and quantitative research is framed in terms of using words rather than numbers or using closed-ended questions rather than open-ended questions. The method selected for this research is mixed methods.

#### 3.2.1 Qualitative approach

Qualitative approach is part of research that deals with methods used to collect information as well as key concepts used in gathering data and collecting information. Qualitative research is aimed at gaining a deep understanding of a specific organization or event, rather than surface description of a large sample of a population. It aims to provide an explicit rendering of the structure, order, and broad patterns found among a group of participants (Anderson, 2010: 2). Observation was used to collect the data from the area since it aims at gaining the deeper understanding of the specific phenomenon because when doing observation, you tend to understand the phenomenon better than through secondary data.

Qualitative research does not introduce treatments or manipulate variables, or impose the researcher's operational definitions of variables on the participants. Rather, it lets the meaning emerge from the participants. Concepts, data collection tools, and data collection methods can be adjusted as the research progresses (Williams, 2011: 67)

Yilmaz (2013: 313) posits that qualitative research is concerned with the process, context, interpretation, meaning or understanding through inductive reasoning. That is why it requires an in-depth study of people's lives or the issues in their natural settings without resorting to standardized, pre-determined categories of analysis.

McCusker *et al.* (2015: 3) assert that qualitative research is more focused on the aspect of social life and its methods which generate words, rather than numbers as data for analysis. It answers the questions such as what, how and why of phenomenon rather than how many, or how much, which are asked by quantitative researchers. The focus is narrowed down to the data derived from specific participants and their opinions. It was used for collecting data through the questionnaire from the participants where there were a number of social and livelihood questions which were asked to address some of the research questions.

Polit and Beck (2010: 1452) maintain that in qualitative studies, the issue of generalizing is more complicated and more controversial since their goal is to provide rich and contextualized understanding of human experience through the intensive study of particular cases. Since there were questionnaires that were distributed it helped to get the view from the participants who are dealing with clearing of IAPs daily rather than getting opinions from the other people who are not hands-on on the project.

The data that form part of qualitative research is observation wherein I observed the methods of work and the resources that were utilized in the field. Observations were done on the area prior to its clearing and after it was cleared. The very same process was done as well on the area that had not been cleared at all to get a deeper understanding of the phenomenon. Qualitative research uses observation as one of its data collection methods. Observation is the selection and recording of behaviours of people in their environment. Observation is useful for generating in-depth descriptions of organizations or events, for obtaining information that is otherwise inaccessible, and for conducting research when other methods are inadequate. Qualitative research aims to get a better understanding through first-hand experience, truthful reporting, and quotations of actual conversations. It aims to understand how the participants derive meaning from their surroundings, and how their meaning influences their behaviour.

It is through the observation process in which the different methods of operation were observed and identified. It also helped to observe the behaviour of the participants while clearing the IAPs in the study area.

### **3.2.2 Quantitative approach**

Yilmaz (2013: 311) defines quantitative research methodology as research that explains the phenomena according to numerical data which are analyzed by means of mathematically based methods, especially statistics. It is further regarded as an empirical research into a social phenomenon or human problem testing a theory consisting of variables which are measured with numbers and analysed with statistics in order to determine if the theory explains or predicts phenomena of interest. The secondary data from the DEA were captured in terms of the amount of money that was used, hectares that had been cleared and person days or units per hectare that have used to clear the specific site were captured in terms of numbers. The analysis of the questionnaires were done averaged into percentage.

Polit and Beck (2010: 1452) maintain that in quantitative research methodology, the issue of generalization is considered as a major criteria for evaluating the quality of the study. The percentages that were produced during the analysis of the questionnaires were used as overall views of the participants.

Henwood (2014: 1615) gave an assumption based on the quantitative research method which states that the world operates in cause–effect manner and people can observe and measure the cause. It requires the researcher to use a pre-constructed standardized instrument or pre-determined response categories into which the participants' varying perspectives and experiences are expected to fit. They randomly select large representative samples in order for the researcher to generalize the findings from the sample (Yilmaz, 2013: 313). The number of participants that were selected from 8 teams were selected randomly to represent the rest of the team in responding to the question. The responses received from the questionnaires were regarded as the general views of all 8 teams. Even though only 4 out of 12 participants per team participated in the study, but when it comes to the results, it was taken as if it was the whole team that responded.

According to McCusker *et al.* (2015: 538), quantitative research requires the extraction of data in a larger volume, using standardized methods that include more generalized samples where the emphasis is on the statistical information rather than individual perception. They argue that most researchers are still using the quantitative methods in today socio-economic environment as a preferred methodology due to its issues related to time and financial consideration. Accessing the quantifiable information and data is relatively simple compared to qualitative research.

The quantitative approach is an approach for testing the objective theories by examining the relationship among variables. These variables in turn, can be measured typically on instruments so that numbered data can be analyzed using the statistical procedures. The questionnaires were analysed using Statistical Package for the Social Sciences (SPSS) to compute the descriptive statistics into frequency and percentage.

The goal of quantitative research is to explain behaviour in terms of specific causes and the measurement of the effect of those causes. Measurement is the conversion of observations into numerical units according to rule (Henwood, 2014: 1615). The quantitative approach was used to get the information about the resources that have been used in the process of clearing alien invasive plant species over the past five years.

The main objective of the quantitative approach was to gain an understanding of underlying reasons and motivations, to provide insights into the setting of a problem, generating ideas and/or hypotheses for later quantitative research, to uncover prevalent trends in thought and opinion, to quantify data and generalize results from a sample to the population of interest, to measure the incidence of various views and opinions in a chosen sample and sometimes followed by qualitative research which is used to explore some findings further (Creswell, 2013: 4).

### **3.2.3 Mixed methods approach**

Cameron (2009: 142) holds that a mixed methods approach has the identifiable methodological movement which can be traced to the early 1980s and has been described as quite a revolution due to its focus of resolving tension between qualitative and quantitative methodology movements.

Ostlund *et al.* (2011: 370) maintain that a mixed methods approach can be viewed as an approach which draws upon the strength and perspective of each method, recognizing the existence and importance of physical, natural world as well as the importance of reality and influence of human experience. The study used both qualitative and quantitative methods which lead us to have the mixed method approach

According to Harrison *et al.* (2011: 8) mixed methods research has become the most popular term for mixing qualitative and quantitative data in a single study. This is a type of research methods in which the researcher combines elements of qualitative and quantitative research approaches for the broad purpose of breadth and depths of understating and corroboration.

Mixed methods is an approach of inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The assumption about this inquiry is that the combination of these two approaches provide a more complete understanding of a research problem than either approach alone (Creswell, 2013: 4).

Williams (2011: 70) opines that mixed method is not a replacement of qualitative and quantitative methods since the latter will continue to be useful and important, but the main aim is to draw from the strength and minimize the weakness of qualitative and quantitative research approach. The mixed methods approach provides the researchers with ability to design a single research study that answers questions about the complex nature of phenomenon from participants' point of view and relationship between measurable variables. The fact that the two approaches are not only compatible but also complementary underpins calls for additional research studies that use the mixed methods.

The research adopted mixed methods since it looks at many approaches for collecting and analyzing data rather than subscribing to only one way. Mixed methods include postmodern turn, a theoretical lens that is reflective of social justice and political aims. The researcher chose this method because it gets deeper understanding of the programme and determines the amount that has been used to achieve the relevant success. It was also needed to check the social impacts of the project on the

community. This entails both qualitative and quantitative approach, which requires the researcher to employ a mixed methods approach.

### **3.3 Research design**

There are three types of research designs under mixed methods approach from which a researcher can choose. The designs include convergent parallel method, explanatory sequential method and exploratory sequential mixed method (Creswell, 2013: 15). Since this research was using the research question to narrow the scope of the study and focused on exploring the new phenomenon using the previous researched phenomenon from various perspectives, it employed inductive methods.

#### **3.3.1 Convergent parallel mixed method**

The convergent parallel mixed method is a form of mixed methods design in which a researcher converges or merges both qualitative and quantitative data in order to provide a comprehensive analysis in the research problem. In this design, the researcher collects both forms of data roughly at the same time and then integrates the information in the interpretation of the overall results. Contradiction or incongruent findings are explained (Creswell, 2013: 16).

Harrison (2011: 18), names the convergent parallel mixed methods the concurrent design since it collects both qualitative and quantitative data at the same time. The design analyses both data strands separately and then mixes the databases by merging the data, but in convergence design, the data are analysed separately and the different results are converged during the interpretation. Concurrent design is conducted to bring together the strength of both quantitative and qualitative data to compare the results or to validate, confirm quantitative results with qualitative findings.

Driscoll (2007: 20), holds that concurrent designs have been employed to validate one form of data with other forms, transform the data for comparison or to address different types of questions as reported by Creswell and Clark (2007: 118). This is the design in which qualitative and quantitative data are collected simultaneously.

The researcher used a convergent parallel mixed method since the data collection was done at the same time for both the qualitative and quantitative data. When conducting interviews with the land owners and participants, I was also doing field

observations on the study areas. Both processes were run concurrently without relying on the analysis of each other.

### **3.3.2 Explanatory sequential mixed method**

Harrison (2011: 16) maintains that explanatory design is the design in which the researcher first collects and analyses quantitative data and then builds those findings in a qualitative follow-up which seeks to provide a better understanding of the quantitative results. Building can involve either using the quantitative data to select a case or to identify a question that needs further explorations in the quality phase.

According to the explanatory sequential mixed method, a researcher first conducts quantitative research, analyzes the results and then builds on the results to explain them in more detail with qualitative research. It is considered explanatory because it starts with quantitative data results and explains later with the qualitative data. This is popular in the field with strong quantitative orientation, but presents challenges of identifying quantitative results to further explore the unequal sample sizes for each phase of the study (Creswell, 2013: 16).

The explanatory sequential mixed method is only applicable to research that deals with experiments that will rely on numbers and results that are obtained from the quantitative data which are then used to define the qualitative method.

### **3.3.3 Exploratory sequential mixed method**

Harrison *et al.* (2011: 15) suggests that exploratory design collects qualitative data, analyses the qualitative data and builds on the qualitative data for quantitative follow-up. This can involve identifying the types of questions that might be asked, determining the items/variables or scales for instruments design and generating a typology or classification. They further opine that this design is useful for exploring relationships when study variables are unknown, developing new instruments based on initial qualitative analysis, generalizing qualitative findings and refining or testing a developing theory. It is conducted when the qualitative data is the only initial exploration to identify variables, constructs, taxonomies, or instruments for quantitative studies.

The exploratory sequential mixed method is a reverse sequence of explanatory sequential design. In this design, the researcher starts with qualitative phase and explores the views of the participants and follow with the quantitative phase. The data are then analyzed and the information used to build into a second quantitative phase. The qualitative phase may be used to build an instrument that best fits the sample under study to identify appropriate instruments to use in the follow-up quantitative phase. Particular challenges to this design reside in focussing on the appropriate qualitative findings to use and the sample selection for both phase of research (Creswell, 2013: 17).

### **3.4 Sampling procedure**

According to Anderson (2010: 4), sampling procedures differ from qualitative to quantitative research. In a quantitative research, it is important to select the probability sampling so that statistics can be used to provide generalizations to the population from which samples were drawn.

Another form of sampling is representative sampling in which the number of people will be chosen to represent the rest in the group. Convenience sampling is a form of sampling in which the researcher chooses research participants who are accessible or willing to take part in the research, but it can lead to bias or other people may not be represented well (Anderson, 2010: 4).

Anderson (2010: 4) regards theoretical sampling as a sampling that uses insights gained from previous research to inform sample selection for a new study.

There was a sampling procedure that was carried out in the field. The sampling procedure that was used is simple random sampling. In this technique, each member of the population has an equal chance of being selected as subject. The main reason that prompted the researcher to opt for simple random sampling is that the envisaged project comprises a number of polygons which are situated in different topographies which have a multiplicity of activities.

United States Environmental Protection Agency (USEPA) (2002: 12) posits that in simple random sampling, particular sampling units are selected using random

numbers, and all possible selections of a given number of units are equally likely to be included.

For example, a simple random sample of a set of drums can be taken by numbering all the drums and randomly selecting numbers from that list or by sampling an area by using pairs of random coordinates. This method is easy to understand, and the equations for determining sample size are relatively straightforward. Simple random sampling is most useful when the population of interest is relatively homogeneous, which means there is no major patterns of contamination or hot spots expected.

The main advantages of this design is that it provides statistically unbiased estimates of the mean, proportions, and variability, it is easy to understand and easy to implement and sample size calculations and data analysis are very straightforward.

In some cases, implementation of a simple random sample can be more difficult than some other types of designs because of the difficulty of precisely identifying random geographic locations. Additionally, simple random sampling can be more costly if there are difficulties in obtaining samples due to location causes and expenditure of extra effort (USEPA, 2002: 12).

There are many methods to proceed with simple random sampling. The most primitive and mechanical sampling method would be the lottery method. Each member of the population is assigned a unique number. Each number is placed in a bowl or a hat and mixed thoroughly. The blind-folded researcher then picks numbered tags from the hat. All the individuals bearing the numbers picked by the researcher are the subjects for the study

Another way would be to let a computer do a random selection from population. For populations with a small number of members, it is advisable to use the first method but if the population has many members, a computer-aided random selection is preferred.

One of the best things about simple random sampling is the ease of assembling the sample. It is also considered as a fair way of selecting a sample from a given population since every member is given equal opportunities of being selected.

Another key feature of simple random sampling is its representativeness of the population. Theoretically, the only thing that can compromise its representativeness is luck. If the sample is not representative of the population, the random variation is called sampling error

An unbiased random selection and a representative sample is important in drawing conclusions from the results of a study. Remember that one of the goals of research is to be able to make conclusions pertaining to the population from the results obtained from a sample. Due to the representativeness of a sample obtained by simple random sampling, it is reasonable to make generalizations from the results of the sample back to the population. The random sampling was undertaken to select the participants for participating in the study. This was done to avoid biasness. It gives each and every individual a chance to be selected.

Polit and Beck (2010: 1452) suggest that random sampling is the vehicle through which the statistical model of generalization can be endorsed. In the study in which participants are sampled at random, cooperation is rarely perfect, which means that random sampling seldom results in random samples. They further indicate that random sampling myth is one in which all researchers conspire when they apply standard statistical tests to analyse their data in violation of the assumption of random sampling.

### **3.5 Data collection**

Data was collected using questionnaires and observations. The information was requested from the Department of Environmental Affairs in Tzaneen Office. The researcher sought consent from the Regional and Area Manager of the Working for Water programme. The data requested comprised the budget, employment and the hectares that have been cleared. This information was obtained from Working for Water Information Management System (WIMS).

The questionnaires were distributed together with the register to workers and contractors as part of random sampling. Informed consent was obtained in writing and verbally from participants before distributing questionnaires and making observations. During verbal consent, participants were informed about the questions and observations, purpose of verbal consent and how the data would be utilized. The data

were collected only from the participants who formed part of the Wolkberg Project, which is Haenertsburg, Segwashe and Spitzkop villages in Limpopo, South Africa.

Data were collected from 32 participants from 8 contract teams. Each contract team was made up of 4 participants. The participants consisted of males and females of various age groups, including youth and the middle aged.

Data were collected from three different areas: area one had been handed over back to landowner by the Department of Environmental Affairs, in area two the participants were working on a contractual basis and in areas three, no work was done. Field work was done to check the infestation and methods of work.

The study used the secondary data that were collected from the Department of Environmental Affairs. This secondary data include the amount of money that was used to clear the area for the period of 5 years from 2012 to 2016, the person days used to clear the area and the hectares that have been cleared.

The hypothesis indicated that the Working for Water is doing nothing about the invasive alien plants. This prompted the researcher to check on the Working for Water Information Management System (WIMS) the extent of hectares that have been cleared for the period from 2012 to 2016. The hectares cleared have to be linked with the number of people that have been employed to clear the area.

The qualitative data were collected through the questionnaire from 32 participants comprising 16 males and 16 females. They were taken from 8 contract teams and 4 participants who responded to the questions were selected from each team.

Three sites which were visited included the Ebenezer Dam, a site next to Haenertsburg Primary School and the other one next to Makgoebaskloof. The ring barking method was used to destroy plants in this instance. The ring barking method is applied on both young and adult species. After ring barking, the herbicide was applied to kill the plant. Only the Pinus species does not need herbicide after the ring barking or cut stump method.

### **3.5.1 Data collection tools and techniques**

According Patton (1990) and Yin (2003), data collection involves use of multiple data sources, a strategy which also enhances data credibility. Potential data sources may

include documentation, archival records, interviews, physical artifacts, direct observations, and participant-observation. Unique in comparison to other qualitative approaches within case study research, the investigators can collect and integrate quantitative survey data, which facilitates reaching a holistic understanding of the phenomenon being studied.

The study employs different types of data collection tools and techniques which include the following:-

- The researcher drafted the questions that assisted in digging the information from the participants. Questionnaires were used to collect data from the participants, including landowners and communities around. The information about the controlled status of the alien invasive plants on the area cleared was gained from the participants as well as information about their livelihood progress since they joined the programme.
- Observation consists of taking field notes on the participants, the setting, the purpose, the social behaviour, frequency and duration of phenomena. Observations may be made of non-verbal behaviour, verbal behaviour, and physical phenomena. Observations were conducted to collect information while the participants were working, checking the methods that they were using, resources which they used and checking the progress on the area cleared, infestation level in the area cleared before and on the area not cleared at all. Field observation information was used to check if the participants were following the Working for Water Programme procedures.
- Other sources of data may include archival records, private records, anecdotes, and erosion or accretion. Data about the resources used, area cleared and employment achieved were collected from the Department of Environmental Affairs Information System that is responsible for capturing detailed information about the programme. This system is referred to as Working for Water Information Management System (WIMS) which provided the archival records for the study.

- A camera was used to take pictures of the site where the project was operating. The pictures that were taken include scenarios before clearing, onsite and after clearing. The camera aids in supporting documents to serve as evidence of what has been observed in the field while doing the field observation.

For data collection we used the secondary sources, questionnaires, a camera and observation.

- **Secondary data**

The information regarding the resources and hectares that have been used to clear the areas have been requested from the Department of Environmental Affairs which is regarded as the Working for Water Information Management System. The information that was requested is from 2012 to 2016.

- **Questionnaire**

The questionnaires were distributed to the participants in 8 teams wherein each team selected 4 participants to complete them. From each of the 4 participants, there was one female and one youth. The questionnaires were completed and handed back to the researcher. One of the questionnaires was blank and +/- 12 were incomplete. The number of questionnaires were 32 in total. The questionnaires were analysed in order to get the frequency, percentage and total number of responses from the participants. The information was presented graphically and through the use of pie charts. The questionnaires were developed in order to answer the research questions and achieve the objectives of the study.

- **Observation**

The researcher visited 3 sites as part of observation and data collection. The sites are Ebenezer Dam where the clearing was done in 2016/2017, Haenertsburg Primary School where the clearing of alien invasive plants were on course when data was collected and lastly, Makgoebaskloof (Richards Farm) which was handed over to the land owner in 2016.

➤ Ebenezer Dam

The area was worked on in 2016/2017 financial year. There were dead cut stumps of the Black wattle and dry Bug weed trees which were ring barked. There were also dead *Hakea spp* which were ring barked. The Castor oil plants were at the young stage of development. There were few seedlings of Black wattle.

➤ Haenertsburg Primary School

In this site, there was a team of 12 participants working. They were treating the species like Bugweed, Castor oil plants, American bramble, Black wattle, *Pinus spp* and *Eucalyptus spp*. The most dominant species in this site was Bugweed which was still at its young stage of development. The participants were cutting and applying herbicides on the cut end of the stumps. Previously, the area was dominated by *Eucalyptus species*. The other species were very low in densities. The foliar application method was applied on the plants that were having leaves and the size of the plant had to be below the waist.

➤ Makgoebaskloof Area.

The area has been handed over to the owner in 2016. It was clean with few alien plants which were under control. When visited in 2017 the area was found full of seedlings, young and adult Bugweed and American bramble.

### 3.6 Data analysis

The purpose of data analysis was to analyze and interpret the data collected. Data from all these multiple sources were then converged in the analysis process rather than handled individually. Each data source is interdependent, with each piece contributing to the researcher's understanding of the whole phenomenon. This convergence adds strength to the findings as the various strands of data are braided together to promote a greater understanding of the case (Baxter & Jack, 2008: 544).

Data were analyzed using SPSS analysis method. SPSS is an enormously powerful data analysis package that can handle very complex statistical procedures. It was used to get the frequency and percentage based on the responses that were received from the questionnaires.

The excel spread sheet was used for capturing the information from DEA in order to present the results into graphs. This system was helpful in terms of analyzing the variation as well as comparing the different attributes for different years.

Data analysis was done through the help of computer programmes. These include Microsoft Word and Excel that was used to capture all the qualitative data and for all the figures that needed to be produced, for example the area cleared as well as the amount of money and time spent in clearing alien invasive plant species. Statistical table percentages, frequency number and graphs and also context analysis were used to present the findings regarding progress for different years. The tables, graphs and pie charts were used to analyze the data as they are most likely to produce good results when it comes to numbers and samples (Richards & Richards, 1994: 445 - 462).

At the analysis stage, the consistency of the findings or “dependability” of the data were promoted by having multiple researchers’ independently coded set of data which were then met together to come to consensus on the emerging codes and categories. The researcher also chose to implement a process of double coding where a set of data were coded, and then after a period of time, the researcher returned and coded the same data set and compared the results (Krefting, 1991: 51).

### **3.7 Data validation and reliability/ credibility and trustworthiness**

For the sake of validity and reliability of the data, the information was compared and the differences and similarities of the data from various sources checked. Researcher should ensure that enough detail is provided so that readers can assess the validity or credibility of the work.

According to Yilmaz (2013: 317), reliability means consistency or the degree to which a research instrument measures a given variable consistently every time it is used under the same condition with the same subjects. Reliability should be applied to the data, not the measuring object or measurement instruments, while validity refers to the accuracy of the research data, which means that data can only be valid if the results of the study measurements process are accurate. The data were found to be reliable since the information was received from the participants who are dealing with

the clearing of IAPs and the Department of environmental Affairs which is the custodian of the programme inform which secondary data were sourced.

There are many different ways of establishing trustworthiness, including member check, interviewer corroboration, peer debriefing, prolonged engagement, negative case analysis, auditability, conformability, bracketing and balance (Baxter & Jack, 2008: 544). The researcher engaged with all different participants to get the views about the research and impacts made by this project.

As a basic foundation to achieve this, researchers have a responsibility to ensure that the case study research question is clearly written, propositions are provided, and the question is substantiated; case study design is appropriate for the research question; purposeful sampling strategies appropriate for case study have been applied; data are collected and managed systematically; and the data are analyzed correctly (Baxter & Jack, 2008: 556).

Triangulation of data sources, data types or researchers is a primary strategy that can be used to support the principle. In case study research, the phenomena can be viewed and explored from multiple perspectives. The collection and comparison of this data enhances data quality based on the principles of idea convergence and the confirmation of findings (Knafl & Breitmayer, 1989: 200).

As data are collected and analyzed, a researcher will integrate a process of member checking, where the researchers' interpretations of the data are shared with the participants, and the participants have the opportunity to discuss and clarify the interpretation and contribute new or additional perspectives on the issue under study (Krefting, 1991: 214). After data collection, there was no member check since the researcher requested the consent from the participants and DEA before the interviews were undertaken.

Additional strategies commonly integrated into qualitative studies to establish credibility include the use of reflection or the maintenance of field notes and peer examination of the data.

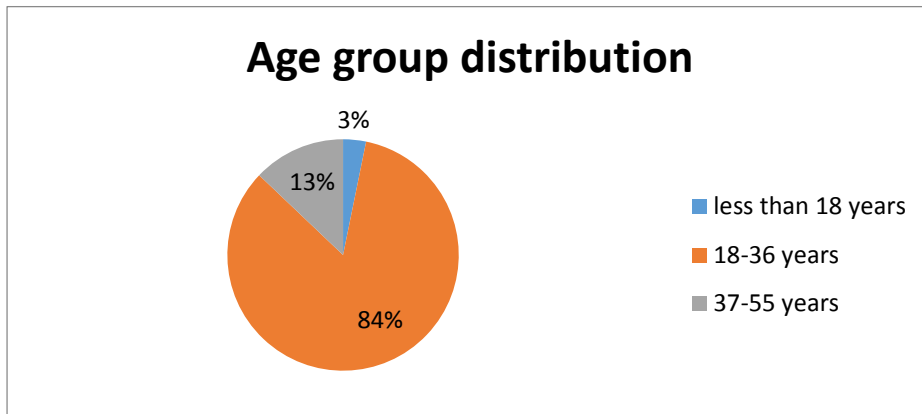
### **3.8 Research ethics**

Since data were collected from participants, landowners and Department of Environmental Affairs, the information gathered remained confidential. Only the figures and the pictures of the areas worked on are depicted in the research. Written consent was granted in writing by the Department of Environmental Affairs, participants and the landowners.

## CHAPTER FOUR: RESULTS

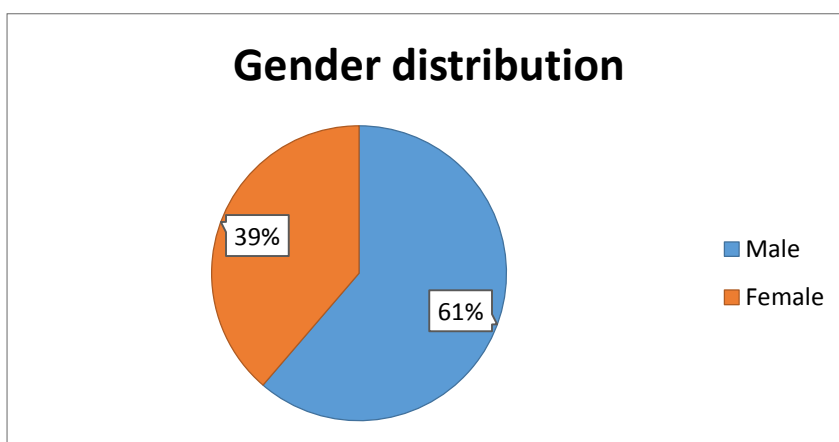
### 4.1 Questionnaire

The analysis were presented in different charts after the questionnaires were developed in order to answer the research questions and to meet the objectives of the research.



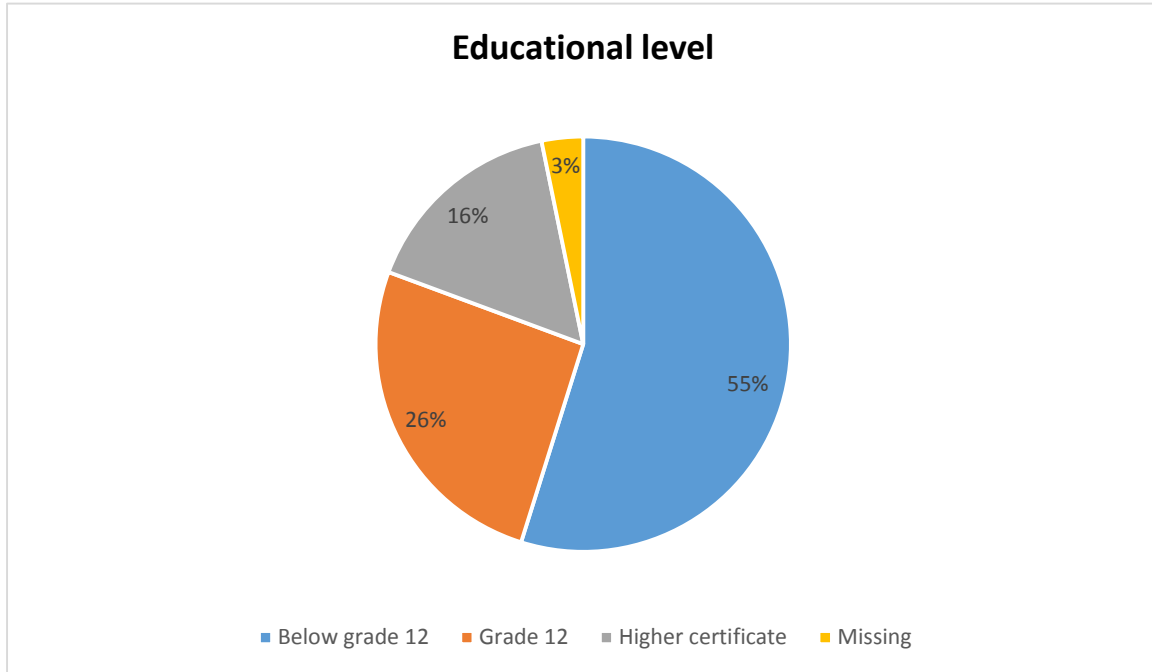
**Figure 4.1: Age group distribution**

Figure 4.1 above indicates that the most dominant age group in the project is the youth whose ages ranged from 18 to 35 years. This age group constitutes 84% of the total age group distribution. The youth are one of the EPWP target group followed by the adults aged 37 to 55 years which constitutes 13% of the total age group distribution. The 3% of the labour force were teenagers aged less than 18 years.



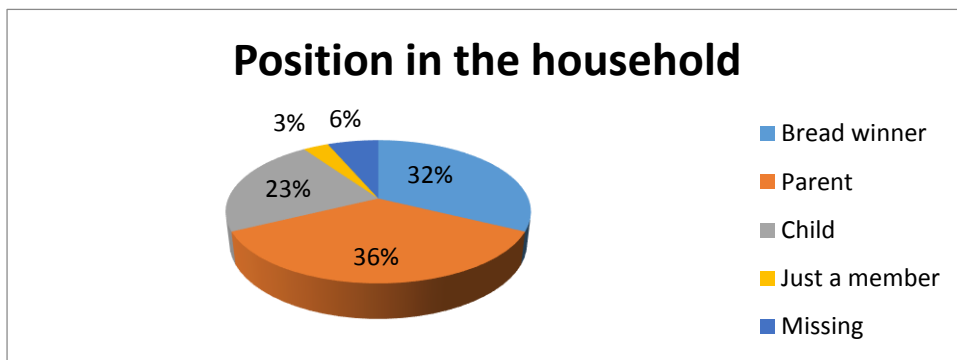
**Figure 4.2: Gender distribution**

The gender distribution in Figure 4.2 above depicts the percentages of males and females who participated in the study. Males (61%) were the most dominant gender in the project while females constituted 39% which is below the EPWP target.



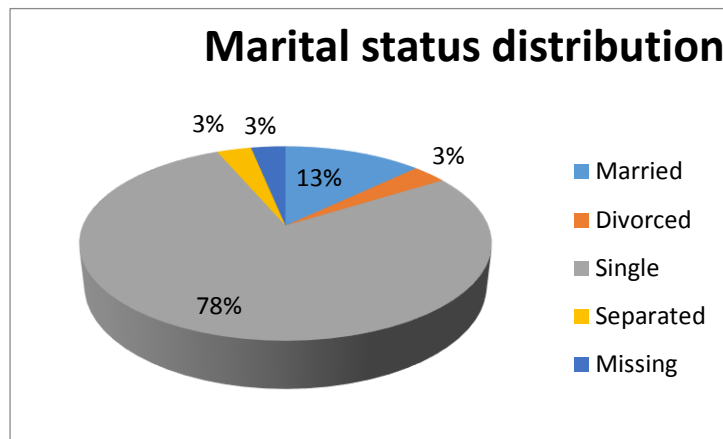
**Figure 4.3: Educational level**

Most of the participants that work in this project do not have grade 12 qualifications as indicated in Figure 4.3. The percentage of below grade 12 qualifications is sitting at 55% followed by 26% with grade 12. Only 16% are having higher certificates. These results generally show that the community is still disadvantaged academically.



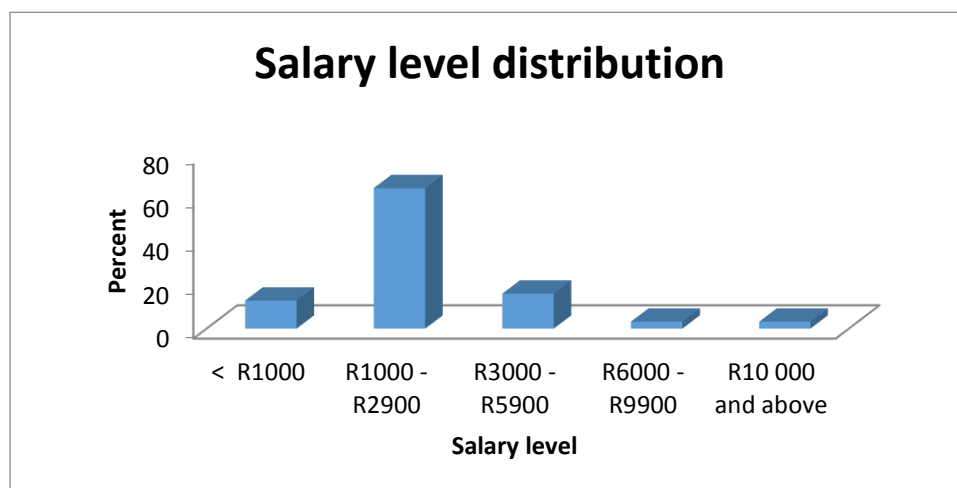
**Figure 4.4: Position in the house hold**

As illustrated in Figure 4.4, most of the participants are parents (36%) and bread winners (32%) in the families. Only few people (3%) are just members and children (23%) in the families.



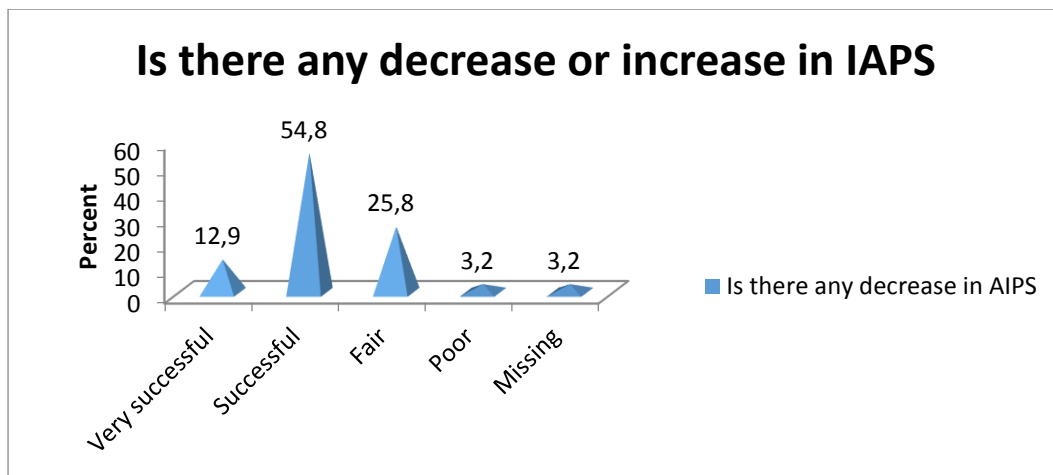
**Figure 4.5: Marital status**

Almost 78% of the total number of participants in the project are single parents, while only 13% are married as indicated in Figure 4.5. The two categories which included divorced and separated were both sitting at 3%. This project is playing a role in providing for the families.



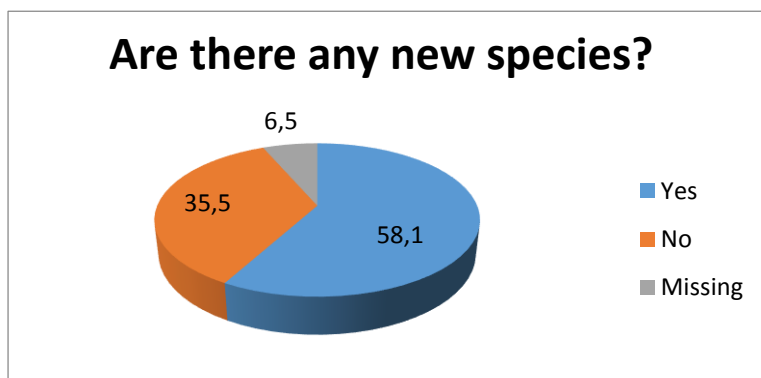
**Figure 4.6: Salary bend**

Majority of the research participants (65%) are earning between R1000 - R2900 per month as illustrated in Figure 4.6. whereas the least (only 3%) are earning more than R10 000.00 per month.



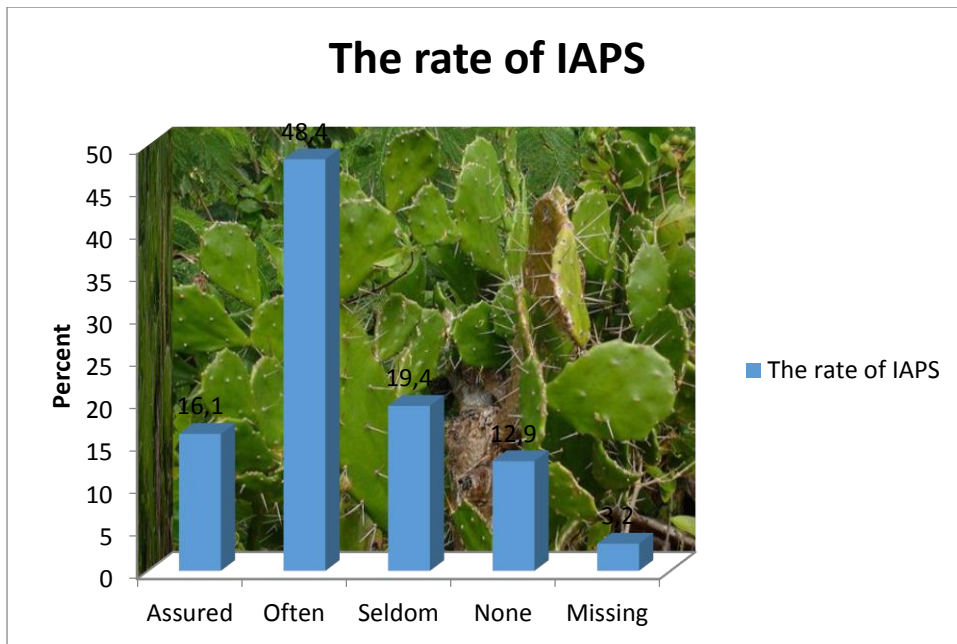
**Figure 4.7: Invasive Alien Plant Species (IAPs) distribution**

Statistics in Figure 4.7 shows that 55% of the people who worked in the project indicated that since the project has started, there has been successful decrease in invasive alien plant species (IAPs) followed by 26% which indicates that a decrease rate is fair. Only 3% of the participants indicated that there is poor success in controlling IAPs whereas 13% reflected that there is great success in terms of clearing IAPs.



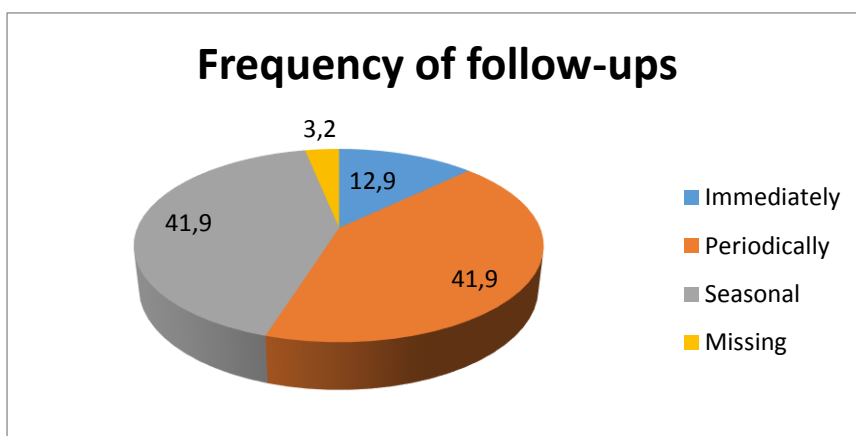
**Figure 4.8: New infestation**

The participants, according to Figure 4.8 indicated that even though there is a decrease in the invasive alien plant species, there are still some species that re-establish after they have been cleared. Of the 32 participants, 58% indicated that there are new species that re-establish after clearing whilst 36% reported that there are no re-establishing species.



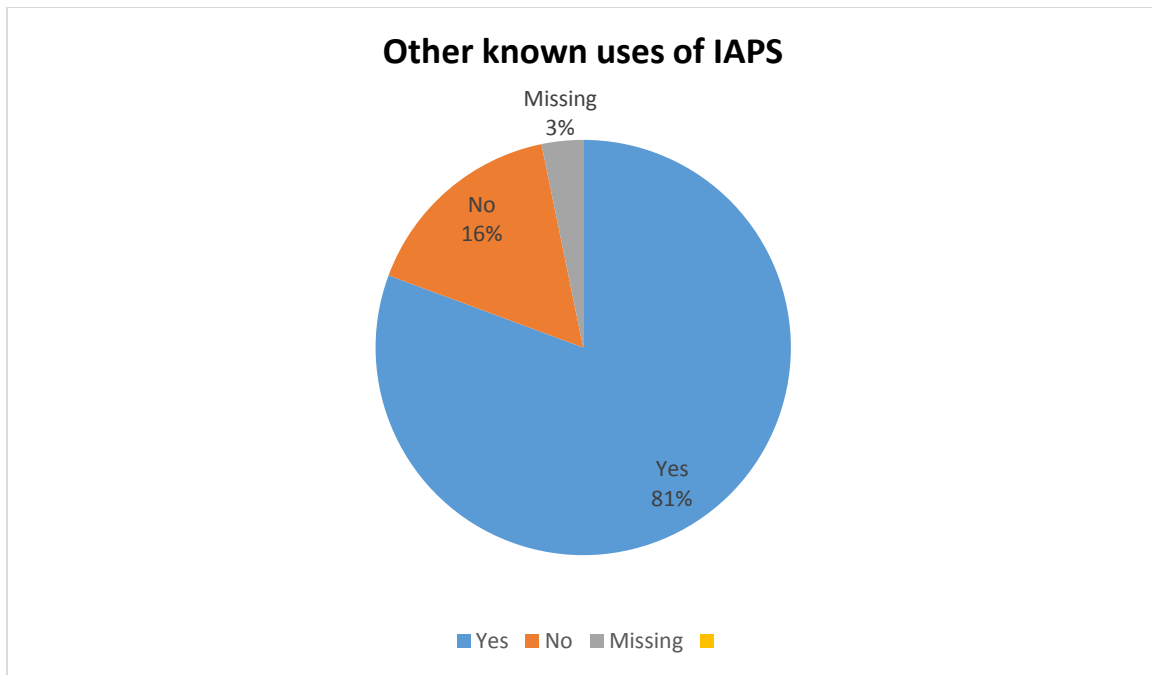
**Figure 4.9: The rate of IAPs in the cleared areas**

48% of the participants as depicted in Figure 4.9 indicated that there is often an increasing rate of invasion by IAPs in the cleared areas while only 13% indicated that there is no increase in the rate of invasion by IAPs in such areas. The two categories consisting of 16% and 19% reported that surely, there is an increase in the number of IAPs in the cleared areas and a seldom increase in the cleared areas respectively.



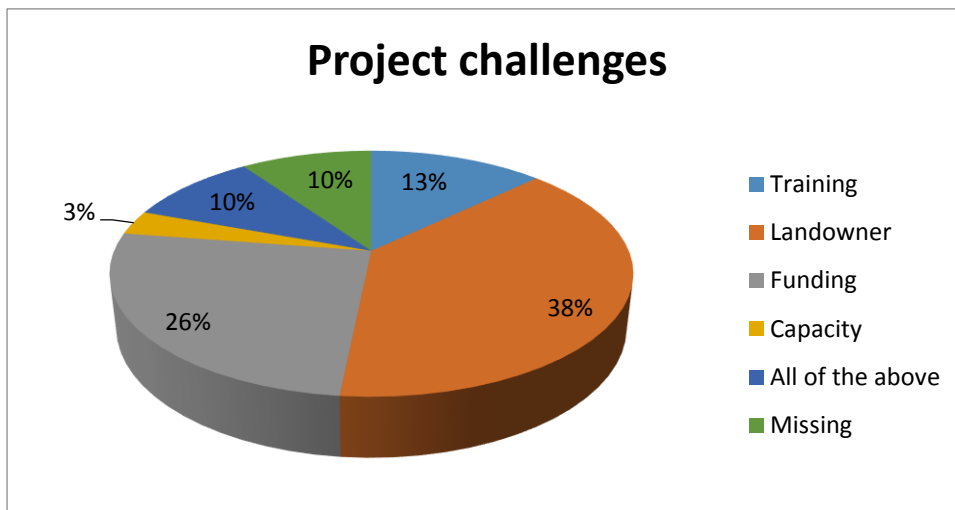
**Figure 4.10: The follow up on the cleared area**

Figure 4.10 reflects that 42% of the participants indicated that the follow-ups are done periodically or seasonally whilst only 13% indicated that follow-ups are done immediately after first treatment.



**Figure 4.11: Other known uses of IAPS**

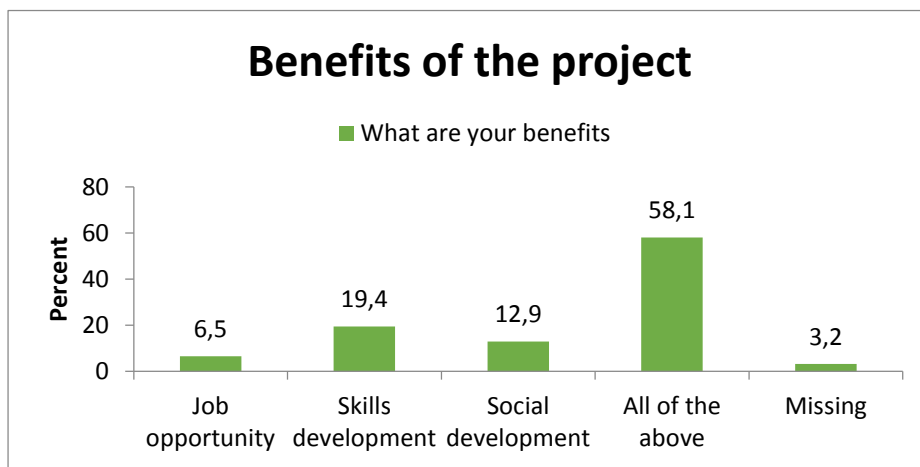
Majority of the participants (81%) as illustrated in Figure 4.11 indicated that there are other uses of IAPS that they are aware of, while 16% reported no knowledge of any other uses of IAPS. Almost everyone in the project knows the different types of invasive alien plant species.



**Figure 4.12: The challenges in the project.**

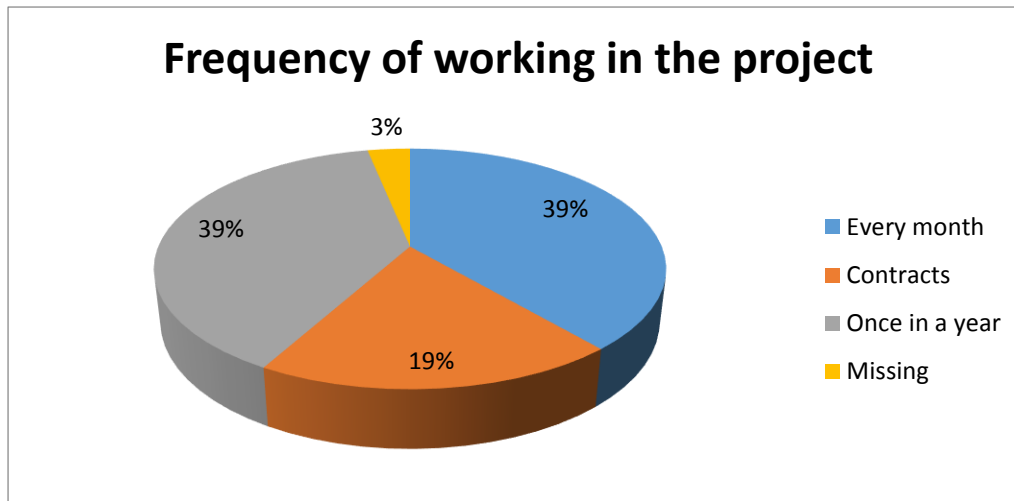
The main challenge that the participants are coming across while clearing the IAPS as depicted in Figure 4.12 are the land owners who are not willing to conjoin when it comes to clearing invasive alien plant species, followed by the under-funding and

human capacity. 38% of the participants indicated that the landowners are the challenges with at least 3% indicating human capacity as their challenge.



**Figure 4.13: The benefits of the project**

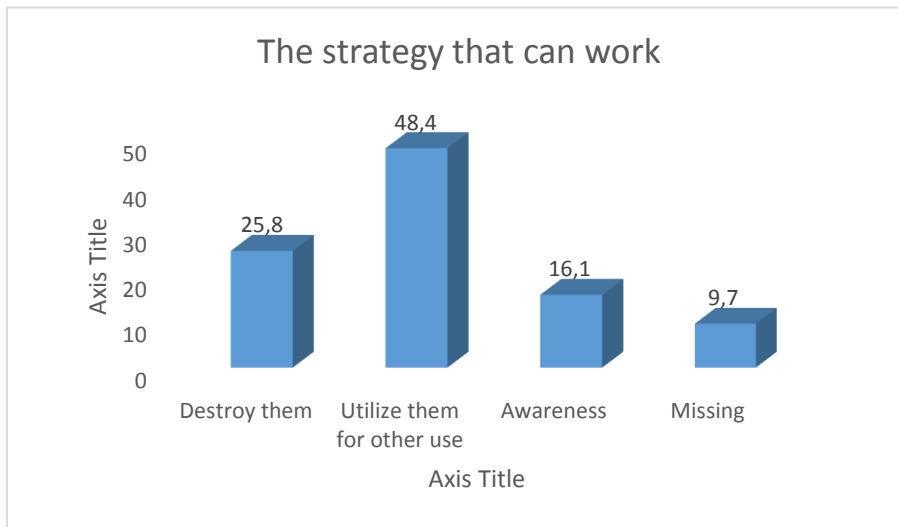
As much as there are challenges in the project, there are also some benefits that come with the project. The job opportunity, skills development and social development all form part of the benefits of the project that sit at 58%.



**Figure 4.14: Time frame of the project**

The project offers employment to the surrounding communities. Statistics in Figure 4.14 shows that there is 50/50 in terms of the sustainability of the employment. Almost 39% indicated that they work only once in a year while 50% indicated that they work every month and the other 19% indicated that they work contractually. Adding

together, the percentage or the frequency of the contracts and the ones who work once in a year, gives a sum of 58% of the participants who do not work every month.



**Figure 4.15: The strategy to be employed**

Of the overall participants, 48% as illustrated in Figure 4.15 indicated that the strategy that can work is to utilise the IPAs for other uses, this was followed by 26% who indicated that the IPAs should be destroyed. 16% of the participants preferred awareness campaigns as the best strategy that can be employed.

## 4.2 Observation

The information observed has been illustrated through the pictures that were taken from 2012 to 2016.

### 4.2.1 Ebenezer Dam



**Figure 4.16 (a): Ebenezer Dam in 2014**



**Figure 4.16(b): Clearing in 2015**



**Figure 4.16(c): The Ebenezer Dam after clearing in 2017**

Figure 4.16(a) shows the area that was worked on and handed over to Lepelle Water two years before 2014. The Working for Water decided to go back to continue with the

clearing of IAPs. When observation were made, the areas were found to be full of adult Black wattle, Bugweed, Pinus species, Bramble, Caster oil and Hakea.

Figure 4.16(b) shows the area after the first treatment in 2015. All the Black wattle were dying whilst Pinus species were showing signs of death.

Figure 4.16(c) shows the dead Black wattle and Pinus species. The cut stumps of the dead Black wattle in the area were presented in Figure 4.16(c).



**Figure 4.17(a): Hakea spp in Ebenezer dam    Figure 4.17(b): Treated Hakea spp in 2017**

Figure 4.17 (a) shows the Hakea species that were emerging and starting to invade around the dam during the year 2015. During the first treatment (ring barking and herbicide application) in 2015, the IAPs did not die: the first follow-up was done in 2016. Figure 4.17 (b) depicts the dead Hakea spp after the second follow-up in 2016:



**Figure 4.18(a): Bugweed infested in 2015.    Figure 4.18 (b): Treatment of Bugweed in 2016.**



**Figure 4.18 (c): Bugweed died in 2017**

Figure 4.18 a, b and c depict areas around the Ebenezer Dam. Figure 23 (a) illustrates Bugweed and Bramble that flourished after the area was handed over to the Lepelle Waters in the Ebenezer Dam. When Working for Water went back to start working in 2015, the IAPs were at their fully fledged stage. The Bugweed and Bramble plants have numerous berries that produce masses of seeds. The Bugweed produces masses of lavender inflorescences maturing into yellow globular and pubescent berries.

Figure 4.18 (b) shows signs of the dying Bugweed plant species after they had been treated in 2016. The Bugweed died and fell down after the follow up in 2016 and there were some of the seedlings and juveniles of Bugweed that re-established on the cleared area though (see Figure 4.18 (c)). The seedlings and the juveniles of Bugweed that are depicted on Figure 4.18 (c) will require necessary attention as they do not take time to re-establish and grow to maturity.

#### 4.2.2 Haenertsburg Primary School



**Figure 4.19 (a): Haenertsburg in 2013. Figure 4.19(b): De-stumping of Eucalyptus in 2014.**

The area was full of adult *Eucalyptus spp*, Bugweed and American bramble with most dominant species being *Eucalyptus species* during the year 2012 before the operation took place by the Working for Water Project. Figure 4.19 (a) shows the area after the adult *Eucalyptus spp* were cleared in the year 2013: the cut stumps are evidence of treatment (see Figure 4.19 (a)).

In the year 2014, the Department of Basic Education through the Haenertsburg Primary School decided to clear the area using the earth moving machine that remove all the stumps and all the species which were part of the area. Figure 4.19 (b) shows the other part of Haenertsburg Primary School which was cleared with the earth moving machine that uprooted all the *Eucalyptus spp* stumps and all other IAPs which were in the area. This was like a relief to Working for Water Project, but after some months, there were new IAPs that re-grew.



**Figure 4.19 (c): New species in 2015. Figure 4.19 (d): Follow-up treatment in 2015.**

In the year 2015, a new species such as the Morning glory (Figure 4.19 (c)) established itself following disturbance that took place as shown in Figure 4.19 (b). Figure 4.19 (d) above depicts the foliar application that was done on the Morning glory and participants busy uprooting the other species such as the Bugweed seedlings. Figure 4.19 (c and d) shows that there was a decrease in the number, size and age of the plants that had to be cleared.



**Figure 4.19 (e): Area infested by Bugweed in Haenertsburg Primary School in 2017**

### 4.2.3 Makgoebaskloof area (Richards Farm)



**Figure 4.20 (a): Bugweed and Black wood at Makgoebaskloof before clearing in 2014**

Figure 4.20 (a) above shows the status of Makgoebaskloof area before it was cleared in 2014. The area was full of Bugweed, Black wattle, American bramble, *Pinus species*, *Eucalyptus spp* and Black wood. The area was highly infested with these alien invasive plant species and it had never been worked on for the past 10 years.



**Figure 4.20 (b): Area after clearing in 2015. Figure 4.20 (c): Area after handed over in 2016**

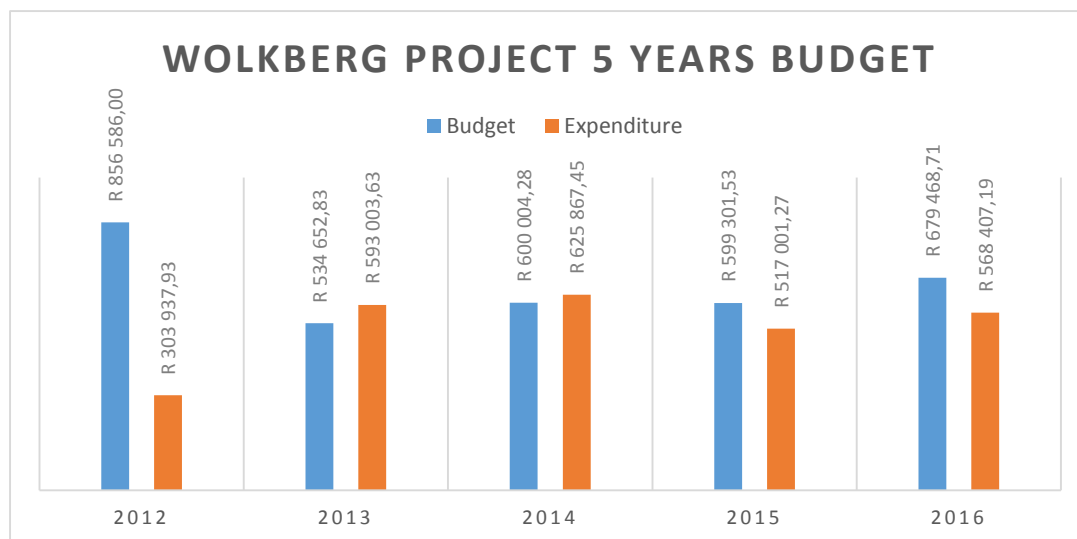
The species were ring barked, cut and foliar application carried out in 2015. Bugweed seedlings were regenerating after the area was cleared in 2015 (see Figure 4.20 (b)).

There were good results after treatment that was carried out in 2015. The method that was used was effective as it managed to kill the adult Black wood and Black wattle.

Figure 4.20 (c) shows the way Bugweed regrew and spread after the handover in 2016. The area returned to its original IAPs invaded stage.

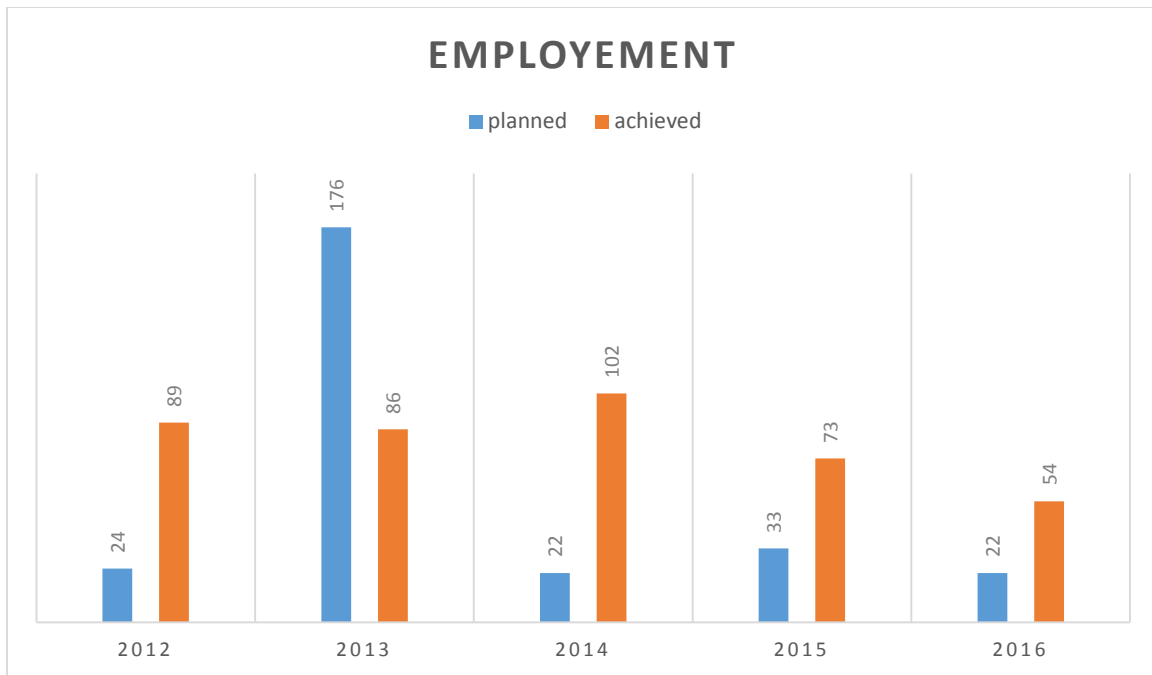
### 4.3 The secondary data

The data that were collected from the Department of Environmental Affairs through e-mails from the manager of the area and GIS technicians were analysed based on the budget, employment and the areas that were cleared for the period of 5 years from 2012 to 2016. The figures below represent the planned versus the actual budget, employment and the areas that were cleared from the year 2012 to 2016.



**Figure 4.21: The budget and expenditure of a five year period from 2012 to 2016**

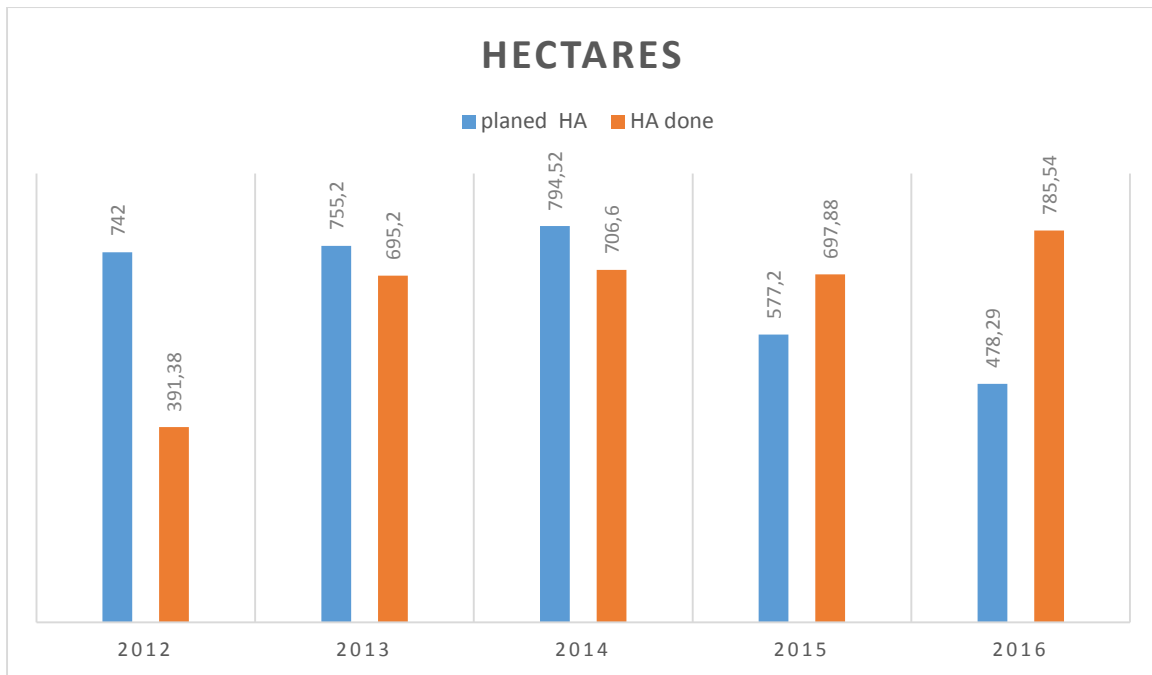
Figure 4.21 shows a decline in the budget allocation for this project from year 2012 to 2016, and an increase in 2014 which was nevertheless below the original budget allocated in 2012. It continued to be below the original budget until 2016. In the year 2015, there was a decline from what was allocated in 2014. There was a relative increase of budget in 2016 compared to the one of 2015 by +/- R80 000; this was less than the original budget of R856 586.00 though.



**Figure 4.22: The employment planned and the achieved number of employment**

Generally, there was notable fluctuation in terms of both planned and actual employment (see Figure 4.22). There was a huge hike in terms of planned employment from year 2012 to 2013 as shown in Figure 4.22 above. There was nevertheless, slight variation regarding planned employment from year 2013 to 2016.

There were no major differences in terms of actual employment variation for the years 2012, 2013 and 2015, whereas actual employment for 2014 was fairly high whilst one for 2016 was fairly lower than for the three years.



**Figure 4.23: The hectares planned and those achieved over a period of 5 years**

There were no agreements in terms of planned and achieved hectares (see Figure 4.23). Hectares planned for the years 2012, 2013 and 2014 were higher than the achieved hectares while planned hectares for the years 2015 and 2016 were lower than the achieved hectares. The number of hectares cleared increased every year except for the year 2015 where there was a slight decrease.

## **CHAPTER FIVE: DISCUSSION**

### **5.1 Aged group distribution**

The highest percentage of the youth age group distribution is attributable to the fact that they are the EPWP target group. It is therefore, commonplace that the percentage age group between 37 and 55 years is less compared to that of the youth age group. It was also stated that the youth are more effective in terms of production compared to the adult participants. The obvious reason for teenagers less than 18 years constituting a percentage of only 3 is because this age group is constitutionally forbidden from being employed. It is a criminal offence to employ a child under the age of 15, except in instances where there is a permit from the Department to employ children in the performing arts. Children aged 15 to 18 may not be employed to do work inappropriate for their age or work that places them at risk based on Legislation in Section 43, of the Basic Conditions of Employment Act.

### **5.2 Gender distribution**

The low percentage of females is probably due to the perception that females are not hard workers. It is common knowledge that males were considered as family providers or breadwinners whereas females were considered as domestic workers. Even though the females are one of the EPWP target group, the stigma that comes with females in terms of performances and hard labour limits their appointments in hard labour working environments. This shows that even if there are laws and regulations that serve as guidelines, if the perception is not addressed towards the specific phenomenon, the laws and regulations would not serve any purpose.

### **5.3 Educational level**

The reason behind the poor quality of education is because the area is surrounded by the farmers who hire youths to work in their farms at their early teenage stage. This leads the community to have a large number of less educated people as they would be focusing on getting money for their survival. Most of the people that are working in these areas are youth that were supposed to have been at school and improving their education.

#### **5.4 Position in the household**

The project focuses mainly on people who were previously disadvantaged and it is regarded as one of the projects or programmes from which the surrounding communities derive income. The fact that the project requires an individual member from each family makes the surrounding communities to rely on this project for survival. The child support grant that is offered to the citizens of South Africa is one of the contributing factors on this statistics since youth get impregnated so as to benefit from the child support grant. This leads to a community that is highly comprised of young parents who are also breadwinners at the same time.

#### **5.5 Marital status**

Most of the participants are single parents due to the fact that they have children out of wedlock at the younger age. Therefore, they see having children as crucial to enable them to qualify for child support grant.

#### **5.6 Salary bend**

The reason behind the 65% of participants that earn between R1000 to R2900 is that they are not educated and most of them are general workers. Some of the salaries are supplemented by the child support grant since most of them are single parents with 3 to 4 children. Only few people who are the contractors are the ones who earn between R6000.00 and R10 000, while others are married and have spouses who have better jobs that pay them better salaries. It is therefore obvious that if the child support grant is terminated, most families will struggle to survive.

#### **5.7 Invasive Aline Plant Species distribution**

The main point behind the 55% of the participants indicating that there is successful decrease of the IAPs in the project was due to the decrease in densities in the area that they have worked on. When comparing the first treatment with the follow-up treatment, there are significant differences in terms of infestation.

26% and 3% of participants indicated that there is fair and poor decrease of IAPs respectively as they usually see the IAPs coming back even after the areas have been cleared. They expected not to see any alien invasive plant species to come back after

clearing. Although there are percentages indicating the poor and fair decrease in IAPs, 13% viewed the project as very successful in controlling the IAPs. Looking at the perceptions of the participants, conclusion can be drawn that there is successful decrease in the distribution rate of IAPs in the project.

### **5.8 New infestation**

The new species of IAPs do re-establish or invade open areas as they are opportunists that require areas that are disturbed. These include species such as Bugweed, Caster oil, Bramble and Black wattle.

The analysis discrepancies between 58% and 36% of the participants regarding observations of more and no new species in the cleared areas respectively, might be that one group is less meticulous than the other in their observations or they want the area to be totally free from the IAPs.

### **5.9 The rate of IAPs in the cleared areas**

The difference in analysis between the 19% and 48% of the participants regarding the decreasing and increasing rate of invasion by IAPs is probably due to the fact that the areas cleared are not the same in terms of the environmental factors such as rainfall, soil type and topography. Some of the areas are infested immediately after the clearing while others take some time to be infested after treatment.

The percentage mixtures of the herbicides also play an important role in the clearing of invasive alien plant species. If the plants require 3% of herbicide and the participants mix 2%, it is obvious that the results would be inconsistent.

16% of participants indicated that there is an increase in the rate of the invasive alien plants in the cleared areas and that the handed over areas did go back to their original stages since there were no regular follow-ups.

13% of the participants indicated that there is no increase in the rate of invasive alien plants because they are working on the follow-up areas that decrease after each treatment. The overall analysis presentation shows that the IAPs always resurface after clearing has been done.

### **5.10 The follow-up on the cleared area**

The reason behind the follow-ups being done seasonally is attributed to other plants such as the American bramble that are only active during summer season. Most of the plant species are dormant in such a way that they would not be able to absorb herbicides during winter time. Therefore, the application of herbicides is ineffective during winter.

The other reason that causes the follow ups to be done periodically is that there are some tendering processes that take place in the projects and this leads the project to run very late as they would be waiting for the order numbers. Most of the projects start the tendering processes around April and deliver the orders in August.

12% of the participants were from the Land Use Incentive Projects (LUIs) that were working timeously because they were working on a 3 year contracts. The overall impression shows that the project operates only seasonally and that leads to some of the follow-ups not to be done on time.

### **5.11 Other known uses of IAPs**

Hence, 81% of the participants indicating that they know the other uses of invasive alien plants. Most of these IAPs are used by the communities as fire wood, to make other products (chairs, tables and under plates for decoration), hedges and fencing poles. Other community members use them as other sources of income as they harvest and sell them to other community members as fire wood. This implies that the majority of the communities do not see the IAPs as only invaders, they also see them as the plants that can benefit them.

The other 16% of the participants which indicated that they do not know other uses of IAPs might have focussed on the species such as Bugweed and Caster oil plant which are not commonly used for other products.

### **5.12 The challenges in the project**

Most of the areas in which the project is operating are within the private owned land and it requires permission of the land owner to cooperate. In most instances, land owners are not amenable and are also not willing to conjoin when it comes to clearing invasive alien plant species. Most of them lock their gates to bar the EPWP workers

from entering their farms and also restrain EPWP workers from clearing the IAPs in their properties.

Since EPWP workers are working in the farms where there are products such as fruits, poles and animals, land owners suspect that the participants might be tempted to steal such products. Some land owners depreciate the work that is being done by the participants.

The project budget is cut on a yearly basis and such causes the project to reduce the number of participants or labour force and hence, the areas that have to be worked. Most of the participants are working without the necessary skills or training due to the fairly low budget or funds for training within the project. Therefore, this means that if some landowners do not allow the participants to work on other areas, the problem of invasive alien plants would not be solved since the propagules will be dispersed and cause re-infestation. Working without skills can also cause major discrepancies in the quality of work done.

### **5.13 The benefits of the project**

The fact that 58% of the participants indicated that they are benefitting in terms of jobs, skills and social development is because it is the only project that employs many people in the surrounding communities. Most of the participants are without grade 12 qualifications, so, when they are appointed in the project, they get opportunity to be somehow trained in different fields such as chain saw, first aid, health and safety and peer educator. This gives them opportunities to be appointed by other sectors.

With money they receive from this project, they manage to afford some food, clothes and are able to pay the education fees for their children and their families. This means that even if the project is not able to satisfy all the needs of the participants, it is able to supply them with the basic needs.

### **5.14 Time frame of the project**

The reason behind the work not done every month is that most of the work is done through the tender system. The work only commences after the tender has been awarded and it also has to wait for the order number to come through. The 39% that indicated that they work every month are the ones who are working under the LUIs wherein they work over a period of 3 years. If only 39% of the participants are working

every month, there is no sustainability of the livelihood of the participants in the project. It means that 58% of the participants spend some months without income in their households.

### **5.15 The strategy to be employed**

By looking at the uses of the IAPs, the participants indicated that it is better to use them for other uses that are highlighted elsewhere in this write-up instead of destroying them. Awareness campaigns were highlighted as other means of using them than destroying them. This is because most of the participants use the IPAs for fire wood, roofing and fencing in their homes. Some of the IAPs are used as hedges in the surrounding communities. The most dominant use of IPAs in the surrounding communities is fire wood.

Majority of the participants (90%) indicated that this project should continue since it is their only source of income as they were jobless before the implementation of the project. They also indicated that there should be an increase in the budget of the project to enable them to work permanently.

### **5.16 The Ebenezer dam clearing (Black wattle & Pinus species)**

The Lepelle Waters were not doing any follow-ups on the area after it was handed over, hence the IAPs went back to their original stage as indicated in Figure 4.16(a). The effectiveness of the herbicide on the IAPs have been illustrated in Figure 4.16(b) after the trees were ring-barked and herbicide applied.

The surrounding communities collected fire wood as indicated in figure 4.16(c) in all the dry IAPs and sold them after the areas had been cleared, particularly the Black wattle since it makes a pleasant fire. The area is now free from the IAPs, but there were some seedlings that were seen re- establishing. This shows that the herbicides had been applied correctly and the treatment was done properly. The re-establishment of seedlings is an indication that IAPs require regular follow-up.

### **5.17 Hakea spp in Ebenezer dam**

It is evident that the species did respond well to the treatment that was applied in 2016. Therefore, the invasion or the spread of Hakea spp around the Ebenezer dam was controlled. There was no sign of seedling recruitment in the area (see Figure 4 .17

(b)). There is probably no infestation that may come from *Hakea* spp as they were well controlled.

### **5.18 Bugweed in Ebenezer dam**

Van den Bosch et al. (2014:98) argued that each berry contains approximately 150 to 250 seeds of which 98% are viable. It is this persistent invasive growth and reproduction that ensures the survival of the plant species.

Van den Bosch et al. (2014:101) further on stated that the results similar to this indicate that Bugweed (*Solanum mauritianum*) has potential to be an allelopathic species in the field. Bugweed may use its leaf drop as a possible offence mechanism preventing the establishment of other plant species in a regeneration situation. This was observed in Figure 4.18 (a) that under the Bugweed canopy, there is no other plant species that grew, mainly under the adult Bugweed plants.

It was observed in Figure 4.18 (a) that if these plant species find themselves under favourable condition, they grow exponentially and turn to out-compete others. The other reason that makes these Bugweed species to regenerate is that they were close to the dam as can be seen in Figure 4.18 (c). Therefore, to avoid overgrowing of these plants responsiveness, treatment should be done timeously.

The reason for the branches of Bugweed to remain where the parent plants were treated is that they are of no use to the surrounding communities. Unlike the Black wattle and Eucalyptus species that are used for fire wood, the leaves of Bugweed are only used by farmers. The farmers use them as manure or compost in their cultivated land. After removing the Bugweed plant species in the area, the aesthetic value of the area was restored as one can see the splendour of the area without any obstruction (see Figure 4.18 (c)).

### **5.19 Haenertsburg Primary School**

The Working for Water project teams in Haenertsburg Primary School were doing constant follow-ups, but in the year 2016, there was a delay in the follow-up treatment which led to the over-growing of the Bugweed to its juvenility and adulthood as indicated in Figure 4.19 (e). In 2017, when the teams went back to the site, they found that the area was highly invaded with the Bugweed that was at an adult stage. The area was like a Bugweed plantation.

Therefore, if the IAPs are not given attention at the right time, they end up invading the place and go back to their original state which will also delay the progress in clearing other areas.

### **5.20 Makgoebaskloof area (Richards Farm)**

The Bugweed produces loads of fruits that produce countless seeds and without any treatment done, they grow very fast. The plants are situated in the area that is always misty and moist. This accelerates the growth of this species in such a way that if they are not controlled at the right time, they re-invade and infest the area profusely.

The area in Makgoebaskloof was less invaded during the handing over in 2016, but when visiting the area in 2017, the area was found re-invaded. This was due to lack of maintenance by the landowner. The main reason of the land owners not clearing the areas after handing over is that they are not attaining any yield by clearing the invasive alien plants. The only areas that they focus on is on the ones from which they receive profits.

The government conducts only three operations which are, initial and two follow-up treatments in private owned land or property. After those treatments, the area is handed over to the landowner for upcoming maintenance. Most of the areas that have been handed over are back to the initial stages of infestation since the land owners were not doing anything about clearing of IAPs in those properties. This shows that the invasive alien plant species require routine maintenance. If the areas are not given attention, no matter how clean they are, they get re-invaded by IAPs. The Department of Environmental Affairs must make sure that they facilitate the enforcement in an effective manner to attain the objective of restoring natural forest or vegetation. Based on the discussion above, conclusion can be drawn that Working for Water is not succeeding in controlling invasive alien plant species.

### **5.21 Wolkberg project five years budget (Budget and expenditure)**

Generally, budget allocation pattern for the period of five years was not conducive to a complete control of invasive alien plant species. The budget was cut due to cost cutting measures that were put in place by all government departments including Department of Environmental Affairs. This is due to the mission of the Treasury of

achieving more with less budget. The budget cuts led to reduction in the number of participants that were employed in the project.

### **5.22 Employment for a period of five years**

The fact that there was major variation between planned and actual employment rates is attributable to slow work pace of participants, unfavourable weather conditions such as rainfall which resulted in work stoppages on other days, and under-planning of employment by the manager to achieve daily target. An increase in planned employment in the year 2013 was probably due to planning based on the actual employment that was achieved in 2012.

The delays in receiving the order numbers in the project led to the catch up plans that resulted in achieving employment that was unplanned. Some of the unplanned training in the project such as induction courses led to the number of employment increasing drastically. Since the project does not have provision for permanent jobs, some of the participants leave the project for permanent jobs or positions. This caused the rate of induction training to increase yearly, which led to achievement of more employment.

Even though there was a slight increase on the actual number of the participants that have worked in the project, it was not due to the budget increase. It was due mainly to the funds which were transferred from other projects that were not performing well and also changes in densities of areas that were supposed to be worked on. This means that such employment does not serve a major purpose of enhancing the livelihood of the local communities.

### **5.23 Hectares for the period of five years**

The 2012 – 2014 employment planning was done during the dry season when the invasive alien plant species (IAPs) densities were low. For this reason, it resulted in the project achieving less hectares to what was planned for. The delay in receiving order numbers resulted in the project not achieving all the hectares that were planned for. The increase in the achieved hectares in 2015 and 2016 was due to underestimation of IAPs densities during planning and there was also a catch-up plan that managed to cover the hectares planned and hence, over-achievement.

The planning of the employment in this project did not include the contractors as part of the employment, but when they invoiced, the contractors were included as part of

employment. This was not due to enough funding and more employment, but to the treatment stage that those areas were in. Most of the areas that were being treated were at the late follow-up stages. These late follow-up stages do not need an increase in labour and funds. It therefore, does not mean that the areas that require clearing are no longer there in the project, it only means that WfW is prioritising the follow-ups due to lack of funding. This therefore, implies that if they had enough funding, they would have done more initial treatment to cover other areas that were infested and that would have led to more employment opportunities to the communities.

Most of the area in Wolkberg Project are found in private owned land. In order for the project to operate in the land which is private owned, there should be agreement forms signed by both parties. Most land owners do not want to sign the agreement forms, and this leads to some areas that are full of invasive alien plant species not attended to. Therefore, the IAPs are likely to produce seeds that land in the areas that have been cleared and cause new infestations.

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS**

### **6.1 Conclusion**

The main objective of the study was to determine “Wolkberg Working for Water’s project’s” level of success in controlling invasive alien plant species. Through the analysis of results and discussion thereof, it became clear that the project is not meeting the objectives of the Department.

#### **6.1.1 Current infestation statuses**

All the areas that were visited for field observations had been heavily infested with IAPs in the beginning of the project. After doing the follow-up treatment, the areas became less infested. During the clearing process, most of the areas experienced the establishment of new IAPs which were not part of the original species. All those species were treated chemically in the process and the area therefore became free from invasion.

#### **6.1.2 The attempt by government in controlling the IAPs**

The areas that receive constant maintenance have less invasive alien plant species that are also at seedling stages, for example, the area around the Ebenezer Dam which was cleared during follow-up stages. The area initially had less amount of seedlings of invasive alien plant species, but areas that missed the follow-up stages had high infestation in terms of IAPs.

#### **6.1.3 Sustainability in the livelihood of the surrounding communities**

It was outlined in the discussion that poverty is one of the factors that accelerate the rate of invasive alien plant species in the local communities as most of the community members use IAPs as their fencing materials or wind breakers which influence the spread of seeds to IAPs free areas. By giving the local communities job opportunities, it will aid on reducing the distribution of IAPs as they will understand the impact of IAPs and hence, remove them from their areas.

According to the responses that were elicited from the questionnaires, it shows that there are more males than females working in the project. This project is not achieving

the employment target in terms of EPWP plan. In order to reach the target, the project was supposed to have 60% women and 55% youth. The project did well on youth target. Majority of employees in the project are single parents who are raising three to four children each. The research findings revealed that only few people in the project have higher certificates, whereas majority of the respondents have qualifications that are below grade 12. This shows that local communities are behind educationally which leads to a high birth rate in the community.

The project is doing well by reducing the rate of unemployment since the community can now make ends meet. The participants know that they will generate income at the end of the month even though they do not have a permanent job.

#### **6.1.4 Strategies that could be employed**

By looking at the responses of the participants, it is clear that there is no strategy that can be effective to completely clear the invasive alien plant species in Wolkberg Project. There is need for follow-up to conquer the IAPs. Controlling of invasive alien plants should therefore, be a continuous activity to achieve the aims and goals of the Department of Environmental Affairs. The type of species should be taken into consideration when planning treatment.

## 6.2 Recommendations

South Africa is one of the countries that have good policies and legislation but the only thing that is lacking is effective implementation of those policies and legislations. Therefore, DEA should make sure that all the policies and legislations that are in place are implemented accordingly.

The issue of child labour should be prohibited as children are supposed to be receiving education at school instead of working in the project to make a living. It is a criminal offence to employ children under the age of 15, except in cases where there is a permit from the Department to employ children in the performing arts. Children aged 15 to 18 may not be employed to do work that is inappropriate to their age or work that may place them at risk.

The percentage of female workers must be adjusted to be in line with the EPWP ministerial determination which should be 60% and above. The project should encourage transformation in terms of gender. Females should be accorded more work opportunities since they were previously disadvantaged. The stigma about hard labour being for males should be removed from the minds of the people.

Youth should be encouraged to further their studies in order to get good job opportunities that may enable them to earn better salaries to ensure that they can sustain their lives since projects like WFW are not permanent and are more likely to change over time.

In order for the project to sustain the livelihood of the local communities and the experienced participants, it has to run throughout the year instead of 3-4 months. This will allow the project to retain the employees since they will be guaranteed their jobs.

In order for the project to be effective, it will require DEA through Working for Water Programme to increase the project budget in order to retain the workers. This will enable the project to run throughout the year without ceasing. The more the project is operating, the slimmer the chances of the workers leaving the project.

More training should be given on the use of the invasive alien plant species to enable the local communities to make use of them in order to produce their own goods. Local

communities should be given enough support from the relevant departments that deal with trade and industry. The products should have their own supply markets.

The species identification should be a priority starting from the officials to the workers as well as the surrounding communities in order to identify the relevant species to be cleared. It was supposed to be done as a prerequisite for each worker prior to commencement of the project.

The officials should be provided with the density classifications course in order for them to produce the infestation status that is accurate. This will assist in terms of planning for their working days as well as the number of workers or units per hectare that will be working in a specific area.

The courses or training that are offered to the workers should be accredited and should be market-based to give workers opportunities to advance. This will enable them to have the chance of being appointed not only by Working for Water Programme, but by other organizations as well.

Follow-ups should be conducted regularly and on time to ensure that no treatment stage is lost due to undue delay. The follow-ups should be done timeously. All the treatment should be done according to the time schedule on the Annual Plan of Operation (APO).

The department should avoid the clearing of invasive alien plant species when the plants already have seeds since those seeds will be adding on the seed bank. It means that clearing should be done at the early stage of plant species development.

Training of workers should be done in due time and it should be relevant to the type of operation to yield good results. Treatment methods should conform to the size and type of plant species treated.

The issuing of the order numbers in the Working for Water contracting teams should be done at the beginning of each financial year to avoid undue delays in operation that may lead to work not done on the correct time and stage.

The follow-ups should be done on all the areas that have been handed over to the land owners. This will require the compliance and enforcement teams to do their duties

on the handed-over areas. All the plantations that deal with invasive alien plant species should make sure that they control the spread of the seeds outside their areas of demarcation. This means that duty of care should be applied to any land-users given that “you infest you clear”.

The Department of Environmental Affairs should give priority to quality assessment and verification. They should make sure that 1<sup>st</sup> Party and 2<sup>nd</sup> Party quality assessments and verifications are done to check if the work is implemented according to specifications (norms and standards) of Working for Water Programme.

The Department of Environmental Affairs should engage the communities in raising awareness such as Weed Buster and Arbor Week. The communities should take ownership of those events to make sure that they implement the strategies. The communities should be educated on the different uses of invasive alien plant species. The Department of Environmental Affairs should not focus much on the attendance of the officials from other departments and neglect the key stakeholders which are the local communities and the traditional leaders.

The use of LUIs in the programme should focus on the priority areas such as rivers, dams, forests, catchments and other areas of specific significance. Most of the LUIs focuses on the areas that are planted and not a priority. These LUIs perform the weeding that include clearing of indigenous plants which are inside the plantations.

Looking at the research findings on the control strategies of IAPs such as awareness campaigns amongst others, it can be recommended that it is better to adopt control strategies that are useful to local communities. Therefore, IPAs, like bush encroachment, should be controlled.

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## APPENDIX

### Annexure 1: Written consent

FILE MESSAGE Re: masters research in Wolkberg Project - Message (HTML)

Thu 2017-09-21 11:59 AM  
Warner Roux  
Re: masters research in Wolkberg Project  
To: Sydwell Matsila  
Cc: Tiribeele Ndlovu; Innocent Ntshahakoboko; Percy Zaubert

Hi Sydwell, as discussed telephonically it won't be a problem and you can facilitate the process and research.

Kind Regards,

On 21 Sep 2017, at 10:53, Sydwell Matsila <[SMatsila@environment.gov.za](mailto:SMatsila@environment.gov.za)> wrote:

Good day

I want to inform you about the research that am doing in the Wolkberg project. I am in need of your consent regarding the access of the information about the project. I will require the participants to complete the questionnaire as well as getting some information regarding the budget, hectares, person days and training from the office.

My initial plan was to get the information from 8 teams but now Wolkberg is left with 4 teams. If possible I would like to use some participants from HADEF for questionnaires. I would like those questionnaires to be completed by 32 participants. 4 participants from each team which is 2 males and 2 females from each team.

Your cooperation will be highly appreciated.

Matsila Sydwell  
Department of Environmental Affairs  
IMSC: QUALITY MANAGEMENT  
Cell no: 082 940 7413  
Fax no: 086 537 9114

Please consider the environment before you print this email. Only print if it is essential. A message from the Department of Environmental Affairs.  
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Matsila Sydwell  
Department of Environmental Affairs  
IMSC: QUALITY MANAGEMENT  
Cell no: 082 940 7413  
Fax no: 086 537 9114

## Annexure 2: Questionnaire

### APPENDIX: A. QUESTIONNAIRE

This questionnaire is meant for academic purpose. Information (data) acquired will not be used for any other purpose. The intended participants are the residents of Haenertsburg area, Segwashe and Spitzkop in the Greater Tzaneen Municipality. All the information will be treated with confidentiality.

### INSTRUCTIONS

Answer all the questions.

Please choose and put a cross against your answer.

Gender

a) Male	
b) Female	

### Annexure A: Personal Information

1. Under which age group do you belong?

a) Less than 18 years	
b) 18 – 36 years	
c) 37 -55 years	
d) 56 – 65 years	
e) Above 65 years	

2. What is your nationality?

a) South African	
b) Other, Specify .....	

3. What is your highest educational level achieved?

a) Below Grade 12	
b) Grade 12	
c) Higher certificate	
c) Diploma	
d) Post Graduate diploma	
e) Degree	

4. What is your position in the household?

a) Bread winner	
b) Parent	
c) Child	
d) Just a member	

5. What kind of family do you live in?

a) Traditionally extended	
b) Modern household	
c) Mixed family	

6. What is your marital status

a) Married	
b) Divorced	
c) Widowed	
d) Single	
e) Separated	

7. How many dependents do you have?

a) 1-3	
b) 4-6	
c) 7-10	
d) 11-13	
e) None	

8. What kind of occupation do you do?

a) Unemployed	
b) General labourer	
c) Public servant	
d) Professional	
e) Self employed	
f) House keeper	
g) Other, please specify.....	

9. Under which salary bracket do you belong?

a) Below R1 000	
b) R1 000-R2 900	
c) R3 000-R5 900	
d) R6 000-R9 900	
e) R10 000 and Above	

## Annexure B: Research question

### SECTION B:

The overall objective of this section is to determine the success and the challenges in controlling Invasive Alien Plants species (IAPs) at Wolkberg project in Greater Tzaneen municipality.

1. How many Invasive Alien Plants Species do you know?

a) 1-5 species	
b) 6-10 species	
C) 0 species	

2. Which of the following invasive alien plant species are dominating Wolkberg? Please indicate by putting a number next to the species ranging from 1-5(1- most dominant, 2 more dominant, 3 dominant , 4 less dominant and 5 very less)

a) Wattle	
b) Bramble	
c) Eucalyptus	
d) Pine species	
e) Bugweed	

3. When did the project start in Wolkberg?

a) 5 years	
b) 10 years	
c) 20 years	
d) More than 20 years	

4. Is there any decrease in the density of Invasive Alien Plants since the project started?

a) Very successful	
b) Successful	
c) Fair	
d) Poor	

5. Are there new species that occur after you have cleared?

a) Yes	
b) No	

6. How is the rate of the invasive alien plant species increasing in the cleared area?

a) Assured	
b) Often	
c) Seldom	
d) None	

7. How soon are the re-occurrence species attended?

a) Immediately	
b) Periodically	
c) Seasonal	
d) Irregular	

8. Are there any other use of IAPs that you know of?

a) Yes	
b) No	

9. Who are the main stakeholders?

a) Land owners	
b) Municipality	
c) Traditional council	
d) Other departments	
e) Local communities	

10. How do you rate the landowners' corporations?

a) Very good	
b) Good	
c) Fair	
d) Poor	

11. What are the challenges that you come across in the project?

a) Training	
b) Landowner	
c) Funding	
d) Capacity	
e) All of the above	

12. What benefits do the project bring to the community?

a) Job opportunity	
b) Skills development	
c) Social development	
d) All of the above	

13. How often do you work in this project?

a) Every month	
b) Contracts	

c) Once in 6 months	
d) Once in a year	

14. Who are the people who receive most trainings in the team?

a) Contractor	
b) First aider	
c) Health & safety rep	
d) Peer educator	
e) General worker	
f) All of the above	

15. What kind of skills are offered?

a) Herbicide	
b) Health and safety	
c) First aid	
d) Peer education	
e) All of the above	
f) Other specify _____	

16. What other strategies do you think can be employed in this project?

a) Adopting alien invasive plants as our own plants	
b) Destroying them	
c) Utilising them for other product	
d) Licencing	
e) Awareness	
f) None of the above	

17. What do you think is the reasons for continuing with this project?

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18. In your opinion, what do you think could be done to make this project a success?

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### Annexure 3: Answers from Participants

QUESTION	THE PARTICIPANTS															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
GENDER	B	B	B	B	A	A	B	A	A	A	B	A	B	A	A	A
AGE	B	C	C	B	B	B	B	B	B	C	B	B	A	B	B	B
NATIONALITY	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
HIGHEST GRADE	C	A	A	B	A	A	A	A	C	A	A	A	A	A	B	B
POSITION IN THE HOUSE HOLD	A	B	B	A	A	B	B	A	C	A	A	A	A	D	C	B
TYPE OF FAMILY	C	A	B	C	A	C	A	A	D	B	C	C	C	A	A	A
MARITAL STATUS	D	D	A	D	D	D	D	D	B	D	D	D	D	D	D	D
DEPENDENTS	C	B	B	C	B	A	B	C	B	A	D	D	B	E	E	A
OCCUPATION	B	B	B	B	B	B	B	B	B	A	B	B	B	B	B	G
SLARY LEVEL	C	B	B	B	B	C	B	B	B	B	C	B	B	E	B	B
HOW MANY IAPS DO YOU KNOW	B	B	B	B	B	B	B	B	A	B	B	B	B	A	B	A
THE DOMINANTS SPECIES	D	D	D	D	D	D	D	D	D	D	D	D	D	A		B
WHEN WAS THE PROJECT START	B	B	B	B	B	A	B	B	A	B	B	B	B	B	B	C
IS THERE ANY DECREASE IN AIPS	B	B	B	B	B	A	B	B	A	B	B	B	B	B	B	C
ARE THE NEW SPECEIS	A	A	A	A	A	B	A	A	A	A	B	A	A	A	D	A
THE RATE OF IAPS	B	C	B	B	B	B	B	B	B	A	B	B	B	A	C	A
WHEN IS FOLLOW-UP DONE	C	C	C	B	B	B	B	B	B	B	C	C	C	B	C	A
ARE THE ANY OTHER IAPS THAT YOU KNOW	A	A	A	A	A	A	A	A	A	A	B	A	A	A	B	B
WHO ARE THE MAIN STAKE HOLDERS	E	E	A	E	E	E	E	E	A	E	E	E	E	E	B	B
HOW DO YOU RATE LAND OWNERS	B	A	C	B	B	A	B	B	B	B	B	B	B	B	D	D

THE PARTICIPANTS																	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
OCCUPATION	B	B	B	B	B	B	B	B	B	A	B	B	B	B	B	G	G
SLARY LEVEL	C	B	B	B	B	C	B	B	B	B	B	C	B	B	E	B	B
HOW MANY IAPS DO YOU KNOW	B	B	B	B	B	B	B	B	A	B	B	B	B	B	A	B	A
THE DOMINANTS SPECIES	D	D	D	D	D	D	D	D	D	D	D	D	D	A		B	
WHEN WAS THE PROJECT START	B	B	B	B	B	A	B	B	A	B	B	B	B	B	B	B	C
IS THERE ANY DECREASE IN AIPS	B	B	B	B	B	A	B	B	A	B	B	B	B	B	B	C	D
ARE THE NEW SPECEIS	A	A	A	A	A	B	A	A	A	A	B	A	A	A	D	A	A
THE RATE OF IAPS	B	C	B	B	B	B	B	B	B	A	B	B	B	B	A	C	A
WHEN IS FOLLOW-UP DONE	C	C	C	B	B	B	B	B	B	B	B	C	C	C	B	C	A
ARE THE ANY OTHER IAPS THAT YOU KNOW	A	A	A	A	A	A	A	A	A	A	B	A	A	A	B	B	B
WHO ARE THE MAIN STAKE HOLDERS	E	E	A	E	E	E	E	E	A	E	E	E	E	E	B	B	D
HOW DO YOU RATE LAND OWNERS	B	A	C	B	B	A	B	B	B	B	B	B	B	B	B	D	D
WHAT ARE YOUR CHALLENGES	B	C	B	B	B	A	A	B	B	B	B	B	B	C	E	E	E
WHAT ARE YOUR BENEFITS	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	A
HOW OFTEN DO YOU WORK IN THIS PROJECT	A	A	A	A	A	B	A	A	A	B	A	A	A	A	D	D	D
WHO RECEIVED TRAINING MOSTLY	F	F	F	F	F	F	F	F	F	F	F	F	F	F	A	A	A
WHAT KIND OF SKILLS ARE OFFERED	E	E	E	E	E	E	E	E	E	E	E	E	E	E	A	F	E
THE STRATEGY THAT CAN WORK	C	C	C	C	B	C	B	C	C	C	C	C	C	C	B	B	B

A	A	A	D	C	B	B	B	C	C	C		B	B	A	B	C	B		A	
C	C	C	A	A	A	A	B	B	B	B	A	A	B	B	B	A	B	B	A	
D	D	D	D	D	A	D	D	D	D	A	D	D	E	D	D	D	A	D		
D	D	B	E	E	A	A	A	A	A	A	B	A		A	A	E	E	B	B	
B	B	B	B	G	G	E	A	A	A	A	E	G	B	A	B	B	B	E	A	
C	B	B	E	B	B	C	B	A	A	B	D	B	B	B	A	B	C	A		
B	B	B	A	B	A	B	A	A	B	A	B	B	B	A	B	B	B	B		
D	D	D	A	B	A	B		B	A											
B	B	B		B	C	D	B	D	B	B	B	B	A	A	A	A		B		
B	B	B	B	C	D	C	C	B	C	C	C	B	A	B	B	A	C	C		
A	A	A	D	A	A	A	A	A	A	A	A	A	A	A	A					
B	B	B	A	C	A	A	C	B	C	C	C	D	D	A	B	D	D		B	
C	C	C	B	C	A	A	C	C	C	C	C	A	B	A	B	B	B		C	
A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A		A	
E	E	E	B	B	D	B			A	A		A	A	A	A	A	A		A	
B	B	B	B	D	D	D		A	B	A	B	A	A	B	C	C		B		
B	B	B	C	E	E	E			C	C	C	D	A	C	A	C	C	B		C
D	D	D	D	D	A	A	C	C	C	C		B	B	B	D	B	B		B	
A	A	A	D	D	D	D	D	D	D	D	D	B	B	B	D	B	B		D	
F	F	F	A	A	A	A					F	F	C	F	F	F		A		
E	E	E	A	F	E	E					C	E	B	E	E	E		E		
C	C	C	B	B	B	B	C	E		C	C	B	E	B	E	E		E		

### Annexure 4: Participants registers

**Roll call for Participation in research questionnaire in Wolkberg Project**

Name	Position	Contact no	E-mail address	Signature
MACWALE M GRACE	TEAM LEADER	0791026782		[Signature]
SEWAPÉ JUY	First Aider	072 055 1090		[Signature]
Moswedi I K	Health Safety	076176 1210		[Signature]
Mogore Anna	First Aider	076 842 8179		[Signature]
Jimmy Mehlapo	First Aider	0720503426		[Signature]
John Macwale	Team Leader	0760797972		[Signature]
<del>Thabane Phisoane</del>	<del>Peer Educator</del>	<del>0721505453</del>		<del>[Signature]</del>
Kgashane Peter	Peer educator	081 8898950		[Signature]
MATHEWS MABOKA	Team leader	0795979400		[Signature]
Michael Mambela	Health Safety	072 4083672		[Signature]
Frank (P) Makoto Lu	First Aider	0764323155		[Signature]
Rosece Mathusi	Team Leader	0761897290		[Signature]
Isaac Letsosalo	Health Safety	0829555707		[Signature]

**Roll call for Participation in research questionnaire in Wolkberg Project**

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Letsosalo Dantla	Contractor	0769867715	-	[Signature]
Letsosalo N.K	P.E	0721377922	-	[Signature]
Mogashoa Msara	G.W	0763264954	-	[Signature]
KWATINA LIDA	FIA	0766835274	-	[Signature]
ANJAH RAMPOTSWA	P.E	0609018753	-	[Signature]
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Mangobole Sarah	G.W	072 390 217	-	[Signature]
John Mehlapo	P.E	076 1304233	-	[Signature]

### Roll call for Participation in research questionnaire in Wolkberg Project

Name	Position	Contact no	E-mail address	Signature
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John Mablo	Yeer Educator	07127989962	N/A	[Signature]
Solly Bopape	General worker	0827664110	N/A	[Signature]