Ethnobotanical survey of problem weeds, alien invasive plant species and their roles in Nzhelele, Makhado Local Municipality, Limpopo Province, South Africa.

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Submitted in fulfillment of the requirements for the degree of

Master of Science (**Botany)**

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Declaration

I, **Luambo Jeffrey Ramarumo** of student number: **11575297** (UNIVEN), declare that the dissertation on **Ethnobotanical survey of problem weeds, alien invasive plant species and their roles in Nzhelele, Makhado Local Municipality, Limpopo Province, South Africa,** submitted for the purpose of Master of Science (Botany) degree at the University of Venda is my own original work and has not been submitted for any degree at this or any other Institution of Higher Learning, in South Africa or elsewhere. This dissertation does not contain other scholar's writings except where otherwise stated and referenced accordingly.

Student Signature:……..…….. Date:……..……July 2017

Mr Luambo Jeffrey Ramarumo (11575297)

Dedications

This work is dedicated to two (2) sophisticated gurus whom by then used their philosophical potential to uncover the hidden eager. The University of Venda, Department of Zoology, retired Professor, Dr Ben van der Waal – the man who discovered my research interest. "*The greatest way to envisage your future is to construct it*". And also to the University of Venda, Department of Botany, the late Professor, Bhat Ramakrishna – the man who has invigorated and shaped my research eager. "*Courage is not a lack of anxiety, hence it is the ability to act while facing anxiety*", may his soul rest in peace.

Acknowledgements

Several people have tirelessly contributed in different levels of responsibilities for the synergistic production of this work. First and primarily, I profoundly want to acknowledge Almighty God "*Ṅwali Mudzimu wa Vhavenḓa*" for granting me with life; wisdom and strength to accomplish this project. In Him I believed that wetlands destruction is such an evil, "*Can the rush grow without mire? Can the flag grow without water? Whilst it is yet in his greenness, & not cut down, it withereth before any other herb*" (Job 8: 11 – 12).

I want to convey my thankfulness to my supervisors, Dr N.A. Masevhe and Prof. M.P. Tshisikhawe for their substantive guidance, passion, support and constructive suggestions over the journey of this project.

I would like to direct my indebtedness to all the informants who participated in this study. For whom without them, the research challenges might not have been overcomed. I would also like to acknowledge the traditional leadership ("*mahosi*"), his majesty, Thovhele (Senior chief) "*Muthu-ha-thoṅwi*" Ravele of the Mauluma jurisdiction and his majesty, Khosi (Chief) vho–Magadani of the Matshavhawe jurisdiction, for their perfect vision in this project and for permitting this project to be undertaken within their respective villages "*Thovhele nga vha lalame"*.

My deepest appreciation goes to the Department of Science and Technology (DST) – National Research Foundation (NRF), Centre for Indigenous Knowledge Systems (CIKS) at the University of Kwazulu-Natal and also Green Empire Biodiversity and Environmental Health Consultant (Pty) Limited for financial support. I would love to acknowledge the university of Venda especially, the work study program for the generous financial support. The Department of Botany was also acknowledged, for allowing this research project to proceed.

Most of all, I would sincerely like to acknowledge my brother, Mr Lufuno Justice Ramarumo for his transportation and tirelessly assistance during the survey. I would also like to pass my profound gratitude to Ms Livhuwani Mabada for her significant role in organizing community meetings.

My heartfelt gratitude is directed to my daughter, Ms Unarine Ramarumo for her understanding over the journey of accomplishing this work. For her I believed she will follow on my footstep. My deepest appreciations goes to my parents, Mr Luambo Michael Ramarumo and Mrs Beyi Florence Sekgobela-Ramarumo (Traditional Healer), for their substantial contributions during identification of alien plant species, guidance, moral support and financial assistance over the journey of this project.

Abstract

Background: Problem plants and alien invasive weed species are part of today's ecological transformation. Ethnobotanical literature on ecological prominence and ethical values of problem alien weeds is scant and should be documented to avoid loss of valuable species.

Aim: The study was aimed at documenting problem weeds and alien invasive plant species considered to be beneficial in deep rural communities.

Materials and method: Purposeful triangulation research methods were used to ensure the proper gathering of both qualitative and quantitative data sets.

Results and conclusion: Some problem weeds and alien invasive plant species are being utilized by local people to maintain their livelihood. A total of 78 plant species from 33 families were recorded. These plant species belonged to diverse growth habits, namely: climbers, herbaceous, succulents, shrubs, trees as well as creepers. Recorded problem weeds and alien invasive plant species were contributing towards ecological, medicinal and social values. These included being utilized as a source of food (14), fruits (4), medicinal (31), ornamentals (7), firewood (3), social (2) and multiple purposes (17). The main utilized families were Asteraceae (14.1%) and Solanaceae (14.1%). These families were mostly utilized for the purpose of medicinal and food. Plant species that were widely used are as follows: *Achyrathes aspera* L., *Agave sisalana* L., *Amaranthus spinosus* L., *Anredera cordifolia* L., *Canna indica* L., *Centella asiatica* L., *Chenopodium album* L., *Chenopodium ambrosioides* L. and *Chromolaena odorata* (L.) R. M. King and H. Rob. The dominant category for problem weeds and alien invasive plant species was 1b (44%) followed by weeds (35%), category 2 (9%), invaders (5%), category 3 (4%) and 1% for both category 1, 1a as well as X3. The results revealed that the legislative listing of plant species as problem weeds and alien invasive species was based on single knowledge basis system, rather than on multi-dimensional knowledge systems. Therefore, this study recommended that for judgment to be considered in decision-making, it should be based on species-specificity as well as multi-dimensional-knowledge basis. The reconciliation of inherent grapples among scientific and indigenous knowledge systems could possibly be underpinned by equal legislative consideration for the aforementioned knowledge systems especially in the establishment and implementation of environmental regulations. This could also aid with the provision to support transformation in South Africa and worldwide.

Key words: *Ethnobotanical, Alien invasive species, Indigenous knowledge, Problem weeds and Scientific knowledge.*

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List of abbreviations

Ca – Calcium

CARA – Conservation of Agricultural Resource Act

Cu – Copper

Fig - Figure

Mg – Magnesium

NEMBA – National Environmental Management: Biodiversity Act

PRA – Participatory Rural Appraisal

RSA – Republic of South Africa

SA – South Africa

SADEC – Southern African Development and Economic Community

Spp – Species

STI – Sexual Transmitted Infections

TB - Tuberculosis

UN – United Nations

Chapter One

1. Introduction.

1.1. Thematic background.

Problem weeds and alien invasive plant species can alter the ecosystem on both the ecological and social level, therefore, the alteration effects can be less negative than undesirable effects (Vitule *et al.*, 2012). There has been no detailed quantitative evaluation for negative alteration of problem weeds and alien invasive plant spp worldwide (Molnar *et al*., 2008). It is, therefore appreciated that some problem weeds and alien invasive plant spp are beneficial to both ecological and social level (Vitule *et al.*, 2012). Problem weeds and alien invasive plant spp are part of today's ecological transformation (Tassin and Kull, 2015). The functionality of the ecosystem and its biodiversity increases with the rapid spread and impact of alien invasive weeds (Rejmánek and Richardson, 2013).

Some problem weeds and alien invasive plant spp are of economic prominence and they aid with the provision of approximately 98% of global food supply (Pimentel *et al*., 2001). Many problem weeds and alien invasive plant spp could contribute significantly in restoring degraded ecological processes within the ecosystem (Funk *et al.,* 2008), and they can be a prominent tool in preventing invasion of higher degree as well as maintaining their aggressive spread (Jiménez–Valverd *et al*., 2011). Problem exotic plant spp could also contribute to cultural services and aesthetics (Prévot–Julliard *et al.,* 2011). It is possible that the numerous diversity of problem weeds and alien invasive plant spp increases in response to the environmental modifications (Maskell *et al.*, 2006), which have displaced the intolerance of native plants.

According to Flory and Bauer (2014), alien invasive weeds can reduce the predation of native plant species by facilitating across the trophic level and as food for herbivores and they can maintain ecosystem services (Tassin and Kull, 2015). Biological invasions are regarded as one of the main causes of biodiversity loss (García-Llorente *et al*., 2011). The eradication of problem weeds and alien invasive plant spp without considering their potential role within the ecosystem can be devastating since it could open gaps for other invaders to degrade the niches (Zavaleta *et al.,* 2001). The elimination of problem weeds and alien invasive plant spp that subsidize either social or ecological livelihood could greatly impact their wellbeing and reduce the functionality of ecological integrity (Pienkowski *et al.*, 2015).

1.2. Problem statement.

The justification for action against invasive problem plants has been invoked (Carruthers *et al*., 2011), and therefore, it does not include biocentrism and ethical reservations. Ethnobotanical literature about the ecological prominence and ethical values regarding problem weeds and alien invasive spp is scant and it should be documented to avoid loss of valuable plant spp (Semenya *et al.*, 2013). Most South African scholars paid great attention to the negativity and impact posed by problem weeds and alien invasive plant spp to environmental biodiversity and therefore, the potential benefits of these spp never received enough considerations (Pienkowski *et al.*, 2015). Too many plant spp were been declared weeds, alien invasive spp, problematic plant spp and unwanted plant spp, under Regulation 15 of the South African, Conservation of Agricultural Resource Act, Act 43 of 1983 (CARA) and Section 70 (1)(A) of the National Environmental Management: Biodiversity Act, Act 10 of 2004 (NEMBA), without considering folk knowledge, ethical beliefs and their ecological role. In South Africa there is an inherent grapples as well as controversial issues about problem weeds and alien invasive plant spp that are ethically important; commercially benefiting, ecological prominent and environmental altering (Carruthers *et al*., 2011).

1.3. Justification of the study.

Conducting this study was important to both traditional knowledge holders and scientific experts, since it could aid with the provision of mitigations on the existing grapples and controversial issues. This study could expand the understanding of problem weeds and alien invasive plant spp. This could also contribute prominently by providing the convenient insight information for both natural scientists, social scientists, traditional knowledge holders and policy makers (Carruthers *et al*., 2011). Nowadays dwellers, in rural communities are moving from subsistence way of living to the economic kind of lifestyle. Thus, this study could lead to the establishment of green-economy by disclosing alien invasive plant spp of high socio-economic and medicinal values to meet the livelihoods of previously disadvantaged people. This study is crucially relevant at this moment of economic collapse-down in South Africa (SA), since it could possibly lead to the reduction of government budget allocated for the elimination of problem weeds and alien invasive plant spp by exposing the economic importance, social uses and ecological roles of these spp.

1.4. Research aim.

The aim of the study was to make an inventory of some valuable, problem weeds and alien invasive plant spp used by the Vhavenda tribe in Nzhelele Region, Vhembe District, Limpopo Province, South Africa.

1.5. Main objective.

The main objective of this project was to ascertain and document information on social, ecological and economic uses of problem weeds and alien invasive plant spp.

1.6. Specific objectives.

The specific objectives of the study were as follows:

i. To acquire and document information on valuable problem weeds and alien invasive plant spp.
ii. To record the traditional uses of problem weeds and alien invasive plant spp.
iii. To resolve the inherent grapples and controversial issues between scientific fundamental and traditional views with regard to some declared plant species as problem weeds, unwanted plants and alien invasive plant spp.
iv. To provide possible mitigations that could promote the sustainable use of problem weeds and alien invasive spp.

1.7. Research hypotheses.

1.7.1. Null hypothesis.

Some problem weeds and alien invasive plant spp are not valuable and could not be considered as having economic, social and ecological benefits to rural communities.

1.7.2 Alternative hypothesis.

Some problem weeds and alien invasive plant spp are valuable and could be considered as having economic, social and ecological benefits to rural communities.

1.8. Research questions.

i. Do problem weeds and alien invasive plant spp contribute to the socio-economic upliftment of rural communities?
ii. Do traditional healers prefer the use of problem weeds and alien invasive plant spp's remedies in the treatment of variety of ailments?
iii. Does the CARA or NEMBA regulations for listed problem weeds and alien invasive plant spp recognize the needs of dwellers in rural communities?

1.9. Project organization.

(a) Chapter one and two deal with the introduction and literature review respectively.
(b) Chapter three provide methodology of the project.
(c) Chapter four and five have been written in the form of manuscripts, there may be repetition of some aspects.
(d) Chapter six (6) provides an overall conclusive statement of the entire project.

1.10. References.

Carruthers, J., Robin, L., Hattingh, J. P., Kull, C. A., Rangan, H. and van Wilgen, B. W., 2011. A native at home and abroad: the history, politics, ethics and aesthetics of acacias. *A Journal of Conservation Biogeography,* **17: 810 – 821.**

Flory, S. L. and Bauer, J. T., 2014. Experimental evidence for indirect facilitation among invasive plants. *Journal of Ecology,* **102: 12 – 18.**

Funk, J. L., Clenland, E. E., Suding, K. N. and Zavaleta, E. S., 2008. Restoration through reassembly plant traits and invasion resistance. *Trends in Ecology and Evolution,* **23 (12): 695 – 703.**

Garía-Llorente, M., Martín-López, B., Nunes, P. A. L. D., Gonza-lez, J. A., Alcorlo, P. and Momtes, C., 2011. Analyzing the social factors that influence willingness to pay for invasive alien species management under two different strategies: Eradication and prevention. *Environmental Management,* **48: 418 – 435.**

Jiménez–Valverd, A., Peterson, A. T., Soberón, J., O' Verton, J. M., Aragón, P. and Lóbo, J. M., 2011. Use of niche model in invasive species risk assessments. *Biological Invasions,* **13 (12): 2785 – 2797.**

Maskell, L. C., Firbank, L. G., Thompson, K., Bullock, J. M. and Smart, S. M., 2006. Interaction between non–native plant species and floristic composition of common habitats. *Journal of Ecology,* **94: 1052 – 1060.**

Molnar, J. L., Gamboa, R. L., Revenga, C. and Spalding, M. D., 2008. Assessing the global threat of invasive species to marine biodiversity. *Frontiers in Ecology and the Environment,* **6: 485 – 492.**

Pienkowski, T., William, S., Mcleren, K., Wilson, B., and Heckey, N., 2015. Alien invasions and livelihoods: Economic benefits of invasive Australian Red Claw cryfish in Jamica. *Ecological Economics,* **112: 68 – 77.**

Pimentel, D., McNair, S., Janecka, J., Wightman, J., Simmonds, C., O' Connell, C., Wong, E., Russel, L., Zern, J., Aquino, T. and Tsomondo, T., 2001. Economic and environmental threats of alien plant, animal and microbe invasions. *Agricultural, Ecosystem and Environment,* **84: 1 – 20.**

Prévot-Julliard, A. C., Clavel, J., Teillac-Deschamps, P. and Julliard, R., 2011. The need for flexibility in conservation practices: exotic species as an example. *Environmental Management*, **47 (3): 315 – 321.**

Rejmánek, M. and Richardson, D. M., 2013. Tree and shrubs as invasive alien species – 2013 update of the global database. *A Journal of Conservation Biogeography,* **19 (8): 1093 – 1094.**

Semenya, S. S., Potgieter, M. J. and Erasmus, L. J. C., 2013. Exotic and indigenous problem plants species used, by the Bapedi, to treat sexually transmitted infections in Limpopo Province, South Africa. *African Health Science,* **3 (2): 320 – 326.**

Tassin, J. and Kull, C. A., 2015. Facing the broader dimensions of biological invasions. *Land use Policy,* **42: 165 – 169.**

Vitule, J. R. S., Freire, C. A., Vazquez, D. P., Nunez, M. A., and Simberloff, D. 2012. Revisiting the Potential Conservation Value of Non – Native Species. *Conservation Biology,* **26 (6): 1153 – 1155.**

Zavaleta, E. S., Hobbs, R. J. and Mooney, H. A., 2001. Viewing invasive species removal in a whole-ecosystem context. *Trends in Ecology and Evolution,* **16 (8): 454 – 459.**

Chapter Two

2. Literature review.

2.1. General overview.

It is evident that problem weeds and alien invasive plant spp negatively modify the natural ecosystem (Obiri, 2011). The integral role of plants, regardless of their invasion or exotic status can be viewed best from being pioneering, restoring and reshaping the natural ecosystem better (Sax *et al*., 2007). The introduction of problem weeds and alien invasive plant spp has been occurring since the 17thcentury as a result of development of human settlement and migration of people (Baret *et al*., 2006). The aggressiveness of the problem weeds and alien invasive plant spp towards native plants within the same niche area can be viewed through competition for resources such as sunlight, water and nutrients (Worku, 2010). The generalist survival mode of problem weeds and alien invasive plant spp enabled them to take advantage of any environmental condition and out-competed the native plants within the niche area (Obiri, 2011). The invasion of problem weeds occurs in many different stages within niche areas and those stages include introduction, naturalization and rapid distribution (Maroyi, 2012).

2.2. Geographical distribution of problem weeds and alien invasive plant species.

The main challenge of the global community today is biological invasion and its implications and the distribution of alien invasive weeds even today is not yet restricted (Semenya *et al.*, 2012a). Problem weeds and alien invasive plant spp are widely spread in South Africa and worldwide due to rapid increases of international tourism (Semenya *et al.,* 2013a). The distribution of some problem weeds and alien invasive plant spp occurred accidentally (Riaz and Javaid, 2011), and their rapid spread has been due to natural disasters (Holmes *et al.,* 2008). The spread of problem weeds and alien invasive plant spp worldwide is being altered by global warming and change in climate (Prévot–Julliard *et al*., 2011). Distribution of exotic alien spp in protected areas such as in national parks might be due to wind, wildlife, human beings or water (Maroyi, 2012). Despite the fact that dispersal of alien species is not necessarily due to human activities (Valéry *et al*., 2009), human disturbance is still widely known to be the major factor in the alteration of invasion by problem weeds and alien invasive plant spp (Semenya *et al*., 2012b). Global climatic change such as floods, high temperature, and high concentration of carbon dioxide emissions in the atmosphere influence the occurrence of invasion by problem weed spp (Bradley *et al.,* 2010).

2.3. Ethical beliefs towards the use of problem weeds and alien invasive plant species.

In South Africa the majority of people still prefer to use medicinal plants (Thring and Weitz, 2006), as another way of accessing primary health care, and some of these plant spp used

are alien invasive plant spp. Human-beings mostly depend on plants regardless of their invasiveness or nativeness status, for various purposes such as traditional medicine, food, shelters, aesthetic as well as cultural identity (Semenya *et al*., 2012a). There has been existing conflicts of interest in terms of plant spp that have value to some local communities, but regarded as problem weeds and alien invasive plant spp by either South African Conservation of Agricultural Resources Act (CARA) (Dold and Cocks, 2000) or National Environmental Management: Biodiversity Act (NEMBA). Problem weeds and alien invasive plant spp have been considered the most regularly used plant spp (de Wet *et al*., 2010) in rural communities. About 2942 medicinal plants found in Southern Africa are being used in the treatment of various human diseases and thus diversity, signifies valuable resources, not only for the commercial purpose or development, but for the basic studies, cultural values as well as intrinsic values (van Wyk, 2008).

The use of both aliens, invasive spp and native plant spp for medicinal purpose has demonstrated African traditional healing as both static, vigorous and adaptive (Dold and Cocks, 2000). Most of the remedies, especially aliens invasives are considered as general health tonics and are used to treat various diseases (van Wyk *et al*., 2008). Some alien invasive spp are beneficial and provide more than 98% of the world's food supply (Pimentel *et al.,* 2001). It has been revealed that invasive spp play a prominent economical role in hosting natural enemies used in the control of crop pests (Lewu and Afolayan, 2009). Local people in poor communities have adapted to biodiversity changes in terms of alien plant spp establishment, especially those species that have become integral part of their way of life. Villagers in local communities do not perceive alien invasive plant spp as a separate category, but as an essential component of their landscape (Shackleton *et al*., 2011). The commercial use of problem weeds and invasive alien plant spp play an essential role in terms of uplifting the economic status of poor rural communities. The use of alien plant spp as a substitute for indigenous medicinal spp could limit the harvesting pressure on native indigenous medicinal plants (Semenya *et al*., 2012b).

2.4. Potential values arising from problem weeds and alien invasive plant species.

The use of plant remedies either native or alien weeds for treating various ailments has been steadily resurgent (Ndawonde, 2015). Both natives and non-native plant spp have economic, ecological and social benefits (Semenya *et al.,* 2013b). Various deep rural communities use edible exotic weed plant spp as a survival strategy, their nutritional and medicinal properties contribute prominently to food security as well as maintaining a healthy diet in rural inhabitants (Maroyi and Mosina, 2014).

2.5. Factors that influence the elimination of problem weeds and alien invasive plant species.

Problem weeds and alien invasive plant spp are being targeted for elimination worldwide to mitigate their threats on environmental biodiversity, ecosystem and economy (Simberloff *et al.,* 2013). The economic collapse-down in most countries, especially in the agricultural sector, was crucially being influenced by the impact of problem weeds and alien invasive plant spp (Eiswerth *et al.,* 2011). The existing disruption of problem alien weed spp to environmental biodiversity has attracted the interference of human to maintain the integrity of natural ecosystems (Sharp *et al.,* 2011). Invasion by the problem weeds and alien invasive plant spp is a threat to the global environment (Bremner and Park, 2007).

The empirical reason behind the eradication of problem weeds and alien invasive plant spp attitudes, can be either economic or non-economic motives (Martín-López *et al.,* 2007), with the essential ideology of maintaining the sustainability of an environmental biodiversity (Larson *et al.,* 2011). The eradication of problem weeds and alien invasive plant spp has been declared the best tool of all proactive management options for mitigating and preventing the impact of weeds on natural environmental biodiversity and the global economy (Bremner and Park, 2007). Modifications of ecosystems within biomes by problem weeds and alien invasive spp are prominently influential on globally eradication policies and their implementations (Selge *et al.,* 2011). Since, some problem weeds and alien invasive plant spp contribute substantially to the reduction of surface water runoff quantity and ground water recharge worldwide, it is therefore crucial to eradicate those plants for the riparian zones to maintain the runoff quantity (van Wilgen *et al.,* 2008).

The SA Conservation of Agricultural Resource Act of 1984 and National Environmental Management: Waste Act, Act 59 of 2008 has crucial influence on environmental managers and policy makers to practice and implement government policies on eradication of problem weeds and alien invasive spp from natural and agricultural environment (Larson *et al.,* 2011). The use of natural enemies in the management of invasions is complex, controversial, too expensive and time consuming, therefore, the eradication method is not optional, but pivotal in the executing of biological invasions (Schűttler *et al*., 2011). Since invasion by exotic problem plant spp is influenced by human beings, therefore, it is the human responsibility to use effective managing method in mitigating the impact of invasion on environmental biodiversity (Kueffer, 2010).

2.6. References.

Baret, S., Rouget, M., Richardson, D. M., Lavergne, C., Egoh, B., Dupont, J. and Strasberg, D., 2006. Current distribution and potential extent of the most invasive alien plant species on La Réunion (Indian Ocean, Mascarene Island). *Austral Ecology,* **31: 747 – 758.**

Bradley, B. A., Blumenthal, D. M., Wilcove, D. S. and Ziska, L. H., 2010. Predicting plant invasions in an era of global change. *Trends in Ecology and Evolution,* **25 (5): 310 – 318.**

Bremner, A. and Park, K., 2007. Public attitudes to the management of invasive non-native species in the Scotland. *Biological conservation,* **139: 306 – 314.**

de Wet, H., Nkwanyana, M. N. and van Vuuren, S. F., 2010. Medicinal plants used for the treatment of diarrhoea in northern Maputaland, Kwazulu-Natal Province, South Africa. *Journal of Ethnopharmacology,* **130: 284 – 289.**

Dold, A. P. and Cocks, M. L., 2000. The medicinal use of some weeds, problem and alien plants in the Grahamstown and Peddie districts of the Eastern Cape, South Africa. *South African Journal of Science,* **96: 467 – 473.**

Eiswerth, M. E., Yen, S. T. and van Kooten, G. C., 2011. Factors determing awereness and knowledge of aquatic invasive species. *Ecological Economics* **70: 1672 – 1679.**

Holmes, P. M., Esler, K. J., Richardson, D. M. and Witkowski, E. T. F., 2008. Guidelines for improved management of riparian zone invaded by alien plants in South Africa. *South African Journal of Botany,* **74: 538 – 552.**

Kueffer, C., 2010. Transdisciplinary research is needed to predict plant invasions in an era of global change. *Trends in Ecology and Evolution,* **25 (11): 619 – 620.**

Larson, D. L., Philips-Mao, L., Quiram, G., Sharpe, L., Stark, R., Sugita, S. and Weiler, A., 2011. A framework for sustainable invasive species management: Environmental and economic objectives. *Journal of Environmental Management,* **92: 14 – 22.**

Lewu, F. B. and Afolayan, A. J., 2009. Ethnomedicine in South Africa: The role of weedy species. *African Journal of Biotechnology,* **8 (6): 929 – 934.**

Maroyi, A. and Mosina, G. K. E., 2014. Medicinal plants and traditional practices in peri – urban domestic gardens of the Limpopo Provinve, South Africa. *Indian Journal of Traditional Knowledge,* **13 (4): 665 – 672.**

Maroyi, A., 2012. The casual, naturalized and invasive alien flora of Zimbabwe based on herbarium and literature records. *Koedoe,* **54 (1): 1 – 6.**

Martín-López, B., Montes, C. and Benayas, J., 2007. The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological Conservation,* **139: 67 – 82.**

Ndawonde, B.G., 2015. *Education for sustainable development of medicinal plant sellers-challenges in relation to marketing, sales, storage and conservation.* Doctoral Thesis, University of Zululand, South Africa.

Obiri, J. F., 2011. Invasive plant species and their disaster – effects in dry tropical forests and rangelands of Kenya and Tanzania. *Journal of Disaster Risk Studies,* **3 (2): 417 – 428.**

Pimentel, D., McNair, S., Janecka, J., Wightman, J., Simmonds, C., O' Connell, C., Wong, E., Russel, L., Zern, J., Aquino, T. and Tsomondo, T., 2001. Economic and environmental threats of alien plant, animal and microbe invasions. *Agricultural, Ecosystem and Environment,* **84: 1 – 20.**

Prévot-Julliard, A. C., Clavel, J., Teillac-Deschamps, P. and Julliard, R., 2011. The need for flexibility in conservation practices: exotic species as an example. *Environmental Management*, **47 (3): 315 – 321.**

Riaz, T. and Javaid, A., 2011. Prevalence of alien weed *Parthenium hysterophorus L*. in grazing and wastelands of district Attock, Pakistan. *The Journal of Animal & Plant Sciences,* **21 (3): 542 – 545.**

Sax, D. F., Stachowicz, J. J., Brown, J. H., Bruno, J. F., Dawson, M. N., Gaines, S. D., Grosberg, R. K., Hastings. A., Holt, R. D., Mayfield, M. M., O'Connor, M. I. and Rice, W. R., 2007. Ecological and evolutionary insights from species invasions. *Trends in Ecology and Evolution,* **22 (9): 465 – 471.**

Schűttler, E., Rozzi, R. and Jax, K., 2011. Towards a societal management: A case study of public of mink and beavers in Cape Horn. *Journal of Natural Conservation,* **19: 175 – 184.**

Selge, S., Fischer, A. and van der Waal, R., 2011. Public and professional view on invasive non-native species – A qualitative social scientific investigation. *Biological Conservation,* **144: 3089 – 3079.**

Semenya, S. S., Potgieter, M. J. and Erasmus, L. J. C., 2013a. Exotic and indigenous problem plants species used, by the Bapedi, to treat sexually transmitted infections in Limpopo Province, South Africa. *African Health Science,* **3 (2): 320 – 326.**

Semenya, S. S., Potgieter, M. J. and Erasmus, L. J. C., 2013b. Bapedi phytomedicine and their use in the treatment of sexually transmitted infections in Limpopo Province, South Africa. *African Journal of Pharmacy and Pharmacology*, **7 (6): 250 – 262.**

Semenya, S. S., Tshisikhawe, M. P. and Potgieter, M. T., 2012a. Invasive alien plant species: A case study of their uses in the Thulamela Local Municipality, Limpopo Province, South Africa. *Scientific Research and Essay,* **7 (27): 2363 – 2369.**

Semenya, S., Potgieter, M., Tshisikhawe, M., Shava, S. and Maroyi, A., 2012b. Medicinal utilization of exotic plants by Bapedi traditional healers to treat human ailments in Limpopo Province, South Africa. *Journal of Ethnopharmacology,* **144 (3): 646 – 655.**

Shackleton, S., Kirby, D. and Gambiza, J., 2011. Invasive plants-friends or foes? Contribution of prickly pear (*Opuntiaficus indica*) to livehoods in Makana Cape, South Africa. *Development Southern Africa,* **28 (2): 177 – 193.**

Sharp, R. L., Larson, L. R. and Green, G. T., 2011. Factors influencing public preferences for invasive alien species management. *Biological Conservation,* **144: 2097 – 2104.**

Simberloff, D., Martin, J., Genoves, P., Maris, V., Wardle, D. A., Aronson, J., Courchamp, F., Ggrcía-Berthou, E., Pascal, M., Galil, B., Pyšk, P., Sousa, R., Tabacchi, E. and Vila, M., 2013. Impacts of biological invasions: what's what and the way forward. *Trends in Ecology and Evolution,* **28 (1): 58 – 66.**

Thring, T. S. A. and Weitz, F. M., 2006. Medicinal plant used in the Bredasdorp/ Elim region of the South Overberg in the Western Cape Province of South Africa. *Journal of Ethnopharmacology,* **103: 261 – 275.**

Valéry, L., Fritz, H., Lefeuvre, J. and Simberloff, D. 2009. Invasive species can also be native. *Trends of Ecology and Evolution,* **24 (11): 585.**

van Wilgen, B. W., Reyers, B., Le Maitre, D. C., Richardson, D. M. and Schonegevel, L., 2008. A biome-scale assessment of the impact of invasive alien plants on ecological services in South Africa. *Journal of Environmental Management,* **89: 336 – 349.**

van Wyk, B. –E., 2008. A broad review of commercially important Southern African medicinal plants. *Journal of Ethnopharmacology,* **119: 342 – 355.**

van Wyk, B. –E., de Wet, H. and Van Heerden, F. R., 2008. An ethnobotanical survery of medicinal plants in the southeastern karoo, South Africa. *South African Journal of Botany,* **74: 696 – 704.**

Worku, M., 2010. Prevalence and distribution survey of an invasive alien weed (*Parhenium hysterophorus L.*) in Sheka zone South Western Ethiopia. *African Journal of Agricultural Research,* **5 (9): 922 – 927.**

Chapter Three

3. Description of the study area.

The study was undertaken in deep rural areas of Mauluma and Matshavhawe villages, Nzhelele region, Makhado Local Municipality, Vhembe District Municipality, Limpopo Province, South Africa. The Mauluma village is located between Maangani and Tswime mountains, hence the Matshavhawe village is located on top of Maangani mountain. Both Tswime and Maangani mountains form part of the Soutpansburg range. Both Mauluma and Matshavhawe Villages are dominated by black ethical group of the Vhavenda tribe and therefore, almost all the village dwellers speak Tshivenda as their first language. The majority of villagers in both villages are unemployed youth, middle-aged and old-aged and they have no source of income.

3.1. Flora and fauna.

The region has rich biodiversity of flora and fauna. The largest portion of the district is classified as savanna biome, widely known as Bushveld (Luseba and Tshisikhawe, 2013), with some patches of grassland and forest biomes. All these biomes are interconnected by the unique and favorable ecological niches that promote diversity of both flora and fauna within the district. Regardless of the fact that the Vhembe Biosphere Reserve is in Vhembe district, almost half of the district is still natural with limited development.

3.2. Study site map.

Figure 1: Vhembe District Municipality map.

Vhembe District Municipality is located in the far northernmost region of the Limpopo Province, South Africa within the latitude 22°93'33" South and longitude 30°46'67" East. It consists of four local Municipalities known as Thulamela, Makhado, Musina and Mutale. The

District covers an area of approximately 25 597 Km^2 with the total population of approximately 1 293 783 people (Statistics South Africa, 2012).

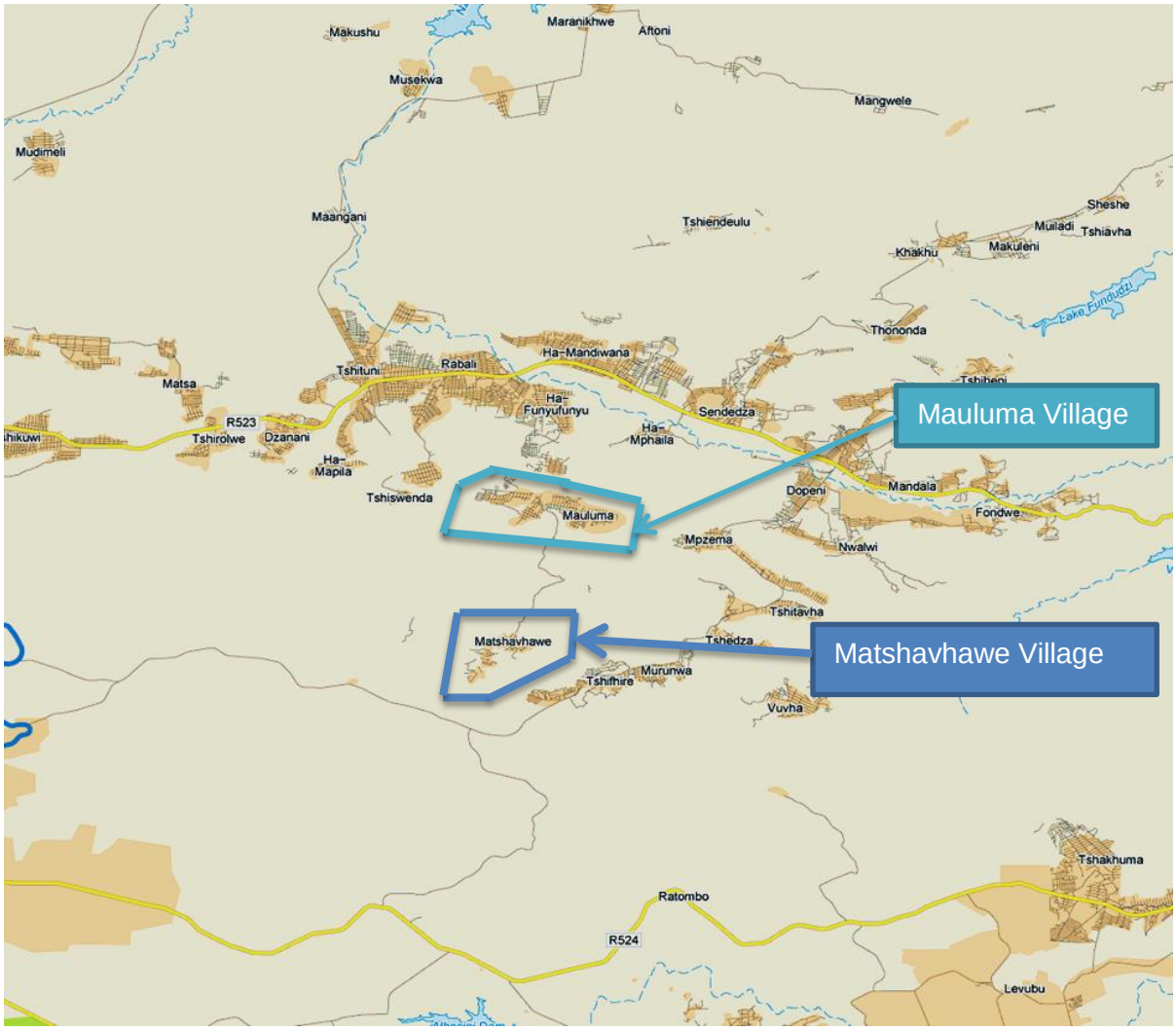

Figure 2: Mauluma and Matshavhawe Villages.

Mauluma village is located within the –22°55'00" South latitude and 30°07'00" East longitude. It covers an area of approximately 2.21 km². The total population of the Mauluma village is approximately 3 413, of which females constitute 54.70% of the population, while males constitute 45.30% (Statistics South Africa, 2012). The total sum of households in Mauluma village is approximately 800.

The geographical coordinates of Matshavhawe village lies between –22 °58'00" South latitude and 30°07'00" East longitude. It covers a total distance area of roughly 1.62 km², with the population size of approximately 1 735 (Statistics South Africa, 2012). Females in Matshavhawe village constitute 55.45% of the entire population, while male constitute 44.55% (Statistics South Africa, 2012). There are approximately 420 households in Matshavhawe village.

3.3. Materials and method.

3.3.1. Justification of the method.

Since the study involved indigenous people and their traditional knowledge on the usage of problem weeds and alien invasive plant spp, purposeful triangulation techniques were appropriate for ensuring proper gathering of both qualitative and quantitative data. Triangulation technique refers to the rigorous data gathering technique that synergistically combine both qualitative and quantitative research methods flawless (Cassim, 2011). Triangulation research technique delves both datasets unambiguously while allowing the use of single research method to validate the findings for other research method (Onwuegbuzie and Leech, 2005).

Purposive sampling method refers to the research tool used for participants selection, since it is the most effective research technique that reaffirm gathering of ethnobotanical information. Questionnaires were developed based on the investigation that can steadily garner substantive and accurate information. The sample survey was organized into different sub-headings which included provision of instructions; length of questionnaires; types of questions; observations; questionnaire construction; interview and systematic sampling (Khorommbi, 2001).

3.3.2. Ethical deliberations.

Since the study was all about Participatory Rural Appraisal (PRA), the endorsement letters for continuing with the study were obtained from both the University of Venda Ethics Committee and Vhembe District Counsel for Traditional Healers. Letters were used to negotiate access for proceeding with the study in the traditional authorities. Ethical principles such as recognition of all the participants, participant's autonomy, participant's beneficences and justice were considered.

3.3.3. Provision of instructions.

Figure 3: Traditional healer interviewed during data gathering.

The purpose and objectives of the survey were explained to all the informants while considering their level of education. All informants were given the opportunity to participate in the survey willingly. Informants were given equal participatory opportunities to impart and convey their knowledge. Different age groups, such as old-aged, middle-aged and youth, were targeted to evaluate their level of knowledge with regard to the uses of problem weeds and alien invasive plant spp.

3.3.4. Observations.

In some instances, informants were requested to observe and identify problem weeds and alien invasive plant spp within and in a way adjacent to their homesteads. Naked eye observations were substantive in the identification of some ecological prominent problem weeds and alien invasive plant spp within the biodiversity ecosystem. Field guide books for problem weeds and alien invasive plant spp were integral for the validation of the identified plant spp.

3.3.5. Interviews.

Face-to-face interviews were conducted and were recorded using cell phone and a tape recorder for the rigorous validation of the information. Both structured and semi-structured

questionnaires were administered based on the informant's level of education and expertise. Structured interview involved requesting a group of selected informants to respond to similar questions, whereas semi-structured interview involved randomly requesting informants to rank, categorize, identify or choose the answer of their options (Dolores and Tongco, 2007).

3.3.6. Pilot survey.

Figure 4: Administration of pilot survey.

Two months pilot surveys were conducted. The objective of the pilot survey was to seek permission for conducting a study within the traditional authorities and to test the vitality and reliability of questionnaires, interview schedules and sampling method. Participants gathered during the traditional Indaba "*Khoroni*" and were informed about the purpose of the study.

3.3.7. Systematic sampling.

One hundred informants, including traditional healers, herbalists and other community knowledge holders were identified and sampled based on community dwelling status, level of education and their expertise. Fifty informants of different genders were sampled in each village. Sampling survey was carried out in both groups and at the individual level, to validate information. Field guides for plants were integral for verifying the status of whether plants were categorized as either indigenous plants or problem weeds and alien invasive spp.

3.4. Data analysis.

Data were analyzed statistically and qualitatively. Quantitative data were analyzed statistically using Microsoft office, on Microsoft excel. Qualitative data were described and interpreted in the form of groups of related information. Other convertible qualitative data were converted into quantitative and then analyzed statistically using Microsoft excel.

3.5. References.

Cassim, L., 2011. *The impact of the current performance management system in a South African retail pharmacy on the provision of pharmaceutical care to patients.* Master's Thesis, University of South Africa, Pretoria, South Africa.

Dolores, M. A. and Tongco, C., 2007. Purposive Sampling as a Tool for Informant Selection. *Ethnobotany Research and Applications,* **5: 147 – 158.**

Khorommbi, K. C., 2001. *The role of venda culture in natural conservation: A case study of the inhabitants of Tshivhase area*. Masters dissertation, Port Elizabeth Technikon, Port Elizabeth, South Africa.

Luseba, D. and Tshisikhawe, M. P., 2013. Medicinal plants used in the treatment of livestock diseases in Vhembe region, Limpopo Province, South Africa. *Journal of Medicinal Plants Research,* **7 (10): 593 – 601.**

Onwuegbuzie, A. J. and Leech, N. L., 2005. On becoming a pragmatic research: The importance of combining quantitative and qualitative research methodologies. *Int. J. Social Research methodology,* **8 (5): 375 – 387**

Statistics South Africa., 2012. *South African Statistics, 2012*. Statistics South Africa. Pretoria, South Africa.

Chapter Four

The utilizations of problem weeds and alien invasive plant species and their roles in Nzhelele, Makhado Local Municipality, Limpopo Province, South Africa.

Abstract.

Background: Regardless of the fact that problem weeds and alien invasive plant species have negative impact towards biodiversity ecosystem and economy, some of these plant species have been utilized by indigenous people for maintaining their livelihood.

Aim: The focus of the study was to document and assess village dweller's knowledge on the benefits or losses derived from problem weeds and alien invasive plant species.

Materials and method: Triangulation research techniques were applied for the purpose of data collection.

Results and conclusion: About 89% informants were more knowledgeable about the benefits or losses derived from problem weeds and alien invasive plant species. It has been revealed that village dweller's knowledge on utilization of problem weeds and alien invasive plant species increased with an increase in age. A total of 78 problem weeds and alien invasive plant species from 33 families were being utilized by villagers for various purposes. Among the 33 families, Asteraceae and Solanaceae were dominantly utilized (14%) followed by Amarathaceae and Fabaceae (9%). About 31 problem weeds and invasive alien plant species were used for medicinal purpose and these species belonged to the following categories: 1b, 2, invaders, weeds and X3. A total of 17 problem alien weed species were utilized for multiple purposes and these plant species belonged to categories such as 1b, invaders, 1, weeds, 2 and 3 whereas, the rest were utilized for food, fruits, ornamental, social and fire wood and they belonged to the following categories: 1a, 1b, 3, weeds, 2 and invaders. Folktales were used as a legitimate means for preserving folk knowledge on plant uses. The dynamic of indigenous knowledge system about utilization of plant species should be seen as a tool to resolve currect challenges. The use of problem weeds and alien invasive plant species as substitute for rare and disappearing indigenous plant species could be perceived as conservation strategy.

Key words: *Alien invasive plant species, Problem weeds, Utilization and Indigenous knowledge system.*

4.1. Introduction.

Problem weeds and alien invasive plant spp are regarded as biodiversity threatening (Roy *et al.,* 2014). Despite the fact that problem weeds and alien invasive plant spp have negative impact towards biodiversity ecosystem and economy in general (Zhu *et al.,* 2016), some of them have been utilized by both indigenous and modernized people for maintaining their livelihood (Rahman and Roy, 2014). Some problem weeds and alien invasive plant spp have been introduced worldwide purposefully (Shackleton *et al.,* 2014), to improve the ecosystem and social services such as erosion control, flood attenuation, fiber and timber production (Dickie *et al.,* 2014). Ecological fusion among natives and alien invasives can aid with the provision to create dynamics within a niche area (Rotherham, 2017). Some alien invasive plant spp can be used alternatively as indicators, for implementing a proactive management plan as well as risk assessment (Novoa *et al.,* 2015). Some problem weeds and alien invasive plant spp are regarded as fodder, especially to low and middle income rural dwellers (Das and Duarah, 2013). Problem weeds and alien invasive plants aid with the provision of diverse services, from economic, medicinal, social and ecological services (Adli *et al.,* 2017). Surface water contamination can lead to the deterioration of freshwater quality (Wang *et al*., 2016), thus, some exotic alien plant species potentially serve with the provision to control excess mine water (Dye *et al.,* 2017). Problem weeds and alien invasive plant spp, aid with the provision to increase soil and nutrient cycle (Gaertner *et al.,* 2014).

The listing of some plant spp as either problematic weeds or alien invasives has mainly been based on the opinions (Wilson *et al.,* 2014), rather than facts. Human perceptions of traditional values derived from problem weeds and alien invasive plant spp are less understood as compared to environmental aspects (Shackleton *et al.,* 2015). Thus, there is a need to understand the potential contribution of plants considered as problematic weeds and alien invasive spp towards solving present challenges to sustain the present and future livelihood needs. Without any reasonable doubt, invasion biology has already advanced knowledge and understanding of invasion by exotics, but the knowing-doing-loophole, seems to be practically un-applicable in terms of implementation of the management action of plans (Matzek *et al.,* 2014). It still remains bias to be fastidious about the negative impact of biological invasion only, whereas, some problem weeds and alien invasive plant spp are considered to be ecosystem transforming and mutualistically benefiting their co-existing natives (Nuñez and Dickie, 2014). Despite the origin or invasiveness status of the plant spp, Mahmood *et al.* (2013), reported that documentation of indigenous knowledge about plant spp can lead to several discoveries. There is an imperative need to better understand the utilization of problem weeds and alien plant spp by rural dwellers in maintaining their livelihood. This could be conceived as an alternative mechanism which could solve present biodiversity and human-development challenges while considering principles of sustainable

development as an essential need of all. The primary focus of this study was to assess village dweller's knowledge on benefits of utilizing problem weeds and alien invasive plant spp, with the objective of documenting their traditional uses.

4.2. Materials and method.

The objectives of the study were unambiguously explained to 100 participants during the pilot survey. Participants were sampled based on their knowledge of expertise, dwelling status, educational level and this included: traditional healers, herbalists, farmers and knowledgeable village dwellers. Participant's knowledge on the benefits of problem weeds and alien invasive plant spp was assessed using questionnaires. The same questions were asked to the participants for the purpose of testing their response's veracity. The acquired data were rigorously analyzed quantitatively and qualitatively. Thus, both qualitative and quantitative techniques were complementary since they provide expected outcomes (Choy, 2014). The diversity of research techniques in single study seemed to be crucial for reconciling the outcomes and development of utmost insights (Antwi and Hamza, 2015). Some qualitative data were converted to become quantitative for statistical analysis purpose. Quantitative data were analyzed on Microsoft Excel using Anova: Single Factor and t-Test: Paired Two Sample for Mean whereas, qualitative data were presented in table and graph forms.

4.3. Results.

4.3.1. Participants profile.

The total number of 100 participants of opposite genders and age discrepancy were interviewed in relation to the utilization of problem weeds and alien invasive plant spp.

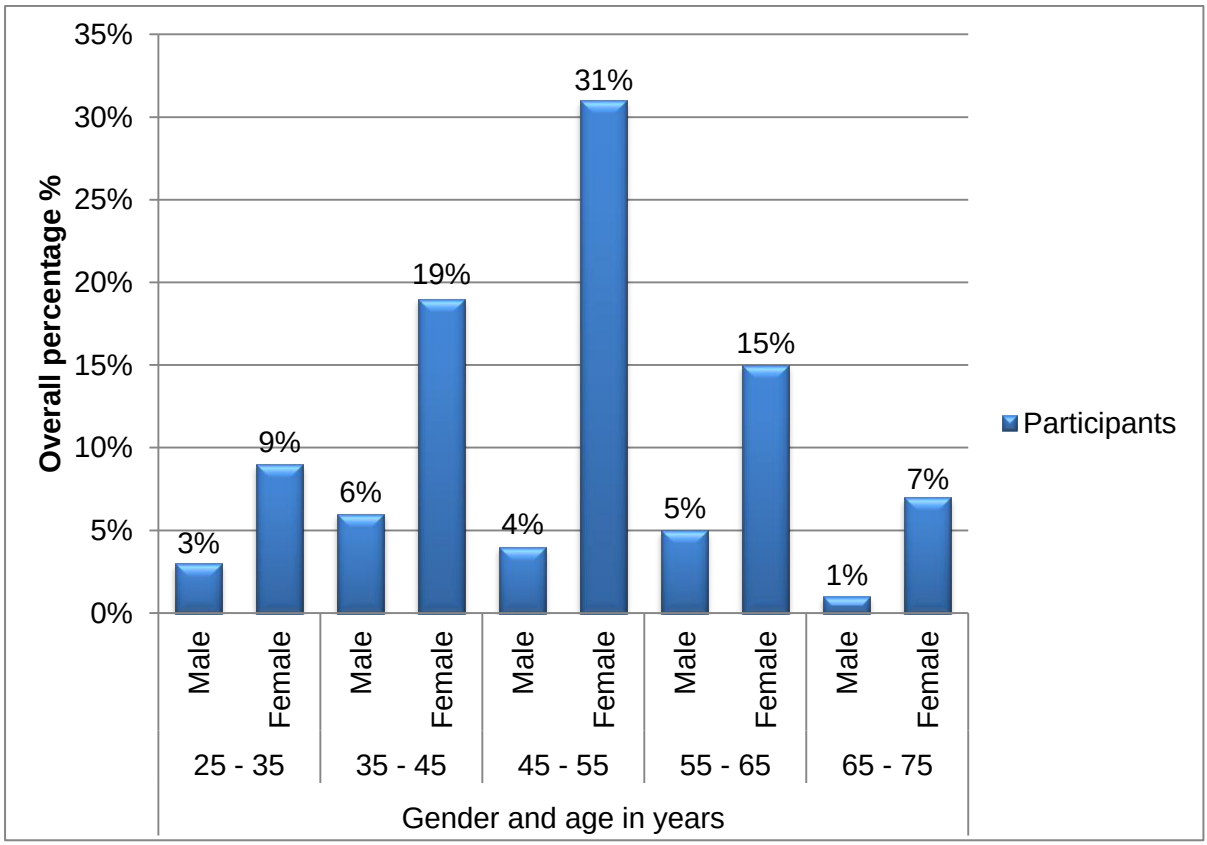

Figure 5: Overall participant's profile in terms of their age group and gender.

Among the 100 informants interviewed, 81% of them were females, hence 19% were male participants. The percentage of female respondents in all five age groups was significantly higher than the male participants. The results also showed that percentage of both male and female participants increased slightly with an increment in age group, especially within the age groups of 25 – 35 years and 45 – 55 years. Within the category of 45 – 55 years, participant's percentage started to decline with an increase in age and vice – versa. Female informants were found to be participating in a large number under the age category of 45 – 55 years. The male informants were found participating in a large number under the age category group of 25 – 35 years.

4.3.2. Recognition of problem weeds and alien invasive species.

Total number of 100 informants were interviewed about recognition of some useful weed plants and alien invasive spp. Among the 100 informants, 11 of them were traditional healers, 19 herbalists, 28 farmers as well 42 village dwellers.

Table 1: Recognition of problem weed plants and alien invasive plant species.

Characteristics	Traditional healers	Herbalists	Farmers	Village dwellers	Total %
A	0	2	3	4	9
B	1	5	5	12	23
C	3	8	14	19	44
D	8	4	6	7	25
Total number of participants	11	19	28	42	100
Net total %					

Keys: *A – Availability, Growth rate & Competition, B – Availability, Abundant & Competition, C – Recolonization rate after being eliminated, Abundant, Growth rate & Competition; D – Availability, Recolonization rate after being eliminated, Abundant, Growth rate & Competition.*

It is evident that 44% of informants recognized problem weeds and alien invasive plant spp using the following characteristics: availability of plants; rate upon which plants recolonized the niche area after being exposed to certain disturbance, abundance of certain plant spp within the niche area and also flourishing to compete with other spp in the ecosystem or niche area. Hence 9% of informants used characters such as availability, growth rate and flourishing as their recognition mechanism for weeds and alien invasive plant spp. It was found that 25% of the participated informants recognized problem weeds and alien invasive plant spp using several characteristics than other participants. Their recognistic mechanisms included, plant availability, recolonization rate after certain disturbance, abundance of spp, growth rate as well as flourishing to out-compete other spp in both agroecosystems and natural ecosystems. About 23% of all the participants used only three characters to recognize problem weeds and alien invasive plant spp, those characters included: availability, abundance and flourishing.

4.3.3. Informant's knowledge on the Conservation of Agricultural Act, National Environmental management: Biodiversity Act, negative impact and benefits derived from problem weeds and alien invasive plant species.

Participants' knowledge on either legislation, benefits or devastating impact of problem weeds and alien invasive plant spp was determined.

Table 2: Informant's knowledge on negative impact and benefits of problem weeds and alien invasive plant spp.

Responses	Participants				Total %
	Traditional healers	Herbalists	Farmers	Village dwellers	
Yes	10	16	26	37	89
No	1	3	2	2	8
Not sure	0	0	0	3	3
Total number of participants	11	19	28	42	100
Net total %					

Table 2 illustrates that the majority of participants responded positively to the question asked and more than two third of all the participants were instructive in terms of either benefits or loss derived from problem weeds as well as alien invasive plant spp. The total percentage of 89 participants were ubiquitously familiar with both legisilation, losses as well as benefits of problem weeds and alien invasive plant spp, whereas the 8% of informants indicated that they were not familiar, hence less than 3% of participants were not familiar with both regulations, negative impact and benefits of those plants.

Table 3: Statistical analysis of participant's responses on whether they were familiar, not familiar or not sure, with the negative impact and benefits of problem weeds and alien invasive plant spp.

Anova:
Single Factor

Groups	*Count*	*Sum*	*Average*	*Variance*	*F*	*P-value*
Yes	4	89	22,25	140,25	12,2078	0,00273
No	4	8	2	0,6666667		
Not sure	4	3	0,75	2,25		

There was high (*p<0.05)* statistically significant difference between participants who were familiar and those not familiar as well as those who were not sure about the negative impact and benefits of problem weeds and alien invasive plant spp. The statistical significant difference between all the participant's responses were *p=0.00273*. Therefore, there was significant statistical difference among participant's response in terms of their knowledge of negative impact and benefits derived from problem weeds and alien invasive plant spp. The average mean for participants who said "Yes", were familiar with the negative impact and benefits of alien invasives and weed plant spp was 22.25, whereas, the lower mean average of 2, was for those who said "no", they were not familiar and therefore, the lowest 0.75, was for the participants who said they were "not sure".

4.3.4. Informants perceptions about benefits and losses derived from problem weeds and alien invasive plant species.

The total number of 89 participants who answered “yes” on above statement were allowed to respond to it. Among the 89 participants, there were 11 traditional healers, 16 herbalists, 28 farmers as well as 37 village dwellers.

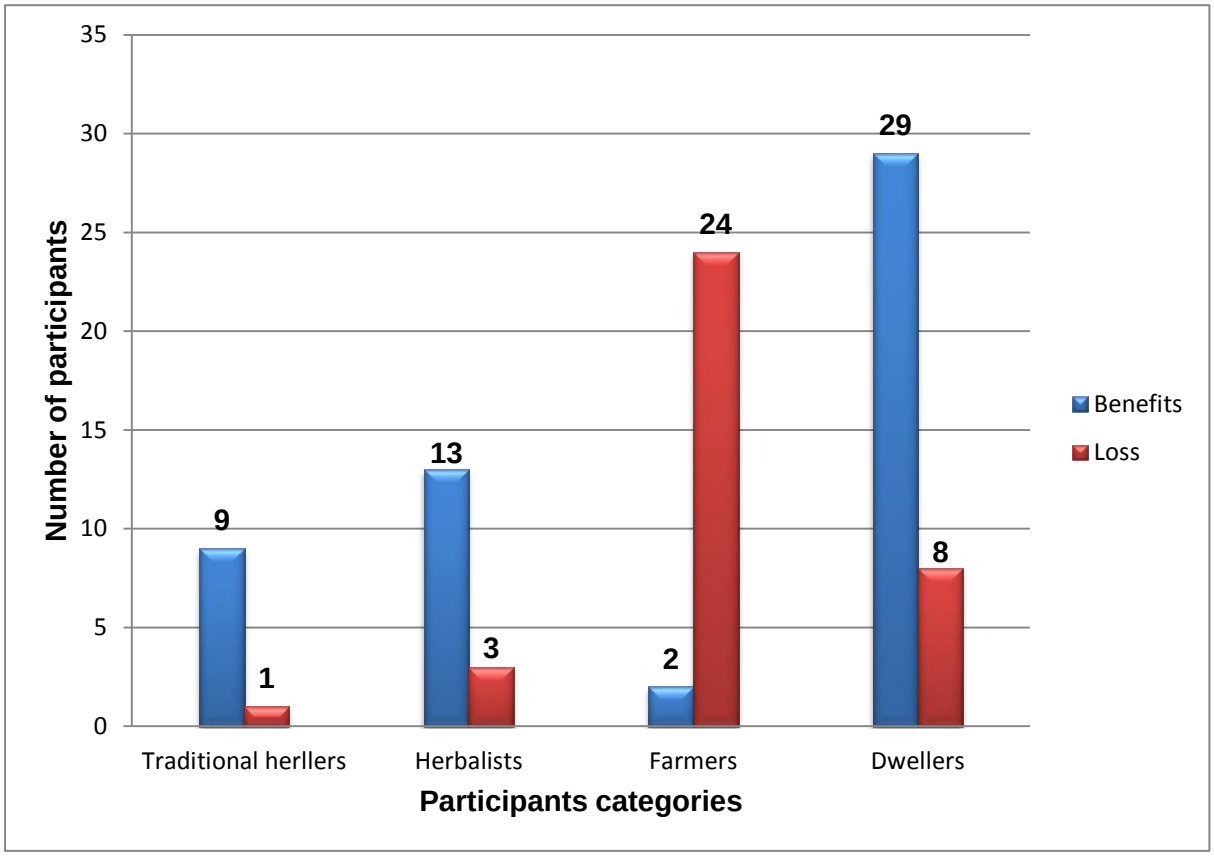

Figure 6: Participant’s perceptions with regards to the benefits and losses of problem weeds and alien invasive plant spp.

All participants agreed that problem weeds and alien invasive plant spp had benefits and losses in ecological, social, medicinal and economical. Among the 89 participants, 53 informants agreed that some alien invasive plant spp have benefits, while the remaining 36 strongly disagreed. Amongst them, 24 were farmers and their perceptions were highly negative as compared to other categories. Thus, more than two third of participants under farming category were aware of the loss caused by invasion of problem weeds than the benefits derived from those plants. Perceptions among other participants categories, seemed to be likely positive about the benefits derived from problem weeds and alien invasive plant spp than the losses.

4.3.5. Benefits of problem weeds and alien invasive plant species.

A total of 53 participants who agreed that they perceived problem weeds and alien invasive spp as having benefits were interviewed further and were classified under four categories: traditional healers, herbalists, farmers and village dwellers. Their response included social, medicinal, ecological and economic benefits.

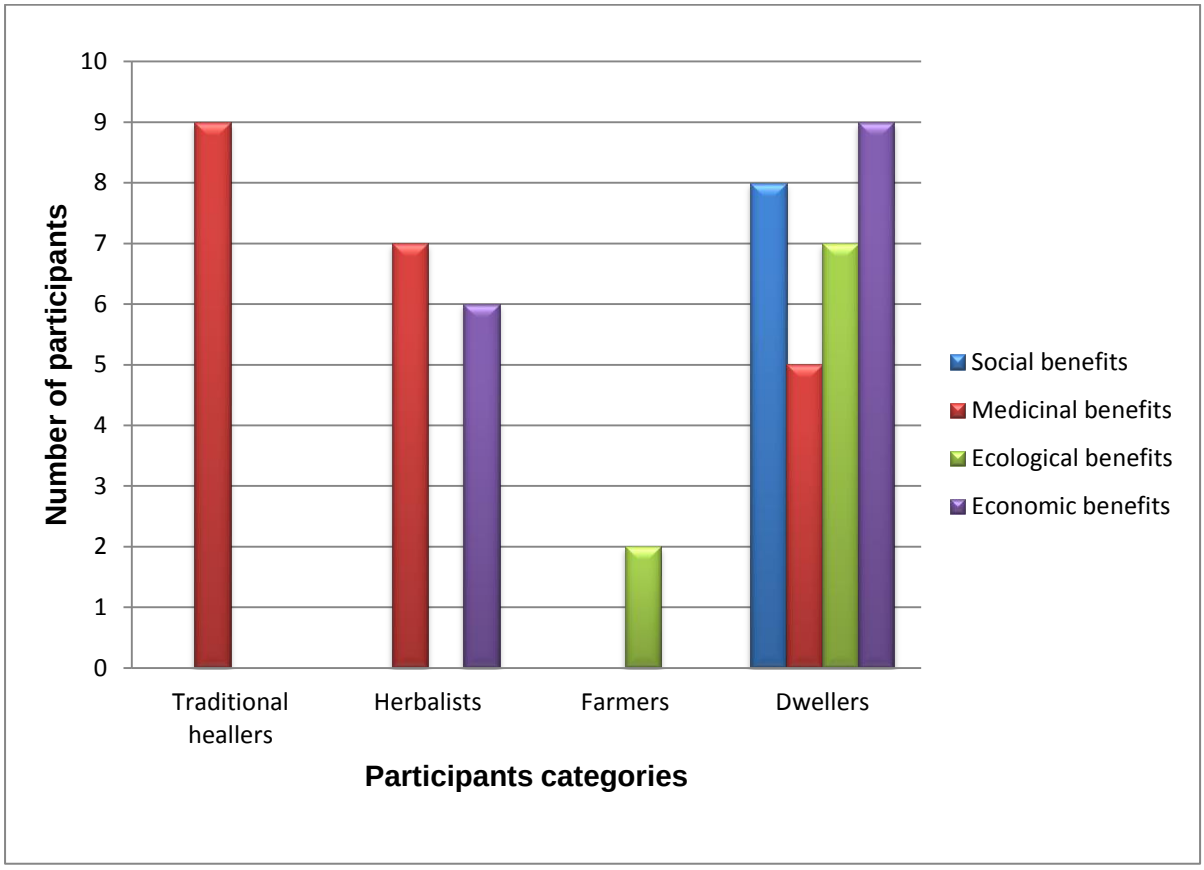

Figure 7: Illustration of benefits derived from problem weeds and alien invasive plant spp.

Almost all participants except farmers, agreed that some problem weeds and alien invasive plant spp had medicinal benefits, whereas, few farmers agreed that those plants had some ecological benefits. Dwellers category had more knowledge and understanding about the benefits derived from problem weeds and alien invasive plant spp.

4.3.6. Inventory of problem weeds and invasive alien plant species.

Table 4: Traditionally useful plant species, but considered as a problem; aliens and invasive weeds in terms of Regulation 15 of the South African, Conservation of Agricultural Resources Act, Act 43 of 1983 and Section 70 (1)(A) of the National Environmental Management: Biodiversity Act, Act 10 of 2004 (Bromilow, 2010).

Botanical name (Family)	Local name (Growth habit)	Harvesting categories	Plant parts and their uses	CARA / NEMBA Catetory	Documented literature
Acacia decurrens Willd. (Fabaceae).	Mutshititshiti (Tree).	Wood.	Used as fire wood.	2.	Used in the production of wattle gum and is ornamental (Maslin and McDonald, 2006).
Acanthospermum australe (Loefl.) Kuntze (Asteraceae).	Spiny-bur (Herbaceous).	Medicinal.	Infusion leaves used for skin rush.	Weed.	Malaria; polio; sores and wounds (Vargas *et al.,* 2014; Nethengwe *et al.,* 2012).
Acanthospermum brasilium (Loefl.) Kuntze (Asteraceae).	Spiny-bur (Herbaceous).	Medicinal.	Infusion leaves used for sikin rush.	Weed.	Wounds (Vargas *et al.,* 2014).
Achyranthes aspera L. (Amaranthaceae).	Mukuluvhali (Herbaceous).	Ecological, Social and	Fresh flowers are burned in fire for weather predictions. Dried leaves are	1.	Asthma, headache and wounds (Vijayaraj and

		medicinal.	smoked to treat lung diseases.		Vidhya, 2016).
Agave sisalana L. (Agavaceae).	Tshikwenga (Secculent).	Ecological Medicinal and social.	Soil fertility. Infusion of roots and leaves used to treat STI. Making of ropes.	2.	Making of ropes (Tewari *et al*., 2014).
Ageratina adenophora (Spreng.) King & H. Rob. (Asteraceae).	Makhulu-wa-thugwi (Herbaceous).	Medicinal.	Infusion of leaves and roots is taken orally to treat snake bite and bee bite.	1b.	Antioxidant and antifungal activities (Ralte and Lallianrawna, 2014).
Alternanthera pungens Kunth (Amaranthaceae).	Tshigwanda (Herbaceous).	Medicinal.	Plant parts burned, ashes are mixed with other medication for treating genital warts.	Weed.	Leaves have antibacterial, antidiabetic and antidyslipidemic properties (Olugbemiga *et al.,* 2016).
Amaranthus caudatus L. (Amaranthaceae).	Vowa (Herbaceous).	Food.	Eddible.	Weed.	Source of minerals such as Ca, Mg and Cu (Bhat *et al.,* 2015).
Amaranthus spinosus L. (Amaranthaceae).	Tshithavha-misisi (Herbaceous).	Ecological, Food, social and medicinal.	Soil anchor to prevent erosion and eddible. Dried stem is burned and its ashes are mixed with snuff to add flavor. Decoction of the whole plant is	Weed.	Cooling, stimulating appetite and also toothache (Rahman and Gulshana, 2014).

			used to treat blood pressure and toothache.		
Amaranthus thunbergii L. (Amaranthaceae).	Thebe (Herbaceou).	Food.	Eddible.	Weed.	Leaves are considered to be highly nutritious (Bvenura and Afolayan, 2014).
Anredera cordifolia (Ten.) Steenis (Basellaceae).	Vhutungu (Climber).	Ecological, ornomental and medicinal.	Used for decoration. Boilled leaves taken orally for chest pains, heart and kidney diseases.	1b.	Wound treatment (Lestari *et al.,* 2015; Miladiyah and Prabowo, 2015).
Argemome ochroleuca Sweet (Papaveraceae).	Shashe (Herbaceous).	Medicinal.	Burned leaves and steam form mixture of medication to treat genital warts in women.	1b.	Antifungal activities (Moustafa *et al.,* 2013).
Argemone Mexicana L. (Papaveraceae).	Shashe (Herbaceous).	Medicinal.	Burned leaves and steam form mixture of medication to treat genital warts in women.	1b.	Tumors, warts, skin rush, inflammations, leprosy, microbial and malaria (Brahmachari *et al.,* 2013).
Asclepia fruiticosa L. (Apocynaceae).	Mumentshisi (Shrub).	Medicinal.	Decoction of root taken orally to treat stomach constipation and dried grounded leaves are smoked for	Weed.	Fine powder is used for treating nose diseases and boiled leaves used

			treating asthma, headache as well as nose pain.		for treating throat sickness (Dyubeni and Buwa, 2012).
Bauhinia variegate L. (Fabaceae).	Orchid tree (Tree).	Ornomental and medicinal.	Used in home gardens as decor. Leaves are boiled and taken orally for the treatment of diarrhoea and body pains.	1b.	Its leaves are used to treat chest pains (Gautam, 2012).
Bidens pilosa L. (Asteraceae).	Mushidzhi (Herbaceous).	Food.	Edible	Weed.	Highly nutritious source of food (Bhat *et al.,* 2015).
Caesalpinia decapetala (Roth) Alston (Fabaceae).	Luanakha (Shrub).	Medicinal.	Root is burned and its ashes is used to form mixture of medication used for treating genital warts in women.	1b.	Cold (Wei *et al.,* 2013).
Canna indica L. (Cannaceae).	Mupupululo (Herbaceous).	Ornamental, cultural and medicinal.	The plant is grown in gardens as decor. The seeds are used for making beads. Decoction of rhizome is used to treat stomach constipation.	1b.	Decoction of zhizome used in the treatment of gonorrhea (Darsini *et al.,* 2015).
Cannabis sativa L. (Cannabaceae).	Mbanzhe (Herbaceous).	Medicinal.	Decoction of fresh leaves is taken orally to treat asthma and TB. Dried leaves are smoked to treat headache.	Weed.	Cancer treatment (Mujuru and Sekhejane, 2014).

Cardiospermum grandiflorum Sw. (Sapindaceae).	Murungudane-wa-nowa (Climber).	Medicinal.	Leaves are used to treat skin burn and snake bites.	1b.	Leaves are used as antibacterial agent and to treat skin diseases (Nnamani *et al*., 2012).
Catharanthus roseus (L.) G. Don (Apocynaceae).	Oldmaid (Herbaceous).	Medicinal.	Boilled roots are used to treat diabetes.	3	The whole plant is also used to treat fatal sickness (Aruna *et al.,* 2015).
Centella asiatica L. (Apiaceae).	Sikeketjane (Herbaceous).	Ecological, food and medicinal.	Prevent soil erosion in river banks and edible. Fluid from crushed fresh leaves is used for treating wounds and infusion of boiled root is taken orally to treat high blood pressure.	Weed	Leprosy (Long *et al.,* 2012).
Chenopodium album L. (Chenopodiaceae).	Musala-marubini (Herbaceous).	Ecological, food and medicinal.	Serve as pioneer and it is edible. Infusion of all parts is taken orally to treat high blood pressure.	Weed	Source of food and crontribute towards dietary diversity (Mavengahama *et al.,* 2013).
Chenopodium ambrosioides L. (Chenopodiaceae).	Muthatha-thuri (Herbaceous).	Ecological, social and Medicinal.	Serve as pioneer in disturbed area. Whole dried plant is burned to repel thunderstorm and lightning. Used to treat the symptons of cancer and	Weed.	Wounds, pneumonia, eczema and fever (Lall and Kishore, 2014).

			swollen body parts.		
Chromolaena odorata (L.) R.M. King & H. Rob. (Asteraceae).	Paraffin weed. (Shrub).	Ecological, medicinal and social.	Provision of pollen to honey bees. Fluid from crushed fresh leaves is used to treat wounds. Dried plant is used for initiating fire and as fire wood.	1b.	Antimicrobial activities (Hanphanphoom and Krajangsang, 2016).
Cleome gynandra L. (Capparaceae).	Murudi (Herbacous).	Food.	Edible.	Weed.	Intestinal parasites (Fouche *et al.,* 2016).
Cleome monophylla L. (Capparaceae).	Mutoho-toho (Herbaceous).	Food.	Edible.	Weed.	Used to enhance immune system (Arhoghro *et al.,* 2014).
Conyza sumatresis L. (Asteraceae).	Nyantse (Herbaceous).	Social.	Dried stems are used for building chicken run.	Weed	Used to treat stomach sickness (Shaha *et al.,* 2012).
Corchorus trilocularis L. (Malvaceae).	Delele (Herbaceous).	Food.	Edible.	Weed	Antimicrobial, anticancer, diuretic and anti inflammatory (Dhanalakshmi and Manavalan, 2014).
Cucumis myriocarpus E. Mey. ex Naudin	Tshinyagu (Herbaceous).	Medicinal.	Decoction of root or tuber is taken orally to stimulate fertility in women.	Weed.	Edible (Nkgapele *et al.,* 2011). gonorrhea

(Cucurbitaceae).					(Semenya *et al.,* 2013).
Datura ferox auct. Non L. (Solanaceae).	Gwanda (Herbaceous).	Medicinal.	Dried crushed leaves are smoked to treat asthma.	1b.	Contains natural tropane alkaloids (Alexander, 2008).
Datura stamonium L. (Solanaceae).	Gwanda-Zavhazavha (Herbaceous).	Medicinal.	Dried crushed leaves are smoked to treat asthma.	1b.	Chest pains and wounds (Sayyed, 2014).
Erucastrum austroafricanum Al-Shehbaz & Warwick (Brassicaceae).	Ndevhe-dza-mpopo (Herbaceous).	Medicinal.	Fluid from crushed fresh leaves is used to treat ear problems.	Weed.	No record.
Eucalyptus camaldulensis Dehnh. (Myrtaceae).	Mubomo (Tree).	Medicinal and wood.	Used to treat cold flu and headache. Stem and branches are used as fire wood.	1b.	Economically important in timber industry (Raath, 2015).
Eucalyptus grandis W. Hill ex Maiden (Myrtaceae).	Mubomo (Tree).	Medicinal and wood.	Used to treat cold flu and headache. Stem and branches are used as fire wood.	1b.	Used for making electrical transmission power pole (Langat *et al.,* 2015).
Gomphrena celosioides auct. non Mart.	Tshigwanda-tshitsuku	Medicinal.	Burn ashes are mixed with other medication for treating genital warts.	Weed.	Used for accumulating heavy metals in mining industry (Mganga,

(Amaranthaceae).	(Herbaceous).				2014).
Guilleminea densa (Humb. & Bonpl. ex Schult.) Moq. (Amaranthaceae).	Tshigwanda-tshitshena (Herbaceous).	Medicine.	Burn ashes are mixed with other medication for treating genital warts.	Weed.	Minimizes soil erosion as well as improving water infiltration (Legwaila *et al*., 2015).
Hibiscus trionum L. (Malvaceae).	Delele-mukhwayo (Herbaceous).	Food.	Edible	Weed.	Leaves are used as substitute for spinach (Essiett and Iwok, 2014).
Hypoestes phyllostachya Baker (Acanthaceae).	Lidzhatholo (Herbaceous).	Ornamental.	Used as home gardens decor.	Weed	Used as bedding plant (Fongod *et al.,* 2013).
Jacaranda mimosifolia D. Don (Bignoniaceae).	Mudzhagarannda (Tree).	Ornamental.	Used as home gardens decor.	1b	Antimicrobial activities (Nisar *et al.,* 2014).
Jatropha curca L. (Euphorbiaceae).	Mafura-donga (Shrub).	Medicinal.	Infussion of rhizome is used for sexual stimulation and blood purification.	2	Nuts are used in the biodiesel production (Kivevele and Huan, 2015).
Lantana camara L. (Verbenaceae).	Tshidzimba-mbule (Shrub).	Food.	Fruits are edible.	1b	Defoliated leaves improve soil fertility

					(Chikuvire *et al.,* 2013).
Ligustrum japonicum Thunb. (Oleaceae).	White wax tree (Shrub).	Ornamental.	Planted in home gardens as decor and wind-breaker.	1b	Used as bioindicator for heavy metals monitoring (Youssef *et al.,* 2013).
Lippia javanica (Burm F.) Spreng (Verbenaceae).	Musudzungwane (Shrub).	Medicinal and catalyst.	Fresh leaves are used as green tea for losing weight.	Invader.	Extract from leaves are used in the synthesis of silver nanocolloid antibacterial (Kumar *et al.,* 2015).
Malvastrum coromandelianum (L.) Garcke (Malvaceae).	Mutombane (Herbaceous).	Food.	Edible.	1b.	Antidiabetic activities (Pandey, 2015).
Melia azedarach L. (Meliaceae).	Muserenga (Tree).	Medicinal.	Infusion of barks are taken orally for abortion.	1b.	Eczema (Adamu *et al.,* 2014).
Morus alba L. (Moraceae).	Mutobeila (Tree).	Fruit.	Edible.	2.	Diabetes and cardiacal disorders (Bagachi *et at.,* 2013).
Nicandra physalodes (L.) Gaertn.	Murungudane-wa-nowa	Medicine.	Dried powdered leaves are smoked to treat asthma and headache.	1b.	Insect repellent (Yadav *et al.,* 2016).

(Solanaceae).	(Herbaceous).				
Nicotiana glauca L. (Solanaceae).	Bulara or fola la ḓaka (Tree).	Social.	Dried powdered leaves are smoked as cirgarrete or taken as snuff.	1b.	Epilepsy and genital warts (Molefe, 2013).
Opuntia ficus-indica (L.) Mill (Cactaceae).	Mudoro (Secculent).	Fruits.	Fruits are edible.	1b.	Fruits are highly nutritionous (El-Mostafa *et al.,* 2014).
Opuntia monocantha (Willd.) Haw. (Cactaceae).	Mudoro (Secculent).	Fruits.	Fruits are edible.	1b.	Urinary diseases (Kifayatullah and Waheed, 2013).
Paraserianthes lophantha (Will.) I.C. Nielsen (Fabaceae).	Muluwa (Tree).	Wood.	Used as fire wood.	1b	Ornamentally used for making shade (Brown and Gardner, 2011).
Physalis angulate L. (Solanaceae).	Murungudane (Herbaceous).	Fruits.	Fruits are edible.	Invader	Urinary infections and gonnorhea (Augustine and Ufuoma, 2013).
Phytolacca octandra L. (Phytolaccaceae).	Muikhi (Herbaceous).	Ornamental.	Liquid from crushed fruits used for nails coloration.	1b.	Bilharzia (Kariuki *et al.,* 2016).
Plectranthus comosus Sims (Lamiaceae).	Tshiololwi (Shrub).	Medicinal and ornomental.	Leaves are used to treat tuberculosisand as snake repellent.	1b.	Infussion of leaves are used to treat herpes (Enyew *et al.,* 2014).

Psidium guajava L. (Myrtaceae).	Mugwavha (Tree).	Medicinal and fruit.	Decoction of root is used to treat STI. Fruits are edible.	2.	Typhoid fever, gastroenteritis as well as enteric fever (Taura *et al.,* 2014).
Ricinus communis L. (Euphorbiaceae).	Mupfure (Shrub).	Medicinal.	Decoction of root and fruits are used to treat STI. Dried powdered leaves are smoked treat asthma.	1b.	Improve fertility in women (Inayor and Ibraheem, 2014).
Rivina humilis L. (Phytolaccaceae).	Muiki (Herbaceous).	Ornamental.	Liquid from crushed fruits is used as nail color.	1a.	Pesticide (Arumugam *et al.,* 2015).
Rubus fruticosus L. (Rosaceae).	Munambala (Shrub).	Fruit and ornamental.	Fruits are edible and also used by ladies for colouration of lips.	2.	Use in the treatment of anxiety problems (Riaz *et al.,* 2014). Fruits are taken as antioxidants (Verma *et al.,* 2014).
Salix babylonica L. (Salicaceae).	Mubibiri (tree).	Medicinal.	Steam from boiled fresh leaves used to treat flu and cough.	2	Liquid from crushed leaves used to treat ear diseases (Khan *et al.,* 2013).
Senna didymobotrya (Fresen.) H.S. Irwin and Barneby	Munembe-nembe (Shrub).	Medicinal.	Bark decoction are used for blood cleansing in men and treating of STI. Infusion of fruits is used for stimulating	1b	Fever and malaria (Amuka *et al.,* 2014).

(Fabaceae).			fertility in women.		
Senna septemtrionalis (Viv.) H.S. Irwin and Barneby (Fabaceae).	Munembe-nembe (Shrub).	Medicinal.	blood cleansing in men and treating of STI.	1b.	Decoction of root used to treat malaria (Ngarivhume *et al.,* 2015).
Sida cordifolia L. (Malvaceae).	Mutombane (Herbaceous).	Food.	Edible.	Weed	Neurological and urinary disorders (Pramanick *et al.,* 2015).
Solanum betaceum Cav. (Solanaceae).	Muindia-tamatisi (Tree).	Food.	Fruits are edible and also used in vegetable for adding flavor	3	Serve as bioactive peptides for human health (Ordóñez *et al.,* 2011). Fruits are mixed with other vegetable for making of green salads (do Nascimento *et al.,* 2013).
Solanum chrysotrichum Schltdl. (Solanaceae).	Mushulwa (Tree).	Medicinal.	Leaves are used to treat inflammatory response on skin and swelling. Decoction of root is used to treat STI.	Invader.	Viginal thrush (Herrera-Arellano *et al.,* 2013).
Solanum	Mututulwa	Medicinal.	Fruits are used to treat tapeworms in	1b.	Insecticides (Hamouda

elaeagnifolium Cav. (Solanaceae).	(Herbaceous).		live stocks. Crushed leaves are used to treat wounds.		*et al.,* 2015).
Solanum incanum L. (Solanaceae).	Mututulwa-muhulwane (Shrub).	Medicinal.	Fruits are used for treating tapeworms in live stocks. Crushed leaves are used to treat wounds.	Invader.	Wounds, stomach constipation and headache (Mwonjoria *et al.,* 2014).
Solanum mauritianum Scop. (Solanaceae).	Mubongabonga (Herbaceous).	Wood.	Used as fire wood.	1b.	Toothache (Semenya *et al.,* 2013a).
Solanum nigrum L. (Solanaceae).	Muxe (Herbaceous).	Food.	Edible.	1b.	Roots are used to treat of vomiting disorder and tetanus following abortion (Muhammad and Shinkafi, 2014).
Sonchus oleraceae L. (Asteraceae).	Shashe (Herbaceous).	Food.	Edible.	Weed.	Diabetes (Teugwa *et al.,* 2013).
Sphagneticola trilobata (L.) Pruski (Asteraceae).	Tshishengelapofu (Herbaceous).	Ornaments.	Used in home gardens as decor.	1b.	Leaves are used for making tea (Trojan-Rodrigues *et al.,* 2012).
Striga asiatica (L.) Kuntze	Vhuri (Herbaceous).	Medicine.	Boiled roots are used to treat urinary infections. Liquid from crushed leaves	X3	Haemorrhoids, wounds and haemorrhoids (Mahwasane *et al.,*

(Orobanchaceae).			used to treat wounds.		2013).
Syngonium podophyllum (W.Bull) Engelm (Araceae).	Mufhongwe (Creepers and climber).	Ornamental.	Used in home gardens as decor.	1b	Used to treat skin burning (Anooj *et al.,* 2016).
Tagetes minuta L. (Asteraceae).	Mushasha-thuri (Herbaceous).	Medicinal.	The whole plant is boiled and its steam used for deliverance of patients from evil spirits.	Weed.	Source of oil and cure for inflammatory disorder (Karimian *et al.,* 2014).
Taraxacum officinale F.H. Wigg (Asteraceae).	Shashe (Herbaceous).	Food.	Edible.	Weed.	Leaves are taken as vegetable (Hamid and Raina, 2014).
Tipuana tipu (Benth.) Kuntze (Fabaceae).	Munanga (Tree).	Medicinal and ornamental.	Decoction of barks used to treat cough and pains. Also used as shade.	3.	Diarrhea and menstrual pains (Amen *et al.,* 2013).
Xanthium strumarium L. (Asteraceae).	Gwanda (Herbaceous).	Medicinal.	Decoction of whole plant used for blood purification in men.	1b.	Tuberculosis as well as kidney disorders (Wariss *et al.,* 2014).

Zaleya pentandra (Linn.) Jeffrey (Aizoaceae).	African-purslane (Herbaceous).	Medicinal.	Used to treat snake bites.	Weed	Treat scorpion bites (Mohammed *et al.,* 2015).

A total of 78 problem weeds and alien invasive plant spp were used by village dwellers for maintaining their livelihood. The plant spp belonged to 33 families. Among the 78 problem weeds and alien invasive plant spp, 34 spp belonged to category 1 whereas, only 1 spp belonged to category 1a.

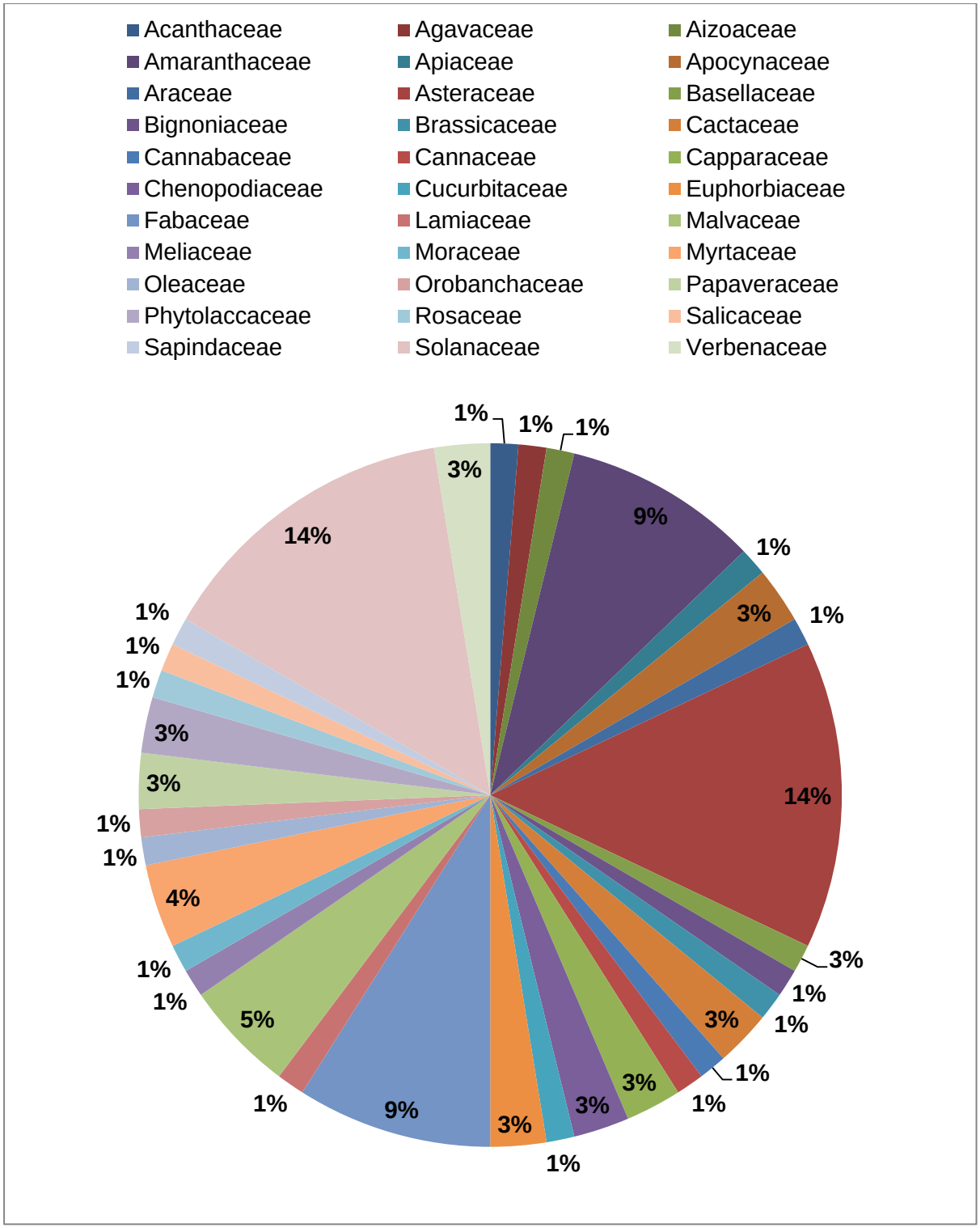

Figure 8: Problem weeds and alien invasive plant spp per family percentage.

Fig. 8 represents the percentage (%) number of problem weeds and alien invasive plant spp utilized per family.

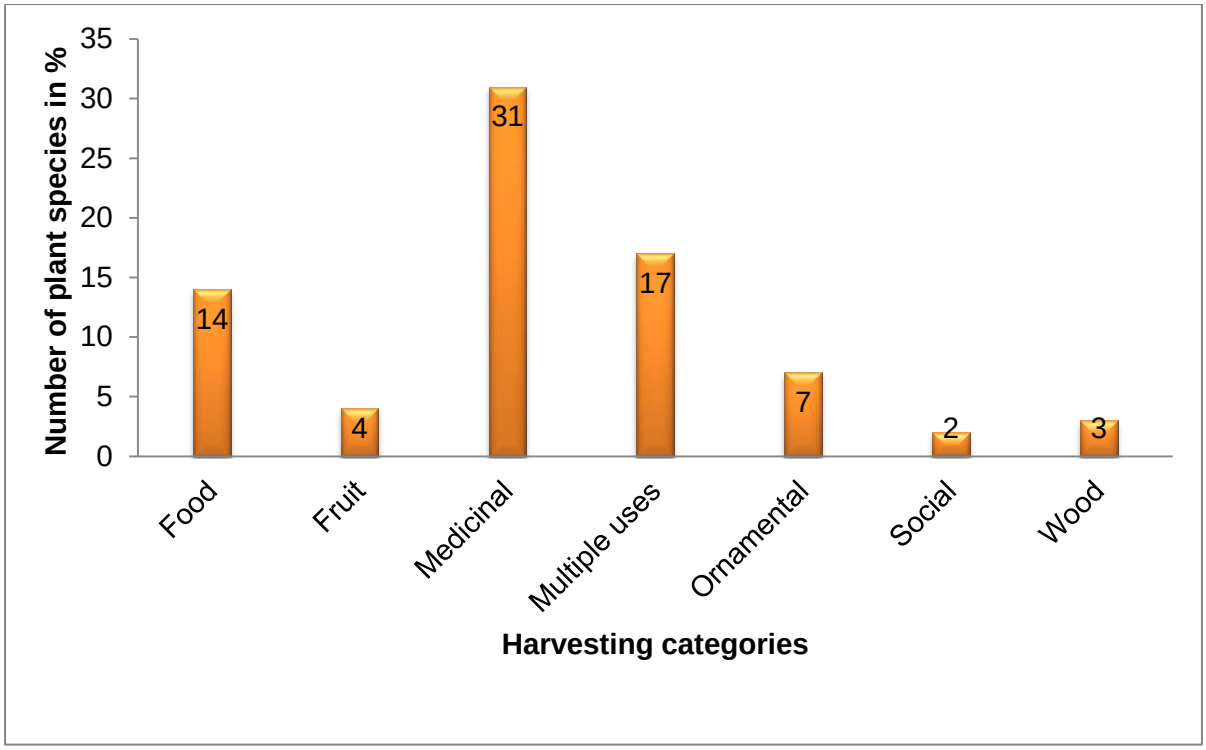

Figure 9: Problem weeds and alien invasive spp utilized per harvesting category.

As shown on Fig. 9, 31% problem weeds and alien invasive plant spp were utilized for medicinal purpose. The rest were utilized for various purposes such as food; fruit; multiple use; ornamental; social and wood.

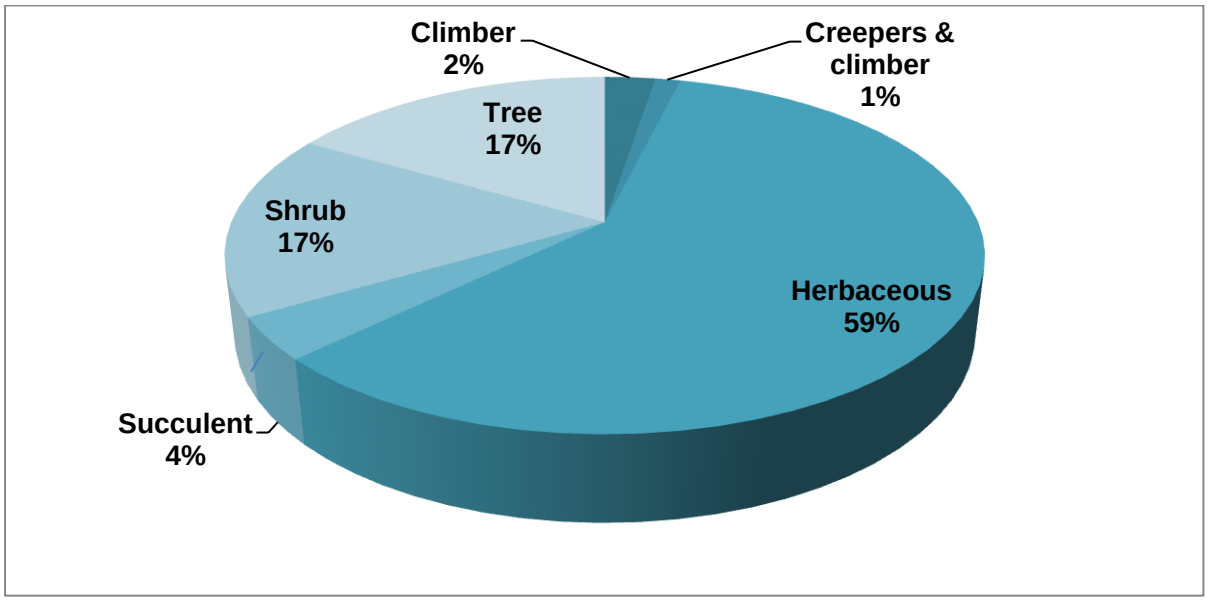

Figure 10: Growth habits of problem weeds and alien invasive plant spp.

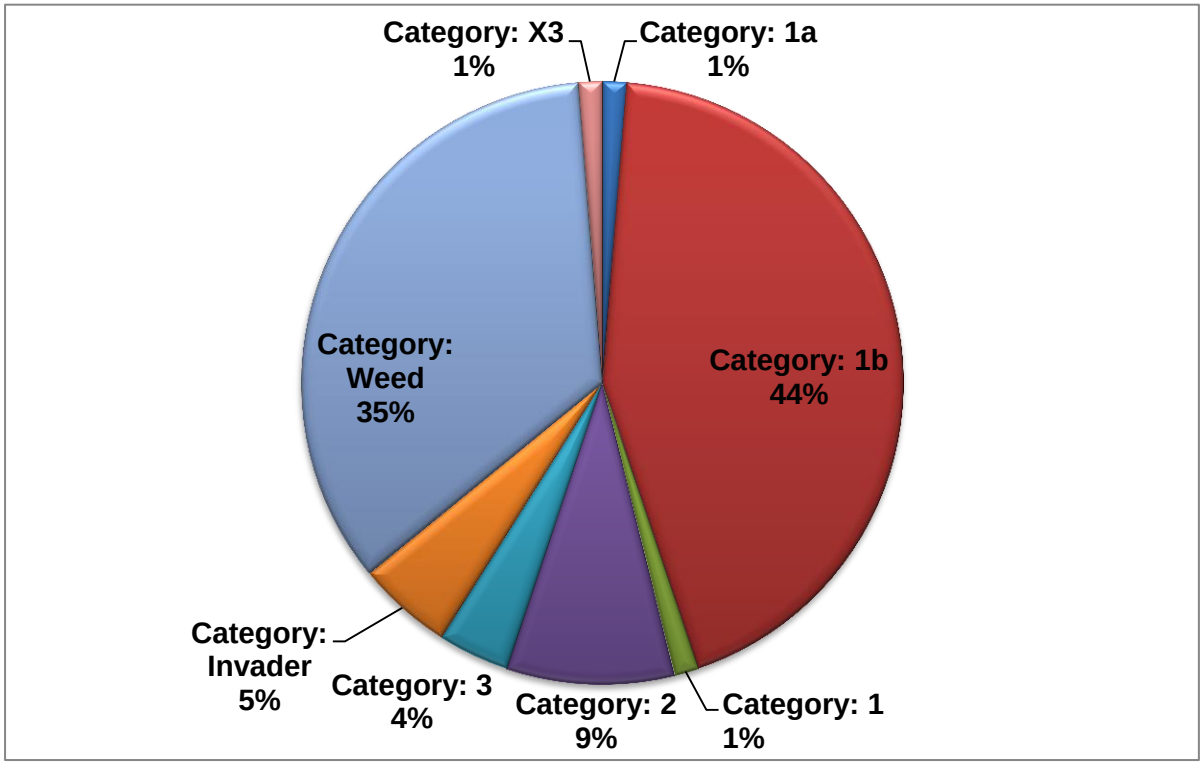

Figure 11: Problem weeds and alien invasive plant species categories.

Fig. 11 illustrates categories of problem weeds and alien invasive plant spp uses in percentage, 44% plants were under category 1b, of the NEMBA regulations, 35% were weeds, 9% were category 2, of the CARA regulations, 5% were invaders, and 4% were category 3, of the CARA. The plant spp under category 1a of the NEMBA and X3 were both 1%.

4.4. Discussion.

Fig. 5 showed that more than two-third of participants were female participants. Howard (2016), reported that indigenous knowledge basis regarding utilization of plant spp is gender imbalanced. Fig. 5 also indicated that both male and female participants declined with an increase in age. This was due to the fact that older age participants for both gender groups were few in both villages. According to the Statistics South Africa (2016), the average male life expectancies in Limpopo Province is approximately 57 years old, whereas, the female average life expectancies are 60 years old.

Table 1 showed that indigenous people were able to recognize problem weeds and alien invasive plant spp using their behavioral characteristics. According to Ghasab *et al.* (2015), recognition of plant spp using their characteristic features has been essential and cost effective for reduction of taxonomic identification cost. Almost all participants categories

were more familiar with the legislative requirements for problem weeds and alien invasive plant spp, as well as their traditional cost and benefits. Various plant spp have been used for various purposes for many years ago (Joseph *et al.,* 2013). Most of participants claimed that the legislative requirement has been biased since it did not consider their knowledge on utilization of problem weeds and alien invasive plant spp. Semenya *et al.* (2012), reported that some of the exotic problem plants are essential for the provision of traditional health care. Almost all participants claimed that their indigenous knowledge on the utilization of alien invasive weeds were being transferred to them by their forefathers through various ways of communications, one but not least being ancestral visit through dreams and visions. According to Paulin and Suneson (2015), knowledge transfer is considered to be crucial for learning and problem solving.

Zurba and Berkes (2014), reported that since indigenous people have different intrinsic relations with ecological environment, their indigenous ecological knowledge can also be communicated differently. The highly significant difference among informant's knowledge on negative impact and benefits of problem weeds and alien invasive spp, demonstrated that the indigenous knowledge system is still vibrant and dynamic (Green, 2012). Perceptions among traditional healers, herbalists and dwellers on socio-economic benefits derived from problem weeds and alien invasive plant spp were higher, whereas farmers' perceptions were higher with regard to the losses. This was influenced by their practical knowledge and experience about the uses of these plant spp in maintaining their wellbeing. According to Tengö *et al.* (2014), local indigenous knowledge can aid with the provision of understanding biodiversity, ecosystem for the benefits of human well-being. Farmers' perceptions were based on the fact that they feared to lose economic benefits due to problem weeds and alien invasive plant spp (Morais *et al.,* 2017).

Fig. 8 showed that the most preferred families for problem weeds and alien invasive plant spp utilized were Asteraceae (14%) and Solanaceae (14%), followed by Fabeceae (9%) and Amaranthaceae (9%). The following families were the least, but equally utilized namely: Agavaceae, Aizoaceae, Apiaceae, Araceae, Brassicaceae, Cannabaceae, Cannaceae, Cucurbitacceae, Lamiaceae, Meliaceae, Moraceae, Oleaceae, Orobanchaceae, Rosaceae, Salicaceae and Sapindaceae. Asteraceae and Solanaceae and some families have had fewer numbers of spp being utilized possibly because they are small families characterized by few spp. According to Maroyi (2013), large plant families are characterized by numerous and diverse spp. Participants especially traditional healers and herbalists reported that they collected medicinal plant materials separately, but mixed those plants when preparing medication for patients. According to Ngarivhume *et al.* (2015), African traditional remedies

administered by either traditional healers or herbalists are dynamically and continuously available at needy time.

Fig. 9 showed that 31 problem weeds and alien invasive plant spp were being utilized for medicinal purpose, followed by multiple-uses (17) and food (14). The rest of the spp were utilized for purposes such as ornamental, fruits, social and wood. According to Rankoana (2016), rural dwellers utilizes plant resources for the purpose of their well-being, food, firewood and shelters. Most of problem weeds and alien invasive plant spp were utilized for medicinal purpose, possibly because of their increasing need to serve as an alternative for the overexploited and disappearing indigenous medicinal plants in the traditional health care system. Bibi *et al.* (2014), reported that two-third of people worldwide prefer the use of herbal medicine. Indigenous medicinal plants are disappearing on a daily basis due to their expanded commercialization, an increase in human population, poverty and expensive western medication (Bodeker *et al.,* 2014).

In Fig. 10, the mostly preferred growth habit was herbaceous (59%), followed by shrubs (17%) and trees (17%). succulent (4%) was the third, followed by climber (2%) and the least was creepers-climber (1%). High utilization of herbaceous spp was fostered by factors such as abundance and domestic values with regard to their uses as vegetables, decorations as well as rehabilitating agricultural soil. Wild plant spp have been playing an essential role in maintaining stability for food security (Chand *et al.,* 2017). Kibar and Kibar (2017), reported that one billion rural dwelling people worldwide, especially in developing and underdeveloped countries consider wild vegetable as a cheap food source for their diet. According to Engemann *et al.* (2016), climatic factors have been influential to the dominance of plant spp. Herbaceous spp are essential for regulating and maintaining ecosystem integrity (Elliott *et al.,* 2015). Other possible reasons for higher utilization of herbaceous spp might be due to their pioneering role and also their abundance on a seasonal basis. Blanco *et al.* (2016), reported that herbaceous plant spp are mostly abundant from December until April in subtropical countries.

In Fig 11, plant spp under category 1b (44%) (NEMBA listed problem weeds and alien invasive plant spp) were highly utilized, followed by weed category (35%), category 2 spp was (9%) (CARA listed problem weeds and alien invasive plant spp). Other moderately utilized categories of problem weeds and alien invasive plant spp were invaders (5%) and category 3 (4%) (CARA). The least but equally utilized categories were category 1a (NEMBA) and X3 (CARA). According to Bramilow (2010), category 1a (NEMBA) and category 1 (CARA) alien invasive spp are regarded as high management priorities and those spp should be compulsory eradicated in the ecosystem. Problem weeds and alien invasive

plant spp under category 1b (NEMBA) and 2 (CARA) are considered as invaders and they colonize biodiversity at a steady rate (Robinson *et al.,* 2016). Their eradications are considered to be a national priority under the South African national management program for aliens invasive (Bromilow, 2010).

High utilization of category 1b, alien invasives could be possibly influenced by their abundance and availability. Almost all these spp were abundantly found on homestead fences, disturbed areas, along the village streets and along the banks main roads. Thus, rural dwellers who unambiguously understand their values could easily utilize them during the needy time, since these plants were abundantly found closer to their dwelling areas. Some of the participants (traditional healers and herbalists), during the sampling survey reported that they mostly preferred to utilize medicinal plant materials from spp that recovered rapidly after being harvested. This was influenced by the cultural belief that the rate at which the medicinal plant recover, indicates that patients could also heal rapidly.

Traditional healers and herbalists also reported that they constantly utilize problem weeds and alien invasive plant spp for medicinal purpose as a substitute for the disappearing as well as rare indigenous medicinal plant spp. Skalli and Jordan (2017), reported that traditional healing has been fostered by religious belief, cultural practices and tradition. The administration of traditional remedies by traditional healers has been essential and alternative for many people to access primary health care system (Sigidi *et al.,* 2016). According to Allen *et al.* (2013), novel disturbance could foster the abundance of alien invasive plant spp. Staudhammer *et al.* (2015), reported that problem weeds and alien invasive plant spp found adjacent to the dwelling areas form part of essential ecological and vegetation structure. According to Pérez-Harguindeguy *et al.* (2013), the functionality of plant spp resembles the ecological strategies to respond to environmental catastrophes.

4.5. Conclusion.

The imbalance in gender participation remains the challenging factor. Bass *et al.* (2016), reported that balanced gender participation could provide a unique insight view. Problem weeds and alien invasive plant spp should not be conceptualized only as a threat, but as a tool to address challenges such as socio-economic, socio-ecological and biosecurity. Boillat and Berkes (2013), reported that the indigenous knowledge system could address existing and future biodivrsity challenges. This study disagreed with the ideas that generalized problem weeds and aliens invasive plant spp as only threats. This study accepts that problem weeds and alien invasive plant spp have both negative impact and benefits towards biodiversity (Riddin *et al.,* 2016). Discrediting the benefits derived from problem weeds and

alien invasive spp could harm their contribution towards maintaining the rural livelihood and biosecurity. In addition, this study supports the idea that the dynamics of indigenous knowledge system should be acknowledged (Boillat and Berkes, 2013). According to Tshisikhawe (2016), sustainable harvesting of plant resources should be conceived as a pillar for promoting good conservation practices. Further survey on the use of problem weeds and alien invasive plant spp as substitutes for rare and disappearing plant spp could provide deeper insights. This could be conceived as a pathway for remedial action plan to help sustain and conserve rare indigenous medicinal plant spp by alternatively using problem weeds and invasive alien spp.

4.6. References

Adamu, M., Naidoo, V. and Eloff, J. N., 2014. The antibacterial activity, antioxidant activity and selectivity index of leaf extracts of thirteen South African tree species used in ethnoveterinary medicine to treat helminth infections. *BMC veterinary research*, **10 (1): 1 – 7.**

Adli, B., Boutekrabt, A., Touati, M., Bakria, T., Touati, A. and Bezini, E., 2017. Phenotypic diversity of *Opuntia ficus indica* (L.) MILL. in the Algerian steppe. *South African Journal of Botany*, **109: 66 – 74.**

Alexander, J., Benford, D., Cockburn, A., Cravedi, J., Dogliotti, E., Di Domenico, A., Fernandez-Cruz, M. L., Fürst, F., Fink-Gremmels, J., Galli, C. L. and Grandjean, P., 2008. Tropane alkaloids (from *Datura* sp.) as undesirable substances in animal feed. *The EFSA Journal*, **691: 1 – 55.**

Allen, J. M., Leininger, T. J., Hurd, J. D., Civco, D. L., Gelfand, A. E. and Silander, J. A., 2013. Socioeconomics drive woody invasive plant richness in New England, USA through forest fragmentation. *Landscape ecology*, **28 (9): 1671 – 1686.**

Amen, Y. M., Marzouk, A. M., Zaghloul, M. G. and Afifi, M. S., 2013. Bioactive compounds from *Tipuana tipu* growing in Egypt. *Journal of American Science*, **9 (10): 334 – 339.**

Amuka, O., Mbugua, P. K. and Okemo, P. O., 2014. Ethnobotanical survey of selected medicinal plants used by the Ogiek communities in Kenya against microbial infections. *Ethnobotany Research and Applications*, **12: 627 – 641.**

Anooj, E. S., Pavithra, K. H., Danie kingsley, J. and Praseetha, P. K., 2016. Biodiversity survey on medicinal and ornamental plants in Vit University. *International Journal of Scientific & Engineering Research,* **7 (10): 1881 – 1898.**

Antwi, S. K. and Hamza, K., 2015. Qualitative and Quantitative Research Paradigms in Business Research: A Philosophical Reflection. *European Journal of Business and Management*, **7 (3): 217 – 225.**

Arhoghro, E. M., Berezi, E. P. and Prohp, T. P., 2014. Phytochemical constituents and effect of combined ethanolic leaf extract of *costus afer* and *cleome rutidosperma* on lipid profile and some haematological parameters in wistar rats. *International Journal of Current Microbiology Applied Sci*ence **3 (5): 673 – 679.**

Arumugam, E., Muthusamy, B., Dhamodaran, K., Thangarasu, M., Kaliyamoorthy, K. and Kuppusamy, E., 2015. Pesticidal activity of *Rivina humilis* L. (Phytolaccaceae) against

important agricultural polyphagous field pest, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). *Journal of Coastal Life Medicine,* **3 (5): 389 – 394.**

Aruna, M. S., Prabha, M. S., Priya, N. S. and Nadendla, R., 2015. *Catharanthus roseus*: Ornamental plant is now medicinal boutique. *Journal of Drug Delivery and Therapeutics*, **5 (3): 1 – 4.**

Augustine, A. A. and Ufuoma, O., 2013. Flavonoids from the leaves of *Physalis angulata* Linn. *African Journal of Pharmaceutical Research & Development,* **5 (1): 40 – 43.**

Bagachi, A., Semwal, A. and Bharadwaj, A., 2013. Traditional uses, phytochemistry and pharmacology of *Morus alba* Linn.: a review. *Journal of Medicinal Plants Research*, **7 (9): 461 – 469.**

Bass, S. B., Wolak, C., Greener, J., Tedaldi, E., Nanavati, A., Ruppert, K. and Gordon, T. F., 2016. Using perceptual mapping methods to understand gender differences in perceived barriers and benefits of clinical research participation in urban minority HIV+ patients. *AIDS care*, **28 (4): 528 – 536.**

Bhat, A., Satpathy, G. and Gupta, R. K., 2015. Evaluation of Nutraceutical properties of *Amaranthus hypochondriacus* L. grains and formulation of value added cookies. *Journal of Pharmacognosy and Phytochemistry*, **3 (5): 51 – 54.**

Bibi, S., Sultana, J., Sultana, H. and Malik, R. N., 2014. Ethnobotanical uses of medicinal plants in the highlands of Soan Valley, Salt Range, Pakistan. *Journal of ethnopharmacology*, **155 (1): 352 – 361.**

Blanco, L. J., Paruelo, J. M., Oesterheld, M. and Biurrun, F. N., 2016. Spatial and temporal patterns of herbaceous primary production in semi-arid shrublands: a remote sensing approach. *Journal of Vegetation Science*, **27: 716 – 727.**

Bodeker, G., van 't Klooster, C. and Weisbord, E., 2014. *Prunus africana* (Hook. f.) Kalkman: The overexploitation of a medicinal plant species and its legal context. *The Journal of Alternative and Complementary Medicine*, **20 (11): 810 – 822.**

Boillat, S. and Berkes, F., 2013. Perception and interpretation of climate change among Quechua farmers of Bolivia: indigenous knowledge as a resource for adaptive capacity. *Ecology and Society*, **18 (4): 1 – 21.**

Brahmachari, G., Gorai, D. and Roy, R., 2013. *Argemone mexicana*: chemical and pharmacological aspects. *Revista Brasileira de Farmacognosia*, **23 (3): 559 – 567.**

Bromilow, C., 2010. *Problem plants and alien weeds of South Africa.* Briza Publications, Arcadia, Republic of South Africa.

Brown, G. K. and Gardner, M. G., 2011. Isolation, characterisation and transferability of microsatellites for *Paraserianthes lophantha*, Cape Wattle (Leguminoseae: Mimosoideae): a significant weed worldwide. *Muelleria*, **29 (1): 87 – 92.**

Bvenura, C. and Afolayan, A. J., 2014. Ethnobotanical survey of wild vegetables in Mbashe and Nkonkobe municipalities, Eastern Cape Province, South Africa. *Acta Botanica Gallica*, **161 (2): 189 – 199.**

Chand, R., Singh, A.N. and Nirmala, C., 2017. Ethnoecological Survey of Underutilized Plant Diversity of Hamirpur District, Himachal Pradesh, India: An Edibility Assessment. *Environment and Ecology Research*, **5 (1): 13 – 29.**

Chikuvire, T. J., Karavina, C., Parwada, C. and Maphosa, B. T., 2013. *Lantana camara* and *Tithonia diversifolia* leaf teas improve the growth and yield *of Brassica napus*. *African Journal of Agricultural Research,* **8 (48): 6220 – 6225.**

Choy, L. T., 2014. The strengths and weaknesses of research methodology: comparison and complimentary between qualitative and quantitative approaches. *IOSR Journal of Humanities and Social Science*, **19 (4): 99 – 104.**

Darsini, I. P., Shamshad, S., and Poul, M. J., 2015. *Canna indic* (L.): A plant with potential healing power: A review. *International Journal of Pharmaceutical and Biological Sciences,* **6 (2): 1 – 8.**

Das, K. and Duarah, P., 2013. Invasive Alien Plant Species in the Roadside Areas of Jorhat, Assam: Their Harmful Effects and Beneficial Uses. *International Journal of Engineering Research and Applications,* **3 (5): 353 – 358.**

Dhanalakshmi, R. and Manavalan, R., 2014. Bioactive compounds in leaves of Corchorus trilocularis L. by GC-MS analysis. *International Journal of PharmTech Research*, **6: 1991 – 1998.**

Dickie, I. A., Bennett, B. M., Burrows, L. E., Nunez, M. A., Peltzer, D. A., Porté, A., Richardson, D. M., Rejmánek, M., Rundel, P. W. and van Wilgen, B. W., 2014. Conflicting values: ecosystem services and invasive tree management. *Biological Invasions*, **16 (3): 705 – 719.**

do Nascimento, G. E., Hamm, L. A., Baggio, C. H., de Paula Werner, M. F., Iacomini, M. and Cordeiro, L. M., 2013. Structure of a galactoarabinoglucuronoxylan from tamarillo

(*Solanum betaceum*), a tropical exotic fruit, and its biological activity. *Food chemistry*, **141 (1): 510 – 516.**

Dye, P., Naiken, V., Clulow, A., Prinsloo, E., Crichton, M. and Weiersbye, I., 2017. Sap flow in *Searsia pendulina* and *Searsia lancea* trees established on gold mining sites in central South Africa. *South African Journal of Botany*, **109: 81 – 89.**

Dyubeni, L. and Buwa, L.V., 2012. An ethnobotanical study of plants used for the treatment of ear, nose and throat (ENT) infections in Nkonkobe Municipality, South Africa. *Journal of Medicinal Plants Research*, **6 (14): 2721 – 2726.**

Elliott, K. J., Vose, J. M., Knoepp, J. D., Clinton, B. D. and Kloeppel, B. D., 2015. Functional role of the herbaceous layer in eastern deciduous forest ecosystems. *Ecosystems*, **18 (2): 221 – 236.**

El-Mostafa, K., El Kharrassi, Y., Badreddine, A., Andreoletti, P., Vamecq, J., El Kebbaj, M., Latruffe, N., Lizard, G., Nasser, B. and Cherkaoui-Malki, M., 2014. Nopal cactus (*Opuntia ficus-indica*) as a source of bioactive compounds for nutrition, health and disease. *Molecules*, **19 (9): 14879 – 14901.**

Engemann, K., Sandel, B., Enquist, B. J., Jørgensen, P. M., Kraft, N., Marcuse-Kubitza, A., McGill, B., Morueta-Holme, N., Peet, R. K., Violle, C. and Wiser, S., 2016. Patterns and drivers of plant functional group dominance across the Western Hemisphere: a macroecological re-assessment based on a massive botanical dataset. *Botanical Journal of the Linnean Society*, **180 (2): 141 – 160.**

Enyew, A., Asfaw, Z., Kelbessa, E. and Nagappan, R., 2014. Ethnobotanical study of traditional medicinal plants in and around Fiche District, central Ethiopia. *Current Research Journal of Biological Sciences*, **6 (4): 154 – 167.**

Essiett, U. A. and Iwok, E. S., 2014. Floral and Leaf Anatomy of *Hibiscus* Species. *American Journal of Medical and Biological Research*, **2 (5): 101 – 117.**

Fongod, A. G. N., Modjenpa, N. B. and Veranso, M. C., 2013. Ethnobotany of *Acanthaceae* in the Mount Cameroon region. *Journal of Medicinal Plants Research*, **7 (38): 2859 – 2866.**

Fouche, G., Sakong, B. M., Adenubi, O. T., Pauw, E., Leboho, T., Wellington, K. W. and Eloff, J. N., 2016. Anthelmintic activity of acetone extracts from South African plants used on egg hatching of *Haemonchus contortus*. *Onderstepoort Journal of Veterinary Research*, **83 (1): 1 – 7.**

Gaertner, M., Biggs, R., Te Beest, M., Hui, C., Molofsky, J. and Richardson, D. M., 2014. Invasive plants as drivers of regime shifts: identifying high-priority invaders that alter feedback relationships. *Diversity and Distributions*, **20 (7): 733 – 744.**

Ghasab, M. A. J., Khamis, S., Mohammad, F. and Fariman, H. J., 2015. Feature decision-making ant colony optimization system for an automated recognition of plant species. *Expert Systems with Applications*, **42 (5): 2361 – 2370.**

Green, L. J., 2012. Beyond South Africa's' indigenous knowledge-science'wars. *South African Journal of Science*, **108 (7-8): 44 – 54.**

Hamid, A. and Raina, A. K., 2014. Ethnobotanical uses of plants in and around Kanji Wildlife Sanctuary, north-west Himalaya. *International Journal of Science and Research*, **3: 538 – 545.**

Hamouda, A. B., Zarrad, K., Laarif, A. and Chaieb, I., 2015. Insecticidal Effect of *Solanum elaeagnifolium* extracts under laboratory conditions. *Journal of Entomology and Zoology Studies*, **3 (3): 187 – 190.**

Hanphanphoom, S. and Krajangsang, S., 2016. Antimicrobial Activity of *Chromolaena odorata* Extracts against Bacterial Human Skin Infections. *Modern Applied Science*, **10 (2): 159 – 171.**

Herrera-Arellano, A., López-Villegas, E. O., Rodríguez-Tovar, A. V., Zamilpa, A., Jiménez-Ferrer, E., Tortoriello, J. and Martínez-Rivera, M. A., 2013. Use of antifungal saponin SC-2 of *Solanum chrysotrichum* for the treatment of vulvovaginal candidiasis: In vitro studies and clinical experiences. *African Journal of Traditional, Complementary and Alternative Medicines*, **10 (3): 410 – 417.**

Howard, P., 2016. *The major importance of'minor'resources: Women and plant biodiversity*. International Institute for Environment and Development, London, United Kingdom.

Inayor, B. N. and Ibraheem, O., 2014. Assessing *Ricinus communis* L.(castor) whole plant parts for Phenolics and Saponins constituents for Medicinal and Pharmaceutical applications. *International Journal of Advances in Pharmacy, Biology and Chemistry,* **3 (4): 815 – 826.**

Joseph, B., George, J. and Mohan, J., 2013. Pharmacology and traditional uses of Mimosa pudica. *International journal of pharmaceutical sciences and drug research*, **5 (2): 41 – 44.**

Karimian, P., Kavoosi, G. and Amirghofran, Z., 2014. Anti–oxidative and anti–inflammatory effects of *Tagetes minuta* essential oil in activated macrophages. *Asian Pacific journal of tropical biomedicine*, **4 (3): 219 – 227.**

Kariuki, S. T., Kariuki, J. M., Mailu, B. M. and Muchiri, D. R., 2016. *Phytolacca octandra* (L.), *Phytolacca dodecandra* (LHerit) and *Balanites aegypiaca* (L.) extracts as potential molluscicides of schistosomiasis transmitting snails. *Journal of Medicinal Plants Research*, **10 (44): 823 – 828.**

Khan, R. U., Khan, S. U., Mehmood, S., Ullah, I. and Khan, A., 2013. Study of chemical constituents and medicinal uses of indicator species of District Bannu. *International Journal of Herbal Medicine*, **1 (2): 59 – 80.**

Kibar, B. and Kibar, H., 2017. Determination of the nutritional and seed properties of some wild edible plants consumed as vegetable in the Middle Black Sea Region of Turkey. *South African Journal of Botany*, **108: 117 – 125.**

Kifayatullah, M. and Waheed, I., 2013. Evaluation of hydroethanolic extract of *Opuntia monacantha* haw cladodes for antipyretic activity. *World Journal of Pharmacy and Pharmaceutical Sciences,* **3 (2): 1021 – 1030.**

Kivevele, T. and Huan, Z., 2015. Review of the stability of biodiesel produced from less common vegetable oils of African origin. *South African Journal of Science*, **111 (9-10): 01 – 07.**

Kumar, S., Singh, M., Halder, D. and Mitra, A., 2015. *Lippia javanica*: a cheap natural source for the synthesis of antibacterial silver nanocolloid. *Applied Nanoscience*, **6 (7): 1001–1007.**

Lall, N. and Kishore, N., 2014. Are plants used for skin care in South Africa fully explored?. *Journal of ethnopharmacology*, **153 (1): 61 – 84.**

Langat, D. K., Cheboiwo, J. K. and Muchiri, M. N., 2015. Financial analysis of growing Eucalyptus grandis for production of medium size power transmission poles and firewood in Kenya. *African Journal of Agriculture and Utilisation of Natural Resources for Sustainable Development*, **1 (1): 38 – 45.**

Legwaila, I. A., Thebe, G. T. and Selebatso, T., 2015. An inventory of plant species found in gravel borrow pit around Gaborone, Botswana. *Journal of Ecology and the Natural Environment,* **7 (11): 271 – 276.**

Lestari, D., Sukandar, E. Y. and Fidrianny, I., 2015. *Anredera cordifolia* Leaves Extract as Antihyperlipidemia and Endothelial Fat Content Reducer in Male Wistar Rat. *International Journal of Pharmaceutical and Clinical Research,* **7 (6): 435 – 439.**

Long, H. S., Stander, M. A. and Van Wyk, B. E., 2012. Notes on the occurrence and significance of triterpenoids (asiaticoside and related compounds) and caffeoylquinic acids in *Centella* species. *South African Journal of Botany*, **82: 53 – 59.**

Mahmood, A., Mahmood, A., Malik, R. N. and Shinwari, Z. K., 2013. Indigenous knowledge of medicinal plants from Gujranwala district, Pakistan. *Journal of ethnopharmacology*, **148 (2): 714 – 723.**

Mahwasane, S. T., Middleton, L. and Boadou, N., 2013. An ethnobotanical survey of indigenous knowledge on medicinal plants used by traditional healers of the Lwamondo area, Limpopo Province, South Africa. *South African Journal of Botany,* **88: 69 – 75.**

Maroyi, A., 2013. Use of weed as traditional vegetable in Shurungwi District, Zimbabwe. *Journal of Ethnobiology and Ethnomedicine,* **9: 1 – 10.**

Maslin, B. and McDonald, M., 2006. AcaciaSearch: evaluation of Acacia as a woody crop option for southern Australia. *Acacia Utilisation and Management–Adding*, **26: 67 – 75.**

Matzek, V., Covino, J., Funk, J. L. and Saunders, M., 2014. Closing the knowing–doing gap in invasive plant management: accessibility and interdisciplinarity of scientific research. *Conservation Letters*, **7 (3): 208 – 215.**

Mavengahama, S., McLachlan, M. and De Clercq, W., 2013. The role of wild vegetable species in household food security in maize based subsistence cropping systems. *Food Security*, **5 (2): 227 – 233.**

Mganga, N. D., 2014. The potential of bioaccumulation and translocation of heavy metals in plant species growing around the tailing dam in Tanzania. *International Journal of Science and Technology,* **3 (10): 690 – 697.**

Miladiyah, I. and Prabowo, B. R., 2015. Ethanolic extract of *Anredera cordifolia* (Ten.) Steenis leaves improved wound healing in guinea pigs. *Universa Medicina*, **31 (1): 4 – 11.**

Mohammed, M. S., Khalid, H. S., Muddathir, A. E., El Tahir, K., Khan, A. A., Algadir, H. A., Osman, W . J. A. and Siddiqui, N. A., 2015. Effect of some plants' extracts used in

Sudanese folkloric medicines on carrageenan-induced inflammation. *Pakistan Journal of Pharmacological Science*, **28 (1): 159 – 165.**

Molefe, N. I., 2013. *Anthelmintic, Anticancer and Phytochemical Screening of Cotyledon Orbiculata; Hermannia Depressa; Nicotiana Glauca and Potassium Permanganate.* Doctoral dissertation, University of the Free State, South Africa.

Morais, M., Marchante, E. and Marchante, H., 2017. Big troubles are already here: risk assessment protocol shows high risk of many alien plants present in Portugal. *Journal for Nature Conservation*, **35: 1 – 12.**

Moustafa, M. F., Alamri, S. A., Taha, T. H. and Alrumman, S. A., 2013. In vitro antifungal activity of *Argemone ochroleuca* Sweet latex against some pathogenic fungi. *African Journal of Biotechnology*, **12(10): 1132 – 1137.**

Muhammad, S. and Shinkafi, M. A., 2014. Ethnobotanical survey of some medicinal important leafy vegetables in North Western Nigeria. *Journal of Medicinal Plants Research*, **8 (1): 6 – 8.**

Mujuru, M. and Sekhejane, P., 2014. Legalising Cannabis for Cancer. *Prostate*, **4315: 15 – 21.**

Mwonjoria, J. K., Ngeranwa, J. J., Kariuki, H. N., Githinji, C. G., Sagini, M. N. and Wambugu, S. N., 2014. Ethno medicinal, phytochemical and pharmacological aspects of *Solanum incanum* (lin.). *International Journal of Pharmacology and Toxicology*, **2 (2): 17 – 20.**

Nethengwe, M. F., Opoku, A. R., Dludla, P. V., Madida, K. T., Shonhai, A., Smith, P. and Singh, M., 2012. Larvicidal, antipyretic and antiplasmodial activity of some Zulu medicinal plants. *Journal of Medicinal Plants Research*, **6 (7): 1255 – 1262.**

Ngarivhume, T., van't Klooster, C. I., de Jong, J. T. and Van der Westhuizen, J. H., 2015. Medicinal plants used by traditional healers for the treatment of malaria in the Chipinge district in Zimbabwe. *Journal of Ethnopharmacology*, **159: 224 – 237.**

Nisar, M. F., Jaleel, F., Waseem, M., Ismail, S., Toor, Y., Haider, S. M. and Zhong, J. L., 2014. Ethno-medicinal uses of plants from District Bahawalpur, Pakistan. *Current Research Journal of Biological Sciences*, **6 (5): 183 – 190.**

Nkgapele, R. J., Mphosi, M. S. and Mashela, P. W., 2011. Comparing *Cucumis africanus* and *Cucumis myriocarpus* using a classical growth analysis tool under five irrigation frequencies. *WIT Transactions on Ecology and the Environment*, **145: 565 – 570.**

Nnamani, P. O., Kenechukwu, F. C. and Oguamanam, W. N., 2012. *Cardiospermum grandiflorum* leaf extract potentiates amoxicillin activity on *Staphylococcus aureus*. *Journal of Medicinal Plants Research*, **6 (5): 901 – 905.**

Novoa, A., Le Roux, J. J., Robertson, M.P., Wilson, J. R. and Richardson, D.M., 2015. Introduced and invasive cactus species: a global review. *AoB Plants*, **7: 078**.

Nuñez, M. A. and Dickie, I. A., 2014. Invasive belowground mutualists of woody plants. *Biological Invasions*, **16 (3): 645 – 661.**

Olugbemiga, O. S., Grace, O. D., Adeola, T. A., Ibibia, E. T., Akhere, O. J., Adeiza, O. D., Oluchi, A. Y., Obiora, N. C. and Stephen A. O., 2016. Antidiabetic and Antidyslipidemic Effect of Ethanolic Extract of *Alternanathera pungens* on Alloxan-Induced Diabetic Rats. *Asian Journal of Biochemistry,* **11 (2): 82 – 89.**

Ordóñez, R. M., Zampini, I. C., Rodríguez, F., Cattaneo, F., Sayago, J. E. and Isla, M. I., 2011. Radical scavenging capacity and antimutagenic properties of purified proteins from *Solanum betaceum* fruits and Solanum tuberosum tubers. *Journal of agricultural and food chemistry*, **59 (16): 8655 – 8660.**

Pandey, D. R., 2015. Optinization of morphological studies on *Malvastrum coromandelianum (Linn)* garcke in different selected sites of Rewa, Madhya Pradedesh. *World Journal of Pharmaceutical Research,* **5 (1): 1198 – 1207.**

Paulin, D. and Suneson, K., 2015. Knowledge transfer, knowledge sharing and knowledge barriers–three blurry terms in KM. *Leading Issues in Knowledge Management*, **2: 73 – 94.**

Pérez-Harguindeguy, N., Díaz, S., Garnier, E., Lavorel, S., Poorter, H., Jaureguiberry, P., Bret-Harte, M. S., Cornwell, W. K., Craine, J. M., Gurvich, D. E. and Urcelay, C., 2013. New handbook for standardised measurement of plant functional traits worldwide. *Australian Journal of Botany*, **61 (3): 167 – 234.**

Pramanick, D. D., Maiti, G. G. and Srivastava, A., 2015. Micro-Morphological Study of 'BALA'Plant (*Sida cordifolia* L., Malvaceae) With Special Reference to Its Propagation Technique. *Journal of Medicinal Plants,* **3 (4): 127 – 131.**

Raath, G., 2015. *The impact of high rainfall and flood events on Eucalyptus camaldulensis distribution along the central Breede River*. Doctoral dissertation, University of Stellenbosch, Stellenbosch, South Africa.

Rahman, A. M. and Gulshana, M. I. A., 2014. Taxonomy and medicinal uses on amaranthaceae family of Rajshahi, Bangladesh. *Applied Ecology and Environmental Sciences*, **2 (2): 54 – 59.**

Rahman, M. H. and Roy, B., 2014. Population Structure and Curative Uses of Invasive Plants in and around the Protected Forests of Bangladesh: A Means of Utilization of Potential Invasive Species. *Journal of Ecosystems*, **2014: 1 – 14.**

Ralte, V. and Lallianrawna, S., 2014. In vitro antioxidant activity of *Ageratina adenophora* (King & Rob) and *Ipomoea cairica* (L) Sweet. *Science Vision,* **14 (3): 128 – 132.**

Rankoana, S. A., 2016. Sustainable Use and Management of Indigenous Plant Resources: A Case of Mantheding Community in Limpopo Province, South Africa. *Sustainability*, **8 (3): 221**

Riaz, M., Zia-Ul-Haq, M., Ur-Rahman, N. and Ahmad, M., 2014. Neuropharmacological effects of methanolic extracts of *Rubus fruticosus* L. *Turkish journal of medical sciences*, **44 (3): 454 – 460.**

Riddin, T., van Wyk, E. and Adams, J., 2016. The rise and fall of an invasive estuarine grass. *South African Journal of Botany*, **107: 74 – 79.**

Robinson, T. B., Alexander, M. E., Simon, C. A., Griffiths, C. L., Peters, K., Sibanda, S., Miza, S., Groenewald, B., Majiedt, P. and Sink, K. J., 2016. Lost in translation? Standardising the terminology used in marine invasion biology and updating South African alien species lists. *African Journal of Marine Science*, **38 (1): 129 – 140.**

Rotherham, I. D., 2017. Eco-fusion of alien and native as a new conceptual framework for historical ecology. *Environmental History in the Making,* **6: 73 – 90.**

Roy, H. E., Peyton, J., Aldridge, D. C., Bantock, T., Blackburn, T. M., Britton, R., Clark, P., Cook, E., Dehnen-Schmutz, K., Dines, T. and Dobson, M., 2014. Horizon scanning for invasive alien species with the potential to threaten biodiversity in Great Britain. *Global Change Biology*, **20 (12): 3859 – 3871.**

Sayyed, A., 2014. Phytochemistry, pharmacological and traditional uses of Datura stramonium L. review. *Journal of Pharmacognosy and Phytochemistry*, **2 (5): 123 – 125.**

Semenya, S. S., Potgieter, M. J. and Erasmus, L. J. C., 2013a. Exotic and indigenous problem plants species used, by the Bapedi, to treat sexually transmitted infections in Limpopo Province, South Africa. *African Health Science,* **3 (2): 320 – 326.**

Semenya, S. S., Potgieter, M. J. and Tshisikhawe, M. P., 2013. Use, conservation and present availability status of ethnomedicinal plants of Matebele-Village in the Limpopo Province, South Africa. *African Journal of Biotechnology*, **12 (18): 2392 – 2405.**

Semenya, S., Potgieter, M., Tshisikhawe, M., Shava, S. and Maroyi, A., 2012. Medicinal utilization of exotic plants by Bapedi traditional healers to treat human ailments in Limpopo province, South Africa. *Journal of ethnopharmacology*, **144 (3): 646 – 655.**

Shackleton, R. T., Le Maitre, D. C. and Richardson, D. M., 2015. Stakeholder perceptions and practices regarding Prosopis (mesquite) invasions and management in South Africa. *Ambio*, **44 (6): 569 – 581.**

Shackleton, R. T., Le Maitre, D. C., Pasiecznik, N. M. and Richardson, D. M., 2014. *Prosopis*: a global assessment of the biogeography, benefits, impacts and management of one of the world's worst woody invasive plant taxa. *AoB Plants***, 6: 01 – 18.**

Shaha, N. Z., Muhammad, N., Azeem, S. and Rauf, A., 2012. Preliminary Phytochemical and Anti-Radical Profile of *Conyza sumatrensis*. *Middle-East Journal of Medicinal Plants Research,* **1 (1): 05 – 08.**

Sigidi, M. T., Anokwuru, C. P., Zininga, T., Tshisikhawe, M. P., Shonhai, A., Ramaite, I. D. I., Traoré, A. N. and Potgieter, N., 2016. Comparative in vitro cytotoxic, anti-inflammatory and anti-microbiological activities of two indigenous Venda medicinal plants. *Translational Medicine Communications*, **1 (1): 1 – 9.**

Skalli, S. and Jordan, S. A., 2017. Herbal and Traditional Medicines, Now and Future. *Pharmacovigilance,* **132: 145 – 159.**

Statistics South Africa, 2016. *Mid-year population estimates 2015.* Stats SA, Pretoria, South Africa.

Staudhammer, C. L., Escobedo, F. J., Holt, N., Young, L. J., Brandeis, T. J. and Zipperer, W., 2015. Predictors, spatial distribution, and occurrence of woody invasive plants in subtropical urban ecosystems. *Journal of environmental management*, **155: 97 – 105.**

Taura, D. W., Yusha'u, M., Bello, U. A., Hassan, A., Saidu, J. and Panda, T. W., 2014. Antibacterial activity of *Psidium guajava* in clinical isolates. *Academia Journal of Microbiology Research*, **2 (2): 79 – 83.**

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P. and Spierenburg, M., 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. *Ambio*, **43 (5): 579 – 591.**

Teugwa, C. M., Mejiato, P. C., Zofou, D., Tchinda, B. T. and Boyom, F. F., 2013. Antioxidant and antidiabetic profiles of two African medicinal plants: *Picralima nitida* (Apocynaceae) and *Sonchus oleraceus* (Asteraceae). *BioMed Central Complementary and Alternative Medicine*, **13 (1): 1 – 9.**

Tewari, D., Tripathi, Y. C. and Anjum, N., 2014. *Agave sislana*: a plant with high chemical diversity and medicinal importance. *World Journal of Pharmaceutical Research*, **3 (8): 238 – 249.**

Trojan-Rodrigues, M., Alves, T. L. S., Soares, G. L. G. and Ritter, M. R., 2012. Plants used as antidiabetics in popular medicine in Rio Grande do Sul, southern Brazil. *Journal of Ethnopharmacology*, **139 (1): 155 – 163.**

Tshisikhawe, M P., 2016. Management plan of a medicinal plant species in demand: the case of *Brackenridgea zanguebarica Oliv*. *Indilinga African Journal of Indigenous Knowledge Systems*, **15 (1): 123 – 135.**

Vargas, C., Rosiely, N., Ceolin, T., Zdanski de Souza, A. D., da Costa Mendieta, M., Ceolin, S. and Heck, R. M., 2014. Plantas medicinais utilizadas na cicatrizaÆo de feridas por agricultores da regiÆo sul do RS. *Revista de Pesquisa: Cuidado e Fundamental*, **6 (2): 550 – 560.**

Verma, R., Gangrade, T., Punasiya, R. and Ghulaxe, C., 2014. *Rubus fruticosus* (blackberry) use as an herbal medicine. *Pharmacognosy reviews*, **8 (16): 101 – 104.**

Vijayaraj, R. and Vidhya, R., 2016. Biological Activity of *Achyranthes aspera* Linn. - A Review. *Asian Journal of Biochemical and Pharmaceutical Research,* **6 (1): 86 – 93.**

Wang, H., Wang, Q., Bowler, P. A. and Xiong, W., 2016. Invasive aquatic plants in China. *Aquatic Invasions,* **11 (1): 1 – 9.**

Wariss, H. M., Ahmad, S., Anjum, S. and Alam, K., 2014. Ethnobotanical studies of dicotyledonous plants of Lal Suhanra national park, Bahawalpur, Pakistan. *International Journal of Science and Research*, **3 (6): 2452 – 2460.**

Wei, X. H., Yang, S. J., Liang, N., Hu, D. Y., Jin, L. H., Xue, W. and Yang, S., 2013. Chemical constituents of *Caesalpinia decapetala* (Roth) alston. *Molecules*, **18 (1): 1325 – 1336.**

Wilson, J. R., Caplat, P., Dickie, I. A., Hui, C., Maxwell, B. D., Nunez, M. A., Pauchard, A., Rejmánek, M., Richardson, D. M., Robertson, M. P. and Spear, D., 2014. A standardized set of metrics to assess and monitor tree invasions. *Biological Invasions*, **16 (3): 535 – 551.**

Yadav, A. K., Manna, S., Pandiyan, K., Singh, A., Kumar, M., Chakdar, H., Kashyap, P. L. and Srivastava, A. K., 2016. Isolation and characterization of biosurfactant producing Bacillus sp. from diesel fuel-contaminated site. *Microbiology*, **85 (1): 56 – 62.**

Youssef, N. A., Gurbanov, E. M., Haciyeva, S. R., Mammedova, A. O. and Khalilov, R. I., 2013. Antioxidant enzymes, fluctuating asymmetry and morphological changes of urban trees as an ecological indicators of heavy metal stress. *International Journal of Pharmaceutical Science and Health Care*, **3 (1): 1 – 18.**

Zhu, Z., Song, S., Li, P., Jeelani, N., Wang, P., Yuan, H., Zhang, J., An, S. and Leng, X., 2016. Growth and physiological responses of submerged plant *Vallisneria natans* to water column ammonia nitrogen and sediment copper. *Peer Journal,* **4: 1953**.

Zurba, M. and Berkes, F., 2014. Caring for country through participatory art: creating a boundary object for communicating Indigenous knowledge and values. *Local Environment*, **19 (8): 821 – 836.**

Chapter Five

The grapples among scientific and traditional knowledge holders with regard to benefits and losses derived from problem weeds and alien invasive plant species.

Abstract.

Background: Many scholars worldwide labeled problem weeds and alien plant invasive species as a global concern. There have been some inherent grapples between naturalists, social scientists and indigenous knowledge practitioners about the benefits derived from problem alien weeds.

Aim: The study was aimed at revealing the inherent fraught between scientifically believed fundamentals and indigenously practiced customs as well as folktales, with regard to utilization of problem weeds and alien invasive plant species.

Materials and method: Both qualitative and quantitative research techniques were purposeful applicable in data gathering.

Results and conclusion: About 45% participants perceived both CARA and NEMBA regulations as having critical and negative impact towards the provision of traditional health care and socio-economic upliftment of rural based communities. Approximately 24% participants agreed that both CARA and NEMBA regulations on weeds management have a serious and negative impact toward the provision of traditional health care and socio-economic upliftment of rural wellbeing. More than two-third of all the participants agreed that both CARA and NEMBA regulations have a negative impact towards maintaining the provision of traditional health care and upliftment of rural communities in terms of socio-economic and socio-ecological benefits. Only 10% of participants reported that they were consulted whereas the remaining 90% were not consulted about either the establishment or implementation of CARA and NEMBA regulations on listed problem weeds and alien invasive plant species. Even though problem weeds and alien invasive plant species have been seen to be contributing substantially towards traditional health care system and socio-economic upliftment of rural communities, their rapid spread has a negative impact on biodiversity and its biosecurity. The inherent grapples between scientifically believed fundamentals and indigenously practiced custom based tales could be mitigated by the establishment of radical integration among both knowledge systems for the purpose of reconciliation.

Key words: *Alien invasive plant species; Inherent grapples; Problem weeds; Scientific narratives and indigenous knowledge system.*

5.1. Introduction.

Many scholars worldwide labeled problem weeds and alien plant invasive spp as a global concern (Mostert *et al.,* 2017). A small number of scholars agreed that the discipline of invasion biology itself contains inherent controversial (Pereyra, 2016). The fundamental patterns of spp diversity within the ecosystems are driven by the interactions between spp (regardless of nativeness or invasiveness), distribution and disturbance (Tsai *et al.,* 2015). Thus, ecosystem services can be considered as a lifetime supporting tool that fortifies both socio-ecological, socio-cultural and socio-economic benefits towards human wellbeing and development in rural communities (Sakai *et al.,* 2016). There has been some inherent grapples between naturalists, social scientists and indigenous knowledge practitioners about the value derived from problem weeds as well as alien invasive plant spp (Estévez *et al.,* 2015). The collaboration between scientific scholars and indigenous knowledge practitioners could lead to the provision of sustainable solutions for inherent grapples, climate change and global warming (Williams and Hardison, 2013).

Most scientific scholars radically narrate only the negativities about problem weeds and alien invasive plant spp. Idström *et al.* (2015), reported that scientific narratives convey some elements of the phenomenon unambiguous with an exclusion of some potential and legitimate vantage insights to validate the holistic of their arguments. The narratives about negative impact of some problem weeds and alien plant invasive spp has been exaggerated (Thomas and Palmer, 2015). Morden scientific knowledge only accept indigenous knowledge system with the hidden capitalism motives (Briggs, 2013). Despite all the critics, African indigenous knowledge on utilization of plant spp has existed long before the discovery of scientific knowledge (Abah *et al.,* 2015). Scientific knowledge depends on the basis of indigenous knowledge system especially in terms of identification of socio-economic values of certain plant spps (Flora *et al.,* 2012). Understanding of the relationship between scientific view and fundamental societal issues of concern can steadily enhance the practices of sustainable development and good community governance (Clark *et al.,* 2016). The recognition of the needs for indigenous people on biodiversity benefits as well as equitable-sharing of societal benefits and ecological requirements, can enhance the practice of sustainability (Peterson *et al.,* 2016; Walsh-Dilley *et al.,* 2016).

Sustainable management of the ecosystem and its biodiversity can only be achievable by combining insights and knowledge basis derived from both knowledge systems (Tengö *et al.,* 2014). This study aimed at revealing the inherent fraught between scientifically believed fundamentals and indigenously practiced customs as well as folktales, with regard to utilization of problem weeds and alien invasive plant spp. The objective of the study being to

elucidate and mitigate the inherent controversy scientific view and indigenous practices towards utilization of problem weeds and alien invasive spp for sustaining livelihood of local people.

5.2. Materials and method.

Both qualitative and quantitative research techniques were purposefully used. The total number of informants who participated in this study were 100. This included traditional healers, herbalist, farmers and dwellers. They were interviewed about the impacts of CARA and NEMBA regulations towards sustaining livelihood. Participants were also interviewed on whether they were once consulted about the establishment and implementation of either CARA or NEMBA regulations for listed problem weeds and alien invasive plant spp. Data were analyzed in table form, descriptively and statistically using Microsoft excel package.

5.3. Results.

A total number of 100 participants were interviewed. Among the interviewed participants, 11 were traditional healers, 19 herbalists and 42 dwellers as well as 28 farmers.

5.3.1. Impact of CARA and NEMBA regulations on suppressing rural socio-economic upliftment.

Table 5: Impact of CARA and NEMBA regulations on listed problem weeds and alien invasive plant spp toward suppressing the provision of traditional primary health care as well as, socio-economic upliftment of rural community.

Impact classes per score %	Traditional healers	Herbalists	Dwellers	Farmers	Total %
A (90 - 100)	11	1	33	0	45
B (80 - 89)	0	18	6	0	24
C (60 - 79)	0	0	0	3	3
D (40 - 59)	0	0	0	6	6
E (20 - 39)	0	0	2	8	10
F (0 - 19)	0	0	1	11	12
Total number of participants	11	19	42	28	100
Net total %					

Keys: *A (90 – 100)% = critical and catastrophic impact, B (80 – 89)% = serious and outrageous impact, C (60 – 79)% = largely impacted, D (40 – 59)% = moderately impacted, E (20 – 39)% = limited impact and F (0 – 19)% = no impact.*

From Table 5, CARA and NEMBA regulations for the listed problem weeds and alien invasive plant spp had a negative impact on the provision of traditional primary health care and socio-economic upliftment of rural communities. About 45% of all the participants perceived CARA and NEMBA regulations as having critical and catastrophic impact towards

the provision of traditional health care and socio-economic upliftment of rural based communities.

Approximately 24% of all participants agreed that both CARA and NEMBA regulations on weeds management have negative impact toward the provision of traditional health care and socio-economic upliftment of rural wellbeing. About 12% of all participants agreed that both CARA and NEMBA regulations for listed exotic alien weeds do not have impact on the provision of traditional health care and socio-economic upliftment of rural based communities. Generally more than two-third of all the participants agreed that both CARA and NEMBA regulations have a negative impact towards maintaining the provision of traditional health care and upliftment of deep rural based communities in terms of socio-economic and socio-ecological benefits.

5.3.2. Scientific narratives and provision of legislative regulations about listed problem weeds and alien invasive plant species.

Table 6: Scientific narratives and requirements for legislative regulations on the listed problem weeds and invasive alien spp.

Legislative categories for listed plant species	Discription as per legislative requirements	Scientific narratives
1a	Alien invasive plant spp that requires an obligatory control and they must be permanently eradicated from the environment.	Problem weeds and alien invasive plant spp have detrimental impacts on both socio-ecological and socio-economic benefit (Robinson *et al.,* 2017).
1	Those plant spp are obligatory prohibited and they must be completely eradicated.	Problem weeds and alien invasive plant spp detrimentally impact the complexity of webs, including the functionality of biodiversity and its biosecurity, cultural and economic relations among environmental need and people's requirements (Idström *et al.,* 2015).

1b	Invasive plant spp that requires obligatory controlled by management program and they must be permanently eradicated from the natural environment by all users.	Bellard *et al.* (2016), reported that biological invasion is regarded as the most threat to biological extinction.
2	Invasive plant spp that are controlled as per demarcation and therefore, permits are required for breeding, moving and growing those species. Most of the aforementioned spp are being commercially utilized.	In RSA, almost all commercial important exotic and invasive plant spp are considered to be ecologically transforming (Bennett and Kruger, 2013). However, problem weeds and alien invasive plant spp are known to alter socio-ecological functions negatively and also have negative impact on biodiversity as well as the local economy (Shackleton *et al.,* 2016).
3	Those plant species are banned and they may not be planted in anyway, however, the existing one may remain, except within the riparian zonation. Most of those plant spp are utilized for ornamental purposes.	Human wants such as the need to have home gardens are known to be influential towards rapid spread of problem weeds and alien invasive plant spp (Vaz *et al.,* 2017).

5.3.3. Consultation of local people with regard to the establishment or implementation of CARA and NEMBA regulations on listed problem weeds and alien invasive plant species.

Table 7: Articulation of local people consultations with regard to the establishment or implementation of CARA and NEMBA regulations on listed problem weeds and alien invasive plant spp.

Consultation	Traditional heallers	Herbalists	Farmers	Dwellers	Total %
Not consulted	11	19	24	36	90
Consulted	0	0	4	6	10
Total number of participants	11	19	28	42	100
Net total %					

It has been found that the majority of local people were not consulted about the establishment and implementation of either CARA or NEMBA regulations on listed problem weeds and alien invasive plant spp. Among all the 100 participants, only 10% of them reported that they were consulted whereas, the remaining 90% were not.

Table 8: Statistical comparison for local people consultation with regard to the establishment and implementation of either CARA or NEMBA regulations on listed problem weeds and alien plant invasive spp.

t-Test: Paired Two Sample for Means

	Not consulted	*Consulted*
Mean	22,5	2,5
Variance	109,6666667	9
Observations	4	4
Pearson Correlation	0,92308017	
P(T<=t) two-tail	0,014302024	

There was a high statistical significant difference ($p<0.05$) among the local people who were not consulted and those who were consulted about the establishment and implementation of both CARA and NEMBA regulations towards listed problem weeds and alien invasive plant spp. The statistical significant difference between the participants who were not consulted

and those consulted was, *p=0.01.* The number of local people not consulted and consulted was highly correlated with the correlation value of 0.92.

5.4. Discussion.

It was revealed that either the establishment or implementation of CARA and NEMBA regulations on listing of problem weeds and alien invasive plant spp was done without proper consultation with rural communities. From Table 6, the difference in terms of participants score percentages (%) regarding the impact of CARA and NEMBA regulations on listed problem weeds and alien invasive plant spp was influenced by utilization of either benefits or losses among participants from dissimilar responsibilities in their respective community. Nomtshongwana (2016) and Taylor *et al.* (2016), reported that villagers from different community responsibilities depend on plant spp for various purposes to maintain their livelihood. According to Delgado (2016), traditional healers and herbalists are considered to perform the substantial roles and hold tremendous responsibilities with regards to provision of primary health care within their respective communities and therefore, they are also custodians of traditional cultures. About 12% of all the participants perceived CARA and NEMBA regulations towards exotic weeds as good regulations for monitoring the aptitude of exotics and not having negative impacts on socio-economic and eco-cultural benefits. This was due to the fact that almost all participants were farmers and therefore, invasive weed plant spp lowered the productivity in the agricultural industry and also caused loss of profit. Problem weeds and alien invasive plant spp are mostly severe limiting factor for agricultural production (Parameswari and Srinivas, 2017).

From Table 8, it can be seen that legislative requirements regarding exotic problem weeds, provide a massive and prestigious support towards scientific narrated evidence without considering perceptions and rights of indigenous people in rural village communities. South Africa is a member in good standing of the United Nation (UN) and it should abide by the UN declarations. Thus, *Article: 2; 3; 8 (1)(2a); 9* and *11 (1)(2)* of the UN Declaration on Rights for Indigenous People direct that indigenous people have the rights to freely practice their cultural activities and traditional customs (United Nations General Assembly, 2007), including their folktales without either being discriminated or neglected. Thus the legislative requirements towards listed exotic problem weeds were based on scientific narrated judgements without precision. According to Kueffer and Kull (2017), judgements without precision are based on emotions. Lichfield *et al.* (2016), reported that some scientific narrated perceptions towards detrimental impacts of problem weeds and non-native spp are regarded as foil-folk ideological based arguments.

Table 8 demonstrated that the decision for the establishment and implementation of CARA and NEMBA regulations on listed problem weeds and alien invasive plant spp was made without proper consultations with civil society and the custodians of indigenous knowledge system as well as other affected stakeholders. This was influenced by quick developing belief that says, the establishment and implementation of policies on either biodiversity values or loss, requires validations by only scientific knowledge practitioners (Nesshöver *et al.,* 2016). According to Carmen *et al.* (2015), participatory rural appraisal could enable the lawmakers to gain an understanding about the motivations behind the utilization of problem weeds and alien invasive plant spp. Despite the origin and informality of indigenous knowledge system, knowledge can be also used to guide lawmakers about the benefits and loss of biodiversity (Livoreil *et al.,* 2016).

The statistical results (Table 9) showed that there was a highly statistical significant difference between participants who were not consulted and those consulted with regards to the establishment and implemrntation of either CARA or NEMBA regulations on listed problem alien weeds. This was influenced by a high number of participants who knew the benefits derived from problem weeds and alien invasive plant spp. However, the participants were not consulted about the establishment and implementation of either CARA or NEMBA regulations against those plant spp. The consultations with interested and affected parties with regard to their own societal issues of concern either the law or policy-makers can promote the integrity of good governance practices (Costanza, 2015). Regardless of invasiveness or nativeness local people depend on all plant spp for their livelihood (Ghosh-Jerath *et al.,* 2015).

5.5. Conclusion.

Even though problem weeds and alien invasive plant spp have been seen to be contributing substantially towards the traditional health care system and socio-economic upliftment of rural communities, their rapid spread have a negative impact on biodiversity and its biosecurity. Despite the inherent grapples among scientific and indigenous knowledge systems, those knowledge systems are both based on the trial-error practical experiments, although they may differ. Useful problem weeds and alien invasive plant spp should be utilized before their reseeding period. Both societal issues of concern and ecological needs must be considered as equal while making judgments about either their potential contribution to livelihood or biodiversity loss. The inherent grapples between scientifically believed fundamentals and indigenously practiced custom based tales could be mitigated by the establishment of radical integration among the both knowledge systems for the reconciliation purpose. The legislative consideration of scientific knowledge based evidence with an

exclusion of indigenous knowledge system could erode ancient and rare indigenous knowledge heritage and caused recoil in cultural diverse communities. An elaborately documented indigenous knowledge system could contribute significantly towards inventing model-resolution for steadily dealing with invasion challenge. However, further study involving multi-disciplinary subjects about invasion could be pivotal for systematical inventing a signified model-resolutions.

5.6. References.

Abah, J., Mashebe, P. and Denuga, D. D., 2015. Prospect of integrating African indigenous knowledge systems into the teaching of sciences in Africa. *American Journal of Educational Research*, **3 (6): 668 – 673.**

Bellard, C., Cassey, P. and Blackburn, T.M., 2016. Alien species as a driver of recent extinctions. *Biology Letters*, **12 (2): 1 – 4.**

Bennett, B. M. and Kruger, F. J., 2013. Ecology, forestry and the debate over exotic trees in South Africa. *Journal of Historical Geography*, **42: 100 – 109.**

Briggs, J., 2013. Indigenous knowledge: A false dawn for development theory and practice?. *Progress in development Studies*, **13 (3): 231 – 243.**

Carmen, E., Nesshöver, C., Saarikoski, H., Vandewalle, M., Watt, A., Wittmer, H. and Young, J., 2015. Creating a biodiversity science community: experiences from a European Network of Knowledge. *Environmental Science & Policy*, **54: 497 – 504.**

Clark, W. C., van Kerkhoff, L., Lebel, L. and Gallopin, G. C., 2016. Crafting usable knowledge for sustainable development. *Proceedings of the National Academy of Sciences*, **113 (17): 4570 – 4578.**

Costanza, J. N., 2015. Indigenous Peoples' Right to Prior Consultation: Transforming Human Rights From the Grassroots in Guatemala. *Journal of Human Rights*, **14 (2): 260 – 285.**

Delgado, N. A., 2016. Community protocols as tools for resisting exclusion in global environmental governance. *Revista de Administração de Empresas*, **56 (4): 395 – 410.**

Estévez, R. A., Anderson, C. B., Pizarro, J. C. and Burgman, M. A., 2015. Clarifying values, risk perceptions, and attitudes to resolve or avoid social conflicts in invasive species management. *Conservation Biology*, **29 (1): 19 – 30.**

Flora, C. B., Bregendahl, C. and Renting, H., 2012. Collaborative community-supported agriculture: balancing community capitals for producers and consumers. *International Journal of Sociology of Agriculture and Food*, **19 (3): 329 – 346.**

Ghosh-Jerath, S., Singh, A., Kamboj, P., Goldberg, G. and Magsumbol, M. S., 2015. Traditional knowledge and nutritive value of indigenous foods in the oraon tribal community of Jharkhand: an exploratory cross-sectional study. *Ecology of food and nutrition*, **54 (5): 493 – 519.**

Idström, S., West, S., Katzschner, T., Pérez-Ramos, M. I. and Twidle, H., 2015. Invasive narratives and the inverse of slow violence: Alien species in science and society. *Environmental Humanities*, **7 (1): 1 – 40.**

Kueffer, C. and Kull, C. A., 2017. Non-native species and the aesthetics of nature. *Impact of Biological Invasions on Ecosystem Services,* **12: 311 – 324.**

Lichfield, G., Adams, A. and Brooks, L. J. A., 2016. The Aliens Are Us: The Limitations That the Nature of Fiction Imposes on Science Fiction About Aliens. *International Journal of Communication,* **10: 5693 – 5698.**

Livoreil, B., Geijzendorffer, I., Pullin, A. S., Schindler, S., Vandewalle, M. and Nesshöver, C., 2016. Biodiversity knowledge synthesis at the European scale: actors and steps. *Biodiversity and Conservation*, **25 (7): 1269 – 1284.**

Mostert, E., Gaertner, M., Holmes, P. M., Rebelo, A. G. and Richardson, D. M., 2017. Impacts of invasive alien trees on threatened lowland vegetation types in the Cape Floristic Region, South Africa. *South African Journal of Botany*, **108: 209 – 222.**

Nomtshongwana, N., 2016. *Indigenous plant use in Gxalingenwa and Kwa Yili Forests in the Southern Drakensberg, KwaZulu-Natal*. Masters dissertation, University of Kwazulu-Natal, South Africa.

Nesshöver, C., Vandewalle, M., Wittmer, H., Balian, E. V., Carmen, E., Geijzendorffer, I. R., Görg, C., Jongman, R., Livoreil, B., Santamaria, L. and Schindler, S., 2016. The Network of Knowledge approach: improving the science and society dialogue on biodiversity and ecosystem services in Europe. *Biodiversity and Conservation*, **25 (7): 1215 – 1233.**

Parameswari, Y. S. and Srinivas, A., 2017. Weed management in rice-A Review. *International Journal of Applied and Pure Science and Agriculture,* **3 (1): 75 – 80.**

Pereyra, P. J., 2016. Revisiting the use of the invasive species concept: An empirical approach. *Austral Ecology*, **41 (5): 519 – 528.**

Peterson, N., Pearl-Martinez, R., Stephens, J. C., Serrano, M., Blondet, M., Rubiños, Á. and Mattsson, E., 2016. Introduction to the special issue on social sustainability: integration, context, and governance. *Sustainability: Science, Practice, & Policy*, **12 (1): 3 – 7.**

Robinson, C. D., Webster, L., Martínez-Gómez, C., Burgeot, T., Gubbins, M. J., Thain, J. E., Vethaak, A. D., McIntosh, A. D. and Hylland, K., 2017. Assessment of contaminant

concentrations in sediments, fish and mussels sampled from the North Atlantic and European regional seas within the ICON project. *Marine environmental research*, **124: 21 – 31.**

Sakai, S., Choy, Y. K., Kishimoto-Yamada, K., Takano, K. T., Ichikawa, M., Samejima, H., Kato, Y., Soda, R., Ushio, M., Saizen, I. and Nakashizuka, T., 2016. Social and ecological factors associated with the use of non-timber forest products by people in rural Borneo. *Biological Conservation*, **204: 340 – 349.**

Shackleton, R. T., Le Maitre, D. C., van Wilgen, B. W. and Richardson, D. M., 2016. Identifying barriers to effective management of widespread invasive alien trees: *Prosopis species* (mesquite) in South Africa as a case study. *Global Environmental Change*, **38: 183 – 194.**

Taylor, A., Lindsey, P., Davies-Mostert, H. and Goodman, P., 2016. *An assessment of the economic, social and conservation value of the wildlife ranching industry and its potential to support the green economy in South Africa*. Department of Environmental Affairs, Republic of South Africa.

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P. and Spierenburg, M., 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. *Ambio*, **43 (5): 579 – 591.**

Thomas, C. D. and Palmer, G., 2015. Non-native plants add to the British flora without negative consequences for native diversity. *Proceedings of the National Academy of Sciences* **112 (14): 4387 – 4392.**

Tsai, C. H., Lin, Y. C., Wiegand, T., Nakazawa, T., Su, S. H., Hsieh, C. H. and Ding, T. S., 2015. Individual species-area relationship of woody plant communities in a heterogeneous subtropical monsoon rainforest. *PloS one*, **10 (4): 124539**

United Nations General Assembly, 2007. *United Nations Declaration on the Rights of Indigenous Peoples*. United Nations Department of Public Information.

Vaz, A. S., Kueffer, C., Kull, C. A., Richardson, D. M., Schindler, S., Muñoz-Pajares, A. J., Vicente, J. R., Martins, J., Hui, C., Kühn, I. and Honrado, J. P., 2017. The progress of interdisciplinarity in invasion science. *Ambio*, **1: 1 – 15.**

Walsh-Dilley, M., Wolford, W. and McCarthy, J., 2016. Rights for resilience: food sovereignty, power, and resilience in development practice. *Ecology and Society*, **21 (1): 1 – 11.**

Williams, T. and Hardison, P., 2013. Culture, law, risk and governance: contexts of traditional knowledge in climate change adaptation. *Climatic Change*, **120 (3): 531 – 544.**

6. Overall conclusion and recommendations.

6.1. Conclusion.

Despite the fact that a large number of rural population seemed to be emigrating towards urban areas due to economic constraints within their dwelling villages (Angelucci, 2015), rural village communities remain a hotspot of indigenous knowledge system. This was influenced by a large number of indigenous knowledge practitioners who are still dwelling in deep rural communities. The irony behind imbalance gender participation was influenced by factors such as cultural norms, traditional customs and tales that marginalize one gender by creating unequal responsibilities among womenfolk and menfolk in rural village communities. Balanced gender participation could have produced same outcomes in terms of either benefits or losses derived from problem weeds and alien invasive plant spp. Womenfolk were more knowledgeable in terms of plant uses as compared to their men folk counterparts. Carrillo (2015), reported that knowledge attributes are based on the capability to balance either family or community responsibilities. It has been concluded that the womenfolk are rich and hotspot-factories for indigenous knowledge system with regard to the uses of problem weeds and alien invasive plant spp. Despite the socio-cultural, socio-economic and socio-ecological benefits derived from problem weeds and alien invasive plant spp, it was noticed that some spp could also alter biodiversity and its biosecurity detrimentally. However, it could be biased and illegitimate to rely on one knowledge judgments with regard to the benefits or losses derived from problem weeds and alien invasive plant spp.

6.2. Recommendations

This study recommended that in order for judgment to be considered in decision-making, especially for the establishment and implementation of regulations involving people and their environment, it should be based on species-specificity and multi-dimensional knowledge disciplines. The reconciliation of inherent grapples among scientific and indigenous knowledge systems could possibly be supported by equal legislative consideration of both knowledge systems. This could aid with the provision to enhence knowledge transformation in South Africa.

6.3. References.

Angelucci, M., 2015. Migration and financial constraints: Evidence from Mexico. *Review of Economics and Statistics*, **97 (1): 224 – 228.**

Carrillo, F. J., 2015. Knowledge-based development as a new economic culture. *Journal of Open Innovation: Technology, Market, and Complexity*, **1 (1): 1 – 15.**

Appendix

7. Questionnaires

7.1. Interviewee particulars

7.1.1. Interviewer Surname & Initial:……..……....

7.1.2. Study Area:……..…….

7.1.3. Interview Date:…..……..…….

7.2. Informant's general information

7.2.1. Tell us about yourself?

7.2.2. How old are you?

a. 25 – 35

b. 35 – 45

c. 45 – 55

d. 55 – 65

e. 65 – 75

7.3. Recognition of problem weeds and alien invasive plant species

7.3.1. How do you recognize problem weed and alien invasive plant spp / what do you look at? (Choose as many options as possible).

i. Availability all over

ii. Re-colonization rate after being eliminated

iii. Abundant

iv. The growth rate

v. Flourishing

Choose the suitable answers below:

A. i; iv & v

B. i; iii; & v

C. i; ii; iii & v

D. Both of the above

7.3.2. Are you familiar with the devastating impacts or benefits of problem weeds and alien invasive spp? Yes/ No/ Not sure.

7.3.3. If yes, what are the loss and benefits derived from problem weeds and alien invasive spp?

7.3.4. Do you consider all problem weeds and alien invasive plant spp as unwanted in your community? Yes/ No. And why?

7.4. Regulations

7.4.1. Are you also familiar with the South African Conservation of Agricultural Act and NEMBA regulations?

7.4.2. Rank the effects of the South African Conservation of Agricultural Act in the provision of traditional health care by giving the score % from 20 – 100, whereby 20, is low effects; 40 – moderate effects; 60 – large effects; 80 – serious effects; 100 - extremely effects?

a) 20

b) 40

c) 60

d) 80

e) 100

7.5. Uses of problem weeds and invasive alien plant species

7.5.1. Do you consider the use of both problem alien plant spp and indigenous plants as medicinal? Yes/ No. And why?

7.5.2. Are the medicinal uses of problem weeds and alien invasive plant spp, effective enough as compared to indigenous medicinal plants?

7.5.3. Which plants are scant medicinal plants between problem alien weeds and indigenous plants?

7.5.4. Rank the effectiveness of the following medicinal plants, by giving a score from 1 – 4, whereby 1, is not effective; 2, effective; 3, most effective; and 4, highly effective?

a) Problem weeds and alien invasive plant spp

b) Indigenous plant spp

7.5.5. Mention all the problem weeds and alien invasive plant spp that you use as medicinal plant?

7.5.6. What part of problem alien plants do you use for medicinal purpose?

i) Roots

ii) Barks

iii) Leaves

iv) Flowers

v) All of the above

7.5.7. Mention any other use of problem weeds and alien invasive plant spp that you know, except their medicinal uses?

7.5.8. Which (if any) indigenous custom inspires the use of problem weeds and alien invasive plant spp?

7.5.9. Do you consider problem weeds and alien invasive plant spp as valuable plants within your community? Yes/ No.

7.5.10. If “yes’, what value does they have?

a) Economic values

b) Medicinal values

c) Ecological values

d) Social values (ritual; aesthetic; shade; food; etc.)

e) Both of the above

7.5.11. What characters do you look at when selecting the useful problem weeds and alien invasive plant spp?

a) Abundances of the plants

b) Health of the plants

c) Location of the plants

d) Both of the above

7.5.12. Mention any problem weeds and alien invasive plant spp that you know?

7.6. Benefits and loss

7.6.1. What are the benefits and loss of problem weeds and alien invasive plant spp?

7.6.2. Are any of the aforementioned plant spp essential to ecosystem and its biodiversity? Yes/ No.

7.6.3. If “yes”, tabulate the names of those problem alien weeds and their ecological roles?

7.6.4. Do you have any additional information with regard to the problem weeds and alien invasive plant spp (general)?

7.7. Impact of regulations

7.7.1. Rank the impact of CARA and NEMBA regulations for problem weeds and invasive alien plant species?

Impact class	Descriptions	Score %	Number of informants %
A	CARA and NEMBA regulations towards problem weeds and alien invasive plant spp have critical and catastrophic impact on socio-economic benefits and to the supply of diverse traditional medicinal plant spp.	90 - 100	
B	CARA and NEMBA regulations towards problem weeds and alien invasive plant spp, have serious and outrageous impact on provision of primary health care, socio-ecological and socio-economic benefits in rural	80 - 89	

	area.		
C	CARA and NEMBA regulations towards problem weeds and alien invasive plant spp, have largely impacted the provision of primary health care, socio-ecological and socio-economic benefits in rural areas.	60 - 79	
D	CARA and NEMBA regulations towards problem weeds and alien plant spp, have moderately impacted the provision of primary health care, socio-ecological and socio-economic benefits in rural areas.	40 - 59	
E	CARA and NEMBA regulations towards problem weeds and alien invasive plant spp, have limitedly impacted the provision of primary health care, socio-ecological and socio-economic benefits in rural areas.	20 - 39	
F	CARA and NEMBA regulations towards problem weeds and alien invasive plant spp, have not negatively impacted the provision of primary health care, socio-ecological and socio-economic benefits in rural areas.	0 - 19	
Total number of informants %			100%