A Review on the Invasiveness, Uses and Opportunities of Rusakadzi (*Helichrysum kraussii*) in Zimbabwe

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Abstract

Livestock based livelihoods of most semi-arid areas are mainly dependent on rangelands for animal nutrition. However, invasive species such as *Helichrysum kraussii* reduce rangeland productivity. The aim of this study was to review invasiveness, uses and opportunities associated with *Helichrysum kraussii*. Data used in this review was accessed through Google Scholar, academiaedu.com, Science Direct, Research Gate and Sci-hub. Literature review indicates that *Helichrysum kraussii* is an evergreen increaser native shrub characterized by aromatic and therapeutic properties. The shrub establishes well in poor and overgrazed sandy grasslands or open woodland. *H. kraussii* has become invasive in rangelands because of its unpalatability, adaptability and reproductive capacity, leading to its adaptive nature and dominance within vegetation communities hence reducing the rangeland's capacity to recover. The health benefits of *H. kraussii* continue to be reviewed. The extensive literature search has revealed how *H. kraussii* can treat human headaches, keloid scars, coughs and pulmonary tuberculosis in the form of a whole or part of the plant. Scientific studies on *H. kraussii* indicate that it has a wide range of pharmacological potential including anti-oxidative, anti-cancer and antiviral properties. Culturally, *H. kraussii* is believed to have supernatural properties even though some cultural uses have been verified by

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phytochemistry, the current knowledge could be improved. *H. kraussii* has potential for use in the medical field as its extracts are effective against HIV and cancer.

Key words: *Helichrysum kraussii*, invasive.

Introduction

The proliferation of invasive species and their detrimental capacity to degrade productive rangelands has resulted in widespread invasion of Savanna rangelands. Globally, both indigenous and alien invasive species invaded millions of hectares of the natural environment (Joshi, 2006). Invasive species are a threat to biodiversity as they spread quickly therefore promoting monoculture or total occurence of plants like Lantana camara which have been observed to be allelopathic (Kato-Noguchi and Kurniadie, 2021). Similarly, Helichysum kraussi (*H. kraussii*) has potential to cause veld deterioration (Gusha & Mugabe, 2013), similarly to invasive native and alien species which are fast replacing the desired plants resulting in livestock feed scarcity now becoming common in Zimbabwe, coupled with climate change (Gusha, 2013). Consequently, this reduces rangeland grazing capacity and imposes a serious threat on livestock production (Gusha et al., 2017). Livestock plays a major role as assets for livelihoods and food security in low economically developed countries and marginal areas unsuitable for crop production (Godber & Wall, 2014). Based on the degree of value attached to livestock production, regular rangeland assessment, management and monitoring is of paramount importance.

Helichrysum kraussii, *Achyrocline batocana* Oliv. & Hiern/ *Achyrocline steetzii Vatke/ Gnaphalium kraussii* (Sch. Bip.) (Hilliard, 1983, Hoskovec, 2018) or Straw everlasting (English) or Rusakadzi / Mupumhanhuka (Shona) is a yellow flowered perennial evergreen increaser native shrub that does well in dense stands, poor and overgrazed sandy soils, grasslands, or open woodland (Flora of Zimbabwe, 2008). The plant has been used cross culturally from medication in respiratory infections, sexually transmitted infections and for religious purposes (Lourens, 2008 et al., 2008). The plant has potential for use in dermatological products and treatment of some viral diseases (Lourens et al., 2008). However, this invader leads to incapacitation of communal grazing

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lands to support livestock (Gusha & Mugabe, 2013). As a result of its unpalatability and invasiveness, *H. kraussi* is a cause for concern.

Invasive species like *Helichrysum kraussii* are widespread throughout Southern Africa and are usually prevalent in the rural areas (Mhlongo, 2021). However, mechanisms driving native species invasiveness are poorly understood. Thus, there is a need to research more into them. Some of the information is also yet to be verified scientifically (Maroyi, 2013) (Van Wyk & Gericke, 2000) (Weitz & Thring 2005).

The main aim of this study was to review the invasiveness, uses and opportunities associated with *H. kraussii*. Specifically, the review sought to (i) determine how much of a threat *H. kraussii* poses to be an environmental weed, (ii) the ways in which the plant is being utilized by communities from diverse backgrounds and (iii) innovative ways to utilize its existence to improve livelihoods through value addition. Information obtained from this study will be used in revisiting some of Zimbabwe's policies like the Noxious Weeds Act Chapter 19:07 and Environmental Management Act Chapter 20:27, future studies on its ecology and value addition.

Methods

The selection of relevant literature for the narrative review was made through a thorough search using the name *Helichrysum kraussii*, *Achyrocline batocana* Oliv. & Hiern, *Achyrocline steetzii Vatke*, *Gnaphalium kraussii*, Straw everlasting or Rusakadzi / Mupumhanhuka in scientific databases such as Google Scholar, academiaedu.com, Science Direct, Research Gate, Sci-hub and Wiley Online Library, Nature, Semantic Scholar for articles published from a period of 1912 to 2023. Searches focused on paper title and abstracts in research articles, books, book chapters, conference proceedings, dissertations, theses, scientific reports, herbarium specimens and editorial letters. An electronic search was conducted with the assistance of skilled academics for the twenty-one articles. The eligibility criteria consisted of any information relating to *Helichrysum kraussii* starting from the Asteraceae family, the uses of this plant and its ecology, with irrelevant papers being screened. Relevant papers were selected by thoroughly screening the titles, abstracts then full articles in the data extraction searches. Exclusion criteria consisted of irrelevant information or unreliable/ineligible sources.

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Results and Discussion

Description of Helichrysum kraussii

Helichrysum kraussii/*Achyrocline batocana* Oliv. & Hiern/ *Achyrocline steetzii Vatke*/ *Gnaphalium kraussii* (Sch. Bip.) is a terrestrial, tropical southern African plant species of the Asteraceae family, Asteral order, Inuleae tribe, with a range extending from Angola through Zambia and Zimbabwe to Mozambique and South Africa (Hoscovec, 2018). It was named after Christian Ferdinand Friedrich von Krauss (1812 - 1890), a professor at Stuttgart, German scientist, traveler and collector who collected extensively in South Africa. *H. kraussii* is a small, woody, yellow flowered perennial, evergreen increaser native shrub that establishes well in dense stands, poor and overgrazed sandy grasslands, or open woodland (Flora of Zimbabwe, 2008). It is popular for its aromatic and therapeutic properties.

Helichrysum kraussii has a height of 1-1,5m, with stiff, grey-green hairy, leafy branches, leaves are sessile and linear. The leaves are linear, up to 2 cm long and about 0.2 cm wide, rolled along the edge, pointed at the top, hairy or on the face, white on the reverse. It has cylindrical bracts, up to 0.35cm long and only 1 mm wide, growing in dense culms, arranged in 5 rows, overlapping, shiny and light yellow in colour (Bellmann, 2009) (Hoskovec, 2018). The stem is shrubby, robust, branches virgate, canous; with strongly revolute margins and mucronate (Wood et al., 1912).

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Fig 1. *Helichrysum kraussii* plant starting to flower.

Source: Author (2023)

Drivers of plant species invasions

Clarity lacks as to why some species become invasive while others naturalize hence questions relating to plant invasion appear to lack satisfactory answers (Rejmanek & Richardson, 1996; Jelbert, 2019). In trying to differentiate invasive from non-invasive species, Rejmanek and Richardson, (1996) mention that, seed mass and minimum juvenile period have been used to categorize plants. The enhanced plant invasion risk in eucalyptus plantations, in the early stages by Asteraceae species, may be due to different factors. Anthropogenic disturbance during eucalypt plantation often removes small trees and shrubs, therefore minimizing populations of important dominant species understory, thus paving way for the recruitment of herbaceous plants. The increased light availability and soil temperature but low soil water availability under eucalypt plantations may benefit the growth of drought tolerant pioneer plants. Asteraceae species often

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produce a large quantity of small seeds that are easily dispersed by wind or animals; maximizing reproductive capacity (Kanowski, 2005).

Great sexual reproduction is a key demographic correlate of invasiveness, as the performance of invasive species is the same as invaders having lives which are strongly reliant on propagule pressure in invasion, suggesting that adaptation mechanisms influencing sexual reproduction are of importance (Moroń et al., 2021). Each adult plant for *H. kraussii* can produce twenty thousand (20 000) seeds per annum (propagation and propagule pressure), ripening and maturing between September and October in Savanna environment giving it a competitive advantage over grasses as it is also unaffected by fire and remains persistent (Owen, 1992).

Propagule pressure, residence time, or extreme events becoming more frequent and chance are important factors that determine invasiveness of a plant (Richardson & Petr Pysˇek, 2006). In order for a plant to become invasive, it should possess two properties, which are not mutually exclusive, physiological tolerance and plasticity, or genetic differentiation. This is adaptive evolutionary change characterized by genetic drift and hybridization, among other factors. Invasion patterns observed in the field at one site may be difficult to represent other sites because those observations are subject to specificity of time, place and spatial scale (Theoharides & Dukes, 2007).

H. kraussii invasion is promoted by, among others, top soil disturbance, and soil moisture. An increase in soil moisture negatively affected size for *H. kraussii* and further highlights the susceptibility of the drier high lying areas were conditions promote larger individuals of this species (Owen, 1992).

Environmental variability promotes the invasion of knotweed, and many other invasive plants. The mechanism explaining this dominance might be the knotweeds' ability to capitalize on high resource availability, they it can respond quicker to nutrition, and have higher growth rates, than native plant species (Parepa et al., 2013). In places they are introduced, invasive knotweed is most dominant, and cause great damage, along rivers where periodic floods create disturbance and nutrient pulses (Parepa et al., 2013).

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Other plants as *Lantana camara* have as many as 14 phenolic compounds that can reduce the seed germination and growth of young plants. These are called allelochemicals that promote or inhibit the crop growth based on their concentration and the concentration of these allelochemicals increases from root, stem to leaf making the leaf toxic to grazing animals. Lantana infestations at some sites have been so persistent that they impede the regeneration of rainforest as Lantana is a very effective competitor and is capable of interrupting the regeneration processes of other indigenous species by decreasing germination (Sharma et al., 2005).

Rodriguez & Holben, (2004) mention that escape from natural enemies, and plant–soil feedback processes are also important in determining invasiveness. If a plant is introduced into an environment that lacks their usual herbivores, it will experience selection favor, thus individuals will allocate less energy to defense and more to growth and reproduction (Leger and Rice, 2003). Buczkowski (2010) argued that native species may possess invasive characteristics which enable them to expand their ecological territory. The author's studies show that aggressive traits may evolve in species as an adaptation mechanism to environmental conditions and these observations have been observed in nature when native species occupy new habitats in their native ranges. Focus has been on avoiding the entry by alien invaders but there is a need to consider indigenous species that have responded to environmental changes or anthropogenic factors and simply upgraded their aggressiveness.

Ecology of Helichrysum kraussii

Helichrysum kraussii grows on grassy and scrubby habitats, often on sandy ground. The plant blooms from June to September in Savanna climate (Hoscovec, 2018). It is a wiry unpalatable sclerophyllous shrub and therefore unaffected by animal grazing or browsing. Increasing grazing pressure may cause an increased ability for *H. kraussii* to out compete desirable grass species through the increased interception of light as a result of increased volumes (Dalton, 2007). This shows how much of a threat this plant is.

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Fig 2. *H. kraussii* seedling in  the veld

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Fig 3. Transplanted *H. kraussii* seedling

Fig 4. *H. kraussii* in an abandoned field in Chihota District, Mashonaland East, Zimbabwe

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Source: Author (2023)

Effect of plant invasion at an ecosystem level

Biological invasions are one of the major drivers of restructuring and malfunctioning of ecosystems and plant invasion is an emerging contributor of global change worldwide (Zhou & Staver, 2019). At an ecosystem level, invasive plants have radically altered fire regimes, in some cases causing regime shifts and transforming woodlands or savannas to grasslands (Foxcroft et al., 2017). Bajwa et al., (2016) mentions that biological invasions were widely considered to be largely confined to anthropogenically disturbed sites. The widespread disruption of ecosystems by invasive species was not globally perceived as a major threat but it has become clear that species abundance, diversity and estimated species richness have been altered, however, these have been reversed following control (Bajwa et al., (2016). With reference to Parthenium weed, a well-known noxious invasive species, the author sheds light on how it invaded diverse climatic and biogeographic regions.

Invasions lead to functional homogenization within communities, which probably reduces the rangeland's capacity to recover (Castro-Díez, 2016), reduced productivity and herbaceous species diversity (Zende et al., 2017), adversely affecting herbaceous species plant vigor, basal cover and species richness in a study on Dichrostachys cinerea by Mudzengi et al., (2014). Despite insufficient information regarding invasion mechanisms and interference with ecosystem stability being available, morphological advantages, reproductive biology, competitive ability and adaptation to abiotic stresses have been cited as some of the major causes. Additionally, the ability to grow in wide range of edaphic conditions, allelopathic potential against pasture species favorable for invasive plant growth, its reproductive output, and therefore its future spread and infestation contribute effectively (Bajwa et al., 2016). These observations can be attributed to the fast growth, giving it competitive advantage with respect to acquisition of light, nutrients and other resources.

i. Invasiveness of Helichrysum kraussii

Communal grazing areas are dominated by the invading shrub Helichyrsum kraussii in Masvingo and this suggests that, if control measures are not put in place, livestock production may not be

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feasible in communal rangelands in the near future because of rangeland deterioration. Gusha et al., 2017. In a study by Gusha et al., (2017), it was observed that communal rangelands had low grazing capacity, with significantly high levels of woody species, unpalatable wiry grass species, low biomass yield and were dominated by the invading shrub Helichyrsum kraussii. These findings suggest that if control measures are not put in place, livestock production may not be feasible in communal rangelands in the near future because of high levels of rangeland deterioration. Invasive and less palatable plant species are prevalent on most rangelands. Finding ways of utilizing them should be a research priority for there is a need to find environmentally friendly and effective methods of controlling them (Mudzengi et al.,2014; Gusha, 2018).

In a research across Zimbabwe, it was observed that alien invasive Lantana camara, and natives as *Helichrysum kraussii*, Acacia species and Dichrostachys cinerea were increasing in abundance in most rangelands, affecting the availability of herbage for livestock grazing thus worsening the challenges faced by communal farmers. (Gusha et al., 2016).

Effect of H. kraussi on other herbaceous species

Helichrysum kraussii was observed to effectively exclude the establishment of grasses but allow woody species to grow underneath. Interestingly its growth results in an increase in light transmission through to the soil surface with an increase in diameter and this may explain the presence of a number of woody species being able to establish beneath the canopies for this species. Thus *H. kraussii* is able to facilitate woody establishment where permitted to grow through to larger individuals and has been identified as a precursor to woodland shrub and fores (Owen, 1992). As an invasive plant, *H. kraussii* has radically altered fire regimes, in some cases causing regime shifts and transforming woodlands or savannas to grasslands (Foxcroft et al., 2017). Burning has no effect on the growth response of *H. kraussii* as the plant rejuvenates readily from the root system (Owen, 1992).

Effect of H. kraussi on woody species

The number of other woody species establishing beneath *H. kraussii* may be due to changes in the transmission of light through the canopy where an increase in canopy diameter resulted in an increase of photosynthetically active radiation at the soil surface (Dalton, 2007). Asteraceae family

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is the most important source of invasive plant species in China. It is ranked third (7.42%) in species importance in the early stages in eucalypt plantations. Among the 20 invasive species recorded in the eucalypt plantations, 9 species were destructive invasive species and 7 of these species belonged to Asteraceae (Jin et al., 2015). The importance of Asteraceae was remarkably higher in eucalypt plantations than in contrast vegetation (Kanowski, 2005).

Effect on microorganisms

Soil microbes have both negative and beneficial effects on invasive plants. Pathogenicity, root–fungus mutualism and driving the nutrient cycles on which plants depend on are some of the major functions (Callaway et al., 2004) These effects contrast each other. Positive feedback occurs when plant species accumulate microbes near their roots that have beneficial effects on the plants that cultivate them, such as mycorrhizal fungi and nitrogen fixers therefore promoting invasion. Contrary to that, negative feedback occurs when plants are affected by pathogenic microbes, creating conditions that are increasingly hostile to the plants that cultivate the pathogens and this enhances community diversity by increasing species turnover rates (Callway et al., 2004).

Plants of the Asteraceae family, often manifest themselves alongside allelopathic properties, the ability to form arbuscular mycorrhiza (AM) and common mycorrhizal networks (Mikhailovich & Valeryevna, 2021), which is believed to have helped tribes of this family to spread around the world, that is, positive feedback. Arbuscular mycorrhiza can significantly improve plant nutrition, water availability, soil structure and fertility, as well as stress resistance and tolerance, for example, arbscular mycorrhiza minimizes effects of stress caused by pathogens, heavy metals, and soil salinization (Jentschke & Godbold, 2000). Plants do not receive large benefits from AM when there is high availability of nutrients, but AM enhances plant development under conditions of nutrient deficiency, explaining why *H. kraussii* is found in overexploited land.

ii. Uses of Helichrysum kraussii by communities

Helichrysum kraussii has since been used in the medical field, in a traditional way for its aromatic, antibacterial and antiviral properties. Depending on the condition being treated, either the whole

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plant or a specific part of the plant was used. The main uses include its use in treating respiratory infections, sexually transmitted infections, cultural uses or dermatological applications.

Treatment of headaches

Highlights the different uses of *H. kraussii* plant parts for the treatment of different conditions (Lourens et al., 2008). Medicinally, *Helichrysum kraussii* is used to treat headaches and the whole plant is used in the process (Mashiloane, 2010).

Treatment of respiratory infections

In other areas, the whole plant is burnt, salt is added to ash and ingested by mouth to treat coughs (Swanepoel, 1997). The Karanga smoke dried flowers and seeds in a pipe smoke as a remedy for coughs and pulmonary tuberculosis. The findings are in concurrence with Watt and Breyer-Brandwijk, (1962) who mentions that *H. kraussii* Sch. Bip. is smoked in a pipe for the relief of cough and as a remedy for pulmonary tuberculosis. Alternatively, in the treatment of tuberculosis, the whole plant was dried, pounded and taken orally with warm water, taken thrice a day (Baloyi & Semenya, 2019). This is an unusual way to treat a respiratory infection.

Treatment of sexually transmitted infections

The root mixed with salt and other ingredients are applied to the child's side with a small amount given orally (Lourens, 2008). The root is used to treat Venereal disease, an STI (Lourens, 2008). These results are similar to those of Swanepoel (1997) who mentions that the Venda drink the decoction of the root for the problems of the genitalia.

Cultural uses/incense

Roots and leaves infusion are used to wash the body, an act to drive bad spirits away. It is burnt as an incense by KwaZulu-Natal diviners (Hilliard,1983).

Other uses

The Lenge in Mozambique use the ground, toasted plant mixed with salt and other remedies as a local application to the child's side (Swanepoel,1997). Leaf decoction is used to wash keloid scars, that is, thick raised scars resulting from excess collagen during wound healing (Hilliard, 1983). In

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a collection by Magwede et al., (2019), the authors highlight that the root is a medicine but did not explain how it is used and what it treats.

iii. Opportunities associated with Helichrysum kraussii and value addition

Invasive and less palatable plant species are prevalent on most rangelands. Finding ways of utilizing them should be a research priority for there is a need to find environmentally friendly and effective methods of controlling them (Mudzengi et al.,2014; Gusha, 2018).

Climate change adaptation and mitigation

Despite its devastating effects, in times where global warming and climate change are evident, plants like *H. kraussii* characterized by their drought tolerance, perennial, evergreen, high biomass and invasive nature, could be used in carbon sequestration hence reducing the devastating effects of the above mentioned processes. Firstly, they are not affected by seasonality +hence photosynthesize all year round, thus reducing the amount of atmospheric carbon dioxide. Secondly, the residue remaining after essential oil extraction can be used in vermicomposting therefore promoting carbon capture and storage via biological means. Lastly, they have essential oils that contain terpenes made up of multiple isoprene units made up of 5 or more carbon atoms. This alone is a carbon store (Munnu et al., 2014).

Production of dermatological products

In a study conducted to investigate the potential of southern African plants against P. acnes, based on antimicrobial, antioxidant and anti-inflammatory activity, Helichryssum kraussii was able to inhibit P. acnes growth at 62.5 µg/ ml. Active antibacterial species *H. kraussii* also showed good antioxidant activity with IC50 of 4.24 µg/ml, (De Canha et al., 2018). This shows that *H. kraussii* essential oils can be incorporated in skin care products that are medical.

Cancer medication

A study to determine the antioxidant and anti-cancer activities of traditionally used medicinal plants was established. The extracts were tested for cytotoxicity against epidermoid carcinoma (A431) and cervical epithelial carcinoma (HeLa). The antioxidant activity was also determined. *H. kraussii* was able to inhibit the A431 and HeLa cells with 50% inhibitory concentrations (IC50)

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ranging from 34.90–56.20 µg/ml. *H. kraussii* showed high 2,2-diphenyl-1-picrylhydrazyl (DPPH) inhibitory activity, with IC50 values ranging from 2.41–5.25 µg/ml. This shows how effective an antioxidant and anticancer this plant is. (Twiley et al., 2017). The species is important in ethnopharmacological practices, hence could contribute perfectly well to aromatherapy. The plant has also proved to have anti-cancer properties (Twilley et al., 2017).

Potential for HIV vaccine and an antibiotic

H. kraussii, exhibited promising HIV inhibition at 2.5 µg/mL (N80%) (Yazdi et al., 2019). *Helichrysum kraussii* contains prenyl-butryl phloroglucinol acid which is highly effective against Staphylococcus aureus, Bacillus cereus, B. pumulis, M. kristinae, Bacillus subtilis, Escherichia coli and S. marcescens. Aurenoic acid is equally effective against Staphylococcus aureus, Bacillus cereus, and Bacillus subtilis (Vuuren, 2008).

Studies show that Helichrysum spp. are very rich in phenolic compounds for their antioxidant, antimicrobial, and anti-inflammatory activities as they have since been used for traditional medicinal practices of many countries around the world (Maryam et al., 2019). In an investigation of the synergistic activity of plant extracts, the combination of Helichrysum odoratissimum and *Helichrysum kraussii* proved to be highly effective against P. acnes hence its application dermatologically (De Canha, 2014). *Helichrysum kraussii* contains prenyl-butryl phloroglucinol acid which is highly effective against *Staphylococcus aureus, Bacillus cereus, B. pumulis, M. kristinae, Bacillus subtilis, Escherichia coli* and *S. marcescens*. Aurenoic acid is equally effective against Staphylococcus aureus, Bacillus cereus, and Bacillus subtilis (Vuuren, 2008). These acids are important components of essential oils the plant contains.

Use of Helichrysum kraussii as a feed

Despite *H. kraussii* having been documented to be unpalatable, in a small fenced confinement, in the dry season, the eland switched to evergreen trees and shrubs such S. lancea and *H. kraussii*, which were avoided in the wet season. Eland in the Zimbabwean Lowveld showed a similar pattern by browsing on woody plants that offer the greatest amount of green leaves, shifting to less palatable species (Parrini et al., 2019). This shows that indeed, the plant is palatable but less acceptable. This could be an opportunity to explore the nutritional content of the plant.

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Control of Helichrysum kraussii

Despite literature missing on the control of *H. kraussii*, these are some methods that we can use to eradicate this invasive species. However, most of these methods work in combinations. According to Sharma et al., (2005), mechanical control can be used if machinery is available to uproot the whole plant in the case of Lantana camara. Alternatively, chemicals like glyphosate can be used to spray a large area (Nergi et al., 2019). However, this is a non-selective herbicide that will damage non-target vegetation leading to loss of biodiversity.

Sustainable Development Goals on Invasive plants

According to the United Nations (2016), Goal 15 of the sustainable development goals (SDGs) focuses on sustainably, halting and reversing land and natural habitat degradation, and stopping biodiversity loss. In this context, preserving diverse forms of life on land requires is of paramount importance and is against invasions that promote monoculture and reduce diversification. It also focuses on measures to prevent the introduction and reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species.

Conclusion

Helichrysum kraussii is fast becoming a threat to desired species and is a cause for concern. If it is not controlled, livestock production might not be feasible in future. However, it promotes growth of woody species. Also, this plant has a potential to play a pivotal role in combating climate change, even though there is a need to back this information statistically. *H. kraussii* is mainly used for the restoration of health as the benefits are mainly on respiratory infections, STIs and cultural beliefs. However, the scientific experiments to link cultural practices are minimal. Thus, there is room for improvement.

Value addition of this plant into a vaccine, antibiotic or dermatological products can be practiced as scientific experiments have proved its efficacy towards a number of microbes. It can also be used as a feed for the eland, however with limited palatability. The genus Helichrysum has been studied extensively. However, not much attention has been paid to *H. kraussii* specifically. The issue of invasiveness is still debatable as very little information is available on the matter. Social

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aspects of biological invasions are less documented, this hinders the development of sound and effective management of invasive species. Studies on biological invasions mainly focused on ecological aspects often neglecting the social aspects hence the importance of public participation in decision making.

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References

1. Akaberi M., Sahebkar A., Azizi, N., & Emami S.A. (2019). Everlasting flowers: Phytochemistry and pharmacology of the genus Helichrysum. Industrial Crops and Products, 138, 111471.
2. Bajw, A.A., Chauhan B.S., Farooq M. (2016). What do we really know about alien plant invasion? A review of the invasion mechanism of one of the world's worst weeds. Planta 244, 39–57.
3. Baluška F., & Mancuso S. (2020). Plants, climate and humans: Plant intelligence changes everything. EMBO reports, 21(3), e50109. https://doi.org/10.15252/embr.202050109.
4. Bellmann H. (2009): The Big Book of Plants. – Euromedia, Prague.
5. Buczkowski G. (2010). Extreme life history plasticity and the evolution of invasive characteristics in a native ant. Biological Invasions, 12(9), 3343-3349.
6. Callaway R.M., Thelen G.C., Rodrigue, A., & Holben W.E. (2004). Soil biota and exotic plant invasion. Nature, 427(6976), 731-733.
7. Castro-Díez P., Pauchard A., Traveset A. & Vilà, M. (2016), Linking the impacts of plant invasion on community functional structure and ecosystem properties. J Veg Sci, 27: 1233-1242.
8. Dalton B.P.A. (2007). The coastal grasslands of Maputaland, South Africa: Effects of fire and grazing on vegetation structure, diversity, and composition (Doctoral dissertation).

ISSN 2518 - 4334

9. De Canha M.N., Kishore N., Kumar V., Meyer D., Nehar S., Singh B., & Lall N. (2018). The potential of Clausena anisata (Willd.) Hook. f. ex Benth against Propionibacterium acnes. South African Journal of Botany, 119, 410-419.
10. Flora of Zimbabwe: Species information: *Helichrysum kraussii* (zimbabweflora.co.zw)
11. Foxcroft L.C., Pyšek P., Richardson D.M. (2017). Plant invasion science in protected areas: progress and priorities. Biol Invasions 19, 1353–1378.
12. Godber O.F. & Wall, R. (2014), Livestock and food security: vulnerability to population growth and climate change. Glob Change Biol, 20: 3092-3102.
13. Gusha J. (2018). Invasive plant species of savanna rangelands: Are they a threat or an opportunity. [Unpublished doctoral thesis]. University of Zimbabwe.
14. Gusha J.& Mugabe P.H. (2013), Unpalatable and wiry grasses are the dominant grass species in semi-arid savanna rangelands in Zimbabwe, International Journal of Development and Sustainability, Vol. 2 No. 2, pp. 1075-1083.
15. Gusha J., Masocha M., & Mugabe, P. H. (2017). Impact of grazing system on rangeland condition and grazing capacity in Zimbabwe. The Rangeland Journal, 39(3), 219-225.
16. Gusha J., Masocha M., Mugabe P.H. (2017) Impact of grazing system on rangeland condition and grazing capacity in Zimbabwe. The Rangeland Journal 39, 219-225.
17. Gusha J., Mugabe, P.H., Masocha M., Halimani T.E., & Ngongoni N.T. (2016). Invasive plants, bush encroachment and rangeland degradation: Farmer's perception and the current status of Zimbabwe rangelands.
18. Hilliard O.M. (1983) Helichrysum. In Flora of Southern Africa 33(7), 2, Leistner OA (Ed.). Botanical Institute of South Africa, Pretoria, 61-310.
19. Hoskovec L. (2018). *Helichrysum kraussii* Sch. Beep. – smil / slamiha. Botany.cz.
20. https://unstats.un.org/sdgs/report/2016/goal-15/
21. Jelbert K., Buss D., McDonald J., Townley S., Franco M., Stott I., Hodgson D. (2019). Demographic amplification is a predictor of invasiveness among plants. Nature communications, 10(1), 1-6.
22. Jentschke G., & Godbold D.L. (2000). Metal toxicity and ectomycorrhizas. Physiologia plantarum, 109(2), 107-116.

ISSN 2518 - 4334

23. Jin D., Huang Y., Zhou X.L., Chen, B., Ma, J., & Yan, Y.H. (2015). High risk of plant invasion in the understory of eucalypt plantations in South China. Scientific reports, 5(1), 1-8.
24. Joshi, RC. (2006, September). Invasive alien species (IAS): concerns and status in the Philippines. In Proceedings of the International Workshop on the Development of Database (APASD) for Biological Invasion. FFTC, Taichung, Taiwan, China (pp. 1-23).
25. Kanowski J., Catterall C.P., & Wardell-Johnson G.W. (2005). Consequences of broad scale timber plantations for biodiversity in cleared rainforest landscapes of tropical and subtropical Australia. Forest Ecology and Management, 208(1-3), 359-372.
26. Kato-Noguchi, H. and Kurniadie, D., 2021. Allelopathy of Lantana camara as an invasive plant. Plants, 10, 1028.
27. Kolar C.S., & Lodge D.M. (2001). Progress in invasion biology: predicting invaders. Trends in ecology & evolution, 16(4), 199–204.
28. Lourens A.C.U., Viljoen A.M., van Heerden F.R. (2008). South African Helichrysum species: A review of the traditional uses, biological activity and phytochemistry, Journal of Ethnopharmacology, Vol.119, Issue 3, Pages 630-652.
29. Magwede K., Van Wyk B. E., & Van Wyk A. E. (2019). An inventory of Vhavenḓa useful plants. South African Journal of Botany, 122, 57-89.
30. Maroyi, A. Traditional use of medicinal plants in south-central Zimbabwe: review and perspectives. J Ethnobiology Ethnomedicine 9, 31 (2013). https://doi.org/10.1186/1746-4269-9-31
31. Mashiloane, M. R. R. (2010). Medicinal Plants used By Mamotintana Community in Mankweng, Limpopo Province (Doctoral Dissertation, University Of Limpopo).
32. Mfutimukiza D. Evaluating rangeland potentials for cattle grazing in a mixed farming system. MSc Dissertation. International institute for Geo-Information Science and Earth Observation, Enschede, Netherlands.ty.
33. Mhlongo E.S. (2021). Perceptions of the role of Lantana camara on human well-being and rural livelihoods in Vhembe Biosphere Reserve, South Africa (Doctoral dissertation, Rhodes University).
34. Mikhailovich M.D., & Valeryevna S.S. (2021). Does arbuscular mycorrhiza favor invasion of some Asteraceae tribes? Вестник защиты растений, 104(3), 144-152.

ISSN 2518 - 4334

35. Moroń D., Marjańska E., Skórka P., Lenda M., & Woyciechowski M. (2021). Invader–pollinator paradox: Invasive goldenrods benefit from large size pollinators. Diversity and Distributions, 27(4), 632-641.
36. Mudzengi C.P, Kativu S., Dahwa E., Poshiwa X., Murungweni C. (2014) Effects of Dichrostachys cinerea (l.) Wight & Arn (Fabaceae) on herbaceous species in a semi-arid rangeland in Zimbabwe. Nature Conservation 7: 51–60.
37. Munnu S., Neha G., Eranki P.R, Prashant G. (2014). Efficient C sequestration and benefits of medicinal vetiver cropping in tropical regions. Agronomy for Sustainable Development, Springer Verlag/EDP Sciences/INRA, 34 (3), pp.603-607.
38. Negi G., Sharma S., Vishvakarma S.C., Samant S.S., Maikhuri R.K., Prasad, R.C., & Palni, L. (2019). Ecology and use of Lantana camara in India. The Botanical Review, 85(2), 109-130.
39. Omotayo A.O., Ndhlovu P.T., Tshwene S.C., & Aremu A.O. (2020). Utilization Pattern of Indigenous and Naturalized Plants among Some Selected Rural Households of North West Province, South Africa. Plants (Basel, Switzerland), 9(8), 953. https://doi.org/10.3390/plants9080953.
40. Parepa, M., Fischer, M. & Bossdorf, O. Environmental variability promotes plant invasion. Nat Commun 4, 1604 (2013).
41. Parrini F., D'Ammando G., & Marshal J.P. (2019). Seasonal shifts in habitat use and diet by eland confined in a small fenced reserve. African Journal of Ecology, 57(3), 394-403.
42. Rejmanek M., & Richardson D.M. (1996). What attributes make some plant species more invasive? Ecology, 77(6), 1655-1661.
43. Richardson D.M., & Pyšek P. (2006). Plant invasions: merging the concepts of species invasiveness and community invasibility. Progress in Physical Geography, 30, 409 - 431.
44. Rodriguez A., & Holben W.E. (2004). Soil biota and exotic plant invasion. Nature, 427, 731-733.
45. Semenya S.S., & Maroyi A. (2019). Ethnobotanical survey of plants used by Bapedi traditional healers to treat tuberculosis and its opportunistic infections in the Limpopo Province, South Africa. South African Journal of Botany, 122, 401-421.
46. Sharma G.P., Raghubanshi A.S., & Singh J.S. (2005). Lantana invasion: an overview. Weed Biology and Management, 5(4), 157-165.

ISSN 2518 - 4334

47. Swanepoel D.P. (1997). The medicinal value of the Southern African Asteraceae (Doctoral dissertation, University of Pretoria).
48. Theoharides K.A., & Dukes J.S. (2007). Plant invasion across space and time: factors affecting nonindigenous species success during four stages of invasion. New phytologist, 176(2), 256-273.
49. Twilley D., Langhansová L., Palaniswamy D., & Lall, N. (2017). Evaluation of traditionally used medicinal plants for anticancer, antioxidant, anti-inflammatory and anti-viral (HPV-1) activity. South African Journal of Botany, 112, 494-500.
50. van Vuuren S.F. (2008) Antimicrobial activity of South African medicinal plants,
51. Watt J.M. and Breyer-Brandwijk M.G. (1962). The medicinal and poisonous plants of Southern and Eastern Africa. 2nd edn. E and S. Livingstone, London.
52. Weisser P.J. (1978). Changes in area of grasslands on the dunes between Richards Bay and the Mfolozi River, 1937 to 1974. Proceedings of the Annual Congresses of the Grassland Society of Southern Africa, 13(1), 95-97.
53. Wood J.M. & Evans, M.S., Natal plants (1899-1912)
54. Yazdi S. E., Prinsloo G., Heyman H.M., Oosthuizen C.B., Klimkait T., & Meyer J.J.M. (2019). Anti-HIV-1 activity of quinic acid isolated from Helichrysum mimetes using NMR-based metabolomics and computational analysis. South African journal of botany, 126, 328-339.
55. Zaloumis N.P., & Bond W.J. (2016). Reforestation or conservation? The attributes of old growth grasslands in South Africa. Philosophical transactions of the Royal Society of London. Series B, Biological sciences, 371(1703), 20150310. https://doi.org/10.1098/rstb.2015.0310.
56. Zende M., Kativu S., & Mhlanga L. (2017). Impact of Lantana Camara On Vegetation, Primary Productivity and Soils At Imire Ranch, Zimbabwe. Kirkia, 19(1), 101–109.
57. Zhou Y., and Staver A.C. (2019). Enhanced activity of soil nutrient-releasing enzymes after plant invasion: a meta-analysis. Ecology 100.

ISSN 2518 - 4334