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Indigenous Strategies for Managing Bush Encroachment in Rural Areas of South Africa

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Abstract: The integration of indigenous knowledge systems into the discussion of bush encroachment management is of paramount importance. Indigenous knowledge and formal monitoring may be mutually beneficial, and using both approaches can improve natural resource management. Savannah rangeland landscapes hold deep cultural and spiritual significance for indigenous communities, and their perceptions can provide valuable insights into creating more effective, community-driven conservation initiatives. This study was aimed at filling the existing knowledge and research gap on bush encroachment control by focusing on the integration of indigenous knowledge systems. To achieve this, the current research included three distinct non-probability sampling strategies: (1) Purposive, (2) Snowball, (3) Convenience sampling methods. The results showed that 90.3% of the participants indicated that the main encroaching species of concern was sickle bush (*Dichrostachys cinerea*) and it is therefore perceived as a problem in the rangeland. The majority of farmer respondents indicated that they cut the encroacher plant down, uproot all root systems, then burn the remaining roots. This is reported to be a more effective way of managing sickle bush as an encroacher plant. Both genders generally believe in the efficacy of these systems, with variations in levels of agreement. However, a gender disparity emerges in opinions on incorporating communal-based approaches, emphasizing the need to consider gender perspectives in environmental management initiatives. Therefore, considering this, the study concludes that a holistic approach, integrating both formal and informal knowledge systems, may be crucial for sustainable and effective management strategies. Given that, recognizing the diversity of perspectives within the community, particularly regarding gender differences, is essential for developing inclusive and community-driven environmental management initiatives.

Keywords: *Dichrostachys cinerea*; rural communities; indigenous knowledge; contemporary control; management practice

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1. Introduction

Globally, semi-arid savannah rangelands are ecologically diverse landscapes of immense importance, balancing a rich array of biodiversity and the livelihoods of the communities residing within them [1]. In recent years, the ecosystem (savannah rangeland) has faced a growing ecological challenge such as soil erosion, bush encroachment, and land degradation, among other environmental issues across the globe. Bush encroachment, which refers to the expansion of woody vegetation into grasslands and savannahs, is a notable ecological problem in the global semi-arid savannah rangelands. These problems include biodiversity loss, water cycle disruption, fire regime changes, and soil degradation [2–4]. The proliferation of bush encroachment in Sub-Saharan Africa is a significant problem due to its extensive impact on not only the environment but also on the economy

and society. The continued relevance of this subject is primarily due to factors such as biodiversity conservation, ecosystem services, land degradation, water resources, livestock farming, fire risk, climate change, invasive species, conservation management, and economic impact. These reasons are supported by various studies [5–8]. Jeltsch et al. [9] conducted a study that found that bush encroachment in southern Africa's arid grasslands affects the ability of the land to support cattle. This reduction is caused by the selective overgrazing of grasses by cattle.

Moreover, the intrusion of bushes causing land degradation has a significant impact on the ecosystem services of the nearby population, often resulting in socioeconomic problems such as loss of income and inadequate productivity to sustain livestock [7]. Community grazing areas that were not encroached upon showed significantly better yields, ranging from 106% to 150%, compared to those that were affected by bush encroachment, which had lower yields [10]. This phenomenon was also illustrated in research conducted by Gobelle and Gure [11], wherein they investigated the impacts of bush encroachment on the composition, diversity, and carbon stock contribution of plant species. Alterations in the ecosystem can exert a substantial influence on cultural identity and societal stability [4,12]. South Africa is not immune to this environmental problem as it is estimated that in South Africa alone, approximately 13 million ha of savannah have experienced encroachment by thorn bushes [12,13]. This encroachment has far-reaching impacts on the environment and the livelihoods of the communities residing within these landscapes [2,10,14]. Research has also shown that factors such as fire, overgrazing, rainfall variability, and soil property can influence the dynamics of shrub encroachment in African savannahs [4,12]. Additionally, the expansion of range enclosures, crop farming, and ranching, as well as the absence of fire, contribute to the expansion of bush cover in rangelands [10,15,16]. Nevertheless, despite the widespread occurrence and significant scale of this phenomenon in unprotected regions, including community rangelands, there is a lack of published information about various management approaches.

Communal rangelands constitute 13% of the agricultural land in South Africa and function as a feed source for both large and small stock [3,7,17]. Insufficient proper management of communal rangelands poses a threat to these areas and encourages the invasion of problematic plants. Various methods for managing bush encroachment are available, including mechanical, biological, chemical, or combined approaches [2,18,19]. Nevertheless, to implement these measures effectively, it is essential to enhance public knowledge and adopt a participatory approach in managing encroaching woody species in regions where they jeopardize the sustainability of rangeland management. Research has been conducted throughout the African continent to assess the impact of community management on bush encroachment in communal rangelands. However, studies on indigenous environmental knowledge and monitoring are very limited in industrialized nations, despite their potential importance in natural resource management [20–22]. Even though local communities globally possess a significant amount of information about monitoring and management of savannah rangelands, there is a lack of documentation or evaluation about its implementation, uses, and benefits [23,24]. In discussions about climate and assessment reports like those from the United Nations Intergovernmental Panel on Climate Change (IPCC) and Sustainable Development Goals (SGDs), Indigenous perspectives and knowledges have often been overlooked historically. Efforts to address this by simply globalizing this knowledge risks stripping it of its original local meaning and purpose. Indigenous pedagogies are intimately and specifically tied to the lands they steward. It is critical to respect the unique local understanding and relationship between knowledge production and application in specific regions. Indigenous knowledge and formal monitoring may be mutually beneficial, and using both approaches can improve natural resource management [18]. Extensive studies have been conducted by ecologists worldwide to understand the causes and impact of bush encroachment. But indigenous-community-based strategies and the perceptions of communal farmers regarding bush encroachment management have been neglected in most studies. To effectively integrate indigenous knowledge and formal methods, it

is necessary to provide a clear definition of indigenous knowledge approaches [18,25] and assess their validity and compatibility with formal methods [26]. The credibility of traditional environmental knowledge is sometimes linked to its level of conformity with formal science.

The integration of indigenous knowledge systems into the discussion of bush encroachment management is of paramount importance. This integration serves to bridge the gap that exists between conventional scientific methods and the invaluable indigenous wisdom that has been cultivated by these communities over centuries. This indigenous knowledge has proven to be highly effective in managing bush encroachment and plays a significant role in ensuring the ecological sustainability of semi-arid rangelands [3,27]. It provides a distinct and valuable perspective on the harmonious coexistence of human activities with nature, a core principle deeply rooted in the indigenous cultures of the region. It is necessary to create a community-based monitoring system in order to regularly evaluate alterations in vegetation cover and pinpoint areas where bush encroachment is becoming more severe. This study sought to fill the existing knowledge and research gap on bush encroachment control by focusing on the integration of indigenous knowledge systems. The primary aim was to evaluate the communal-based approaches that have evolved and been conserved by indigenous communities for generations. The hypothesis of this study was that the increase in bush encroachment is correlated with the community's management techniques. This hypothesis was accompanied by the following questions:

1. What are the perceptions of communal farmers on bush encroachment management in savannah rangelands?
2. How does traditional knowledge influence the strategies used by communities to manage bush encroachment?

2. Methodology

2.1. Study Area

The study was conducted at Mafarani village, which is located within the Greater Tzaneen local municipality of the Mopani District in Limpopo province, as shown in Figure 1. This study area is a rural village located near Letsitele town, which is surrounded by other previously disadvantaged communities. Mafarana village falls under the jurisdiction and leadership of Chief Mohlaba of the Nkuna tribe. This village is located (GPS coordinates: 23.9594° S, 30.3563° E) on the southeastern side of Tzaneen main town. It neighbors Lenyenye, Nkowankowa, and Letsitele townships and covers an area of 2.02 km^2 with an estimated population of 2554 [28]. The dominant population group is black Africans speaking Xitsonga language, which is the widely spoken language (92% of the population in the area speaks Xitsonga). Farming remains the primary land use within this community, encompassing both crop cultivation and animal husbandry. Rangeland grasses, as reported by Lam et al. [29], cover a significant portion of the landscape, constituting approximately 32.33% of the land use. Figure 2A,B: Overall perspective of the landscape and savannah affected by the encroachment of sickle bush. This invasive plant engages in competition with grasses and trees, resulting in detrimental effects on the natural environment and the formation of densely populated and difficult-to-reach regions.

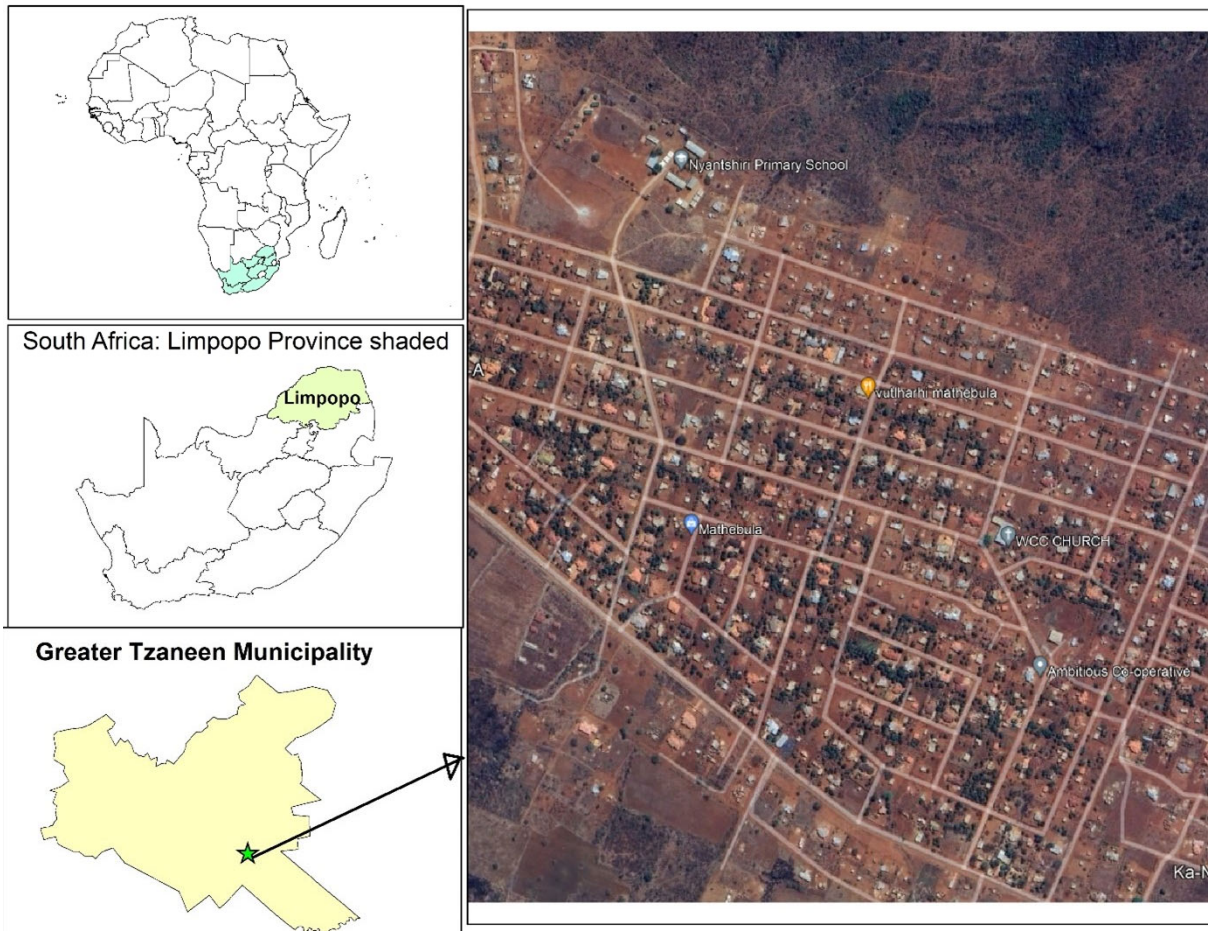

Figure 1. Study area map of Mafarana village (green star) in the Great Tzaneen local municipality (yellow).

(**A**) (**B**)

Figure 2. (**A**,**B**): General view of the landscape and savannah encroached by sickle bush.

2.2. Data Collection Method

2.2.1. Sampling Method

Case studies enable researchers to understand, interpret, observe, and study complex phenomena in their natural contexts; thus, this exploratory study employed a qualitative case study methodology. In qualitative methods, it is common to collect data from a small number of study objects [30]. The researcher's perspective on the data was distinctive [31]. There were three different non-probability sampling techniques used in this study: purposive sampling, snowball sampling, and convenience sampling. All participants, including tribal leaders, community members, and community partners, were interviewed using data collection techniques. To interview participants who were believed to possess a thorough understanding of the study and were likely to provide the required responses, a purposive

sampling method, a non-probability approach, was used. The majority of participants in this category were tribal leaders and community partners. On the other hand, the snowball method was used to locate participants, such as community leaders, who are also key respondents for this study. The convenience sampling method focused on public locations in close proximity to the village, where individuals who were willing to participate and were residents of the area were identified and interviewed.

2.2.2. Sampling Size

The sample size for data collection was determined using Slovin's formula, which calculates the sample size (n) based on the population size (N) and a desired margin of error (e). It is computed as, $n = \frac{N}{1+Ne^2}$ with a 95% confidence interval, therefore the margin of error is 0.05%.

The formula helped determine how many people must be sampled from the original population size of 2554. The selected sample size of 350 was cost-effective and required less time than the actual sample size.

2.2.3. Data Collection Procedure

A mixed-methods approach was used to collect data, utilizing a combination of qualitative and quantitative techniques, through questionnaires, structured interviews, and observation. The community surrounding Mafarana village was asked to fill out questionnaires to collect information about the methods and strategies employed by the community to curb the encroachment of *Dichrostachys cinerea*, the dominant invasive species. A combination of open-ended and closed-ended questions was used in the questionnaires. Interviews with tribal authorities consisted of open discussions designed to raise awareness and explore relationships with neighboring communities. As well as observing individuals' behavior patterns, observational assessment was applied to their interactions with the environment.

2.2.4. Validity and Reliability

During data collection, the structured interviews and questioners administered to the participants were guided by the study objective. These structured interviews and questionnaires were reviewed and approved by the experts (who are co-authors, e.g., Siyabonga Madonsela) in the field of bush encroachment management prior to going to the field. Furthermore, before heading to the field (pre-tests), the questionnaires and interviews were administered to individuals to assess how participants would respond to questionnaires and interact with the structured interviews. In this instance, the feedback from the pilot study assisted the researcher to adjust accordingly the questionnaires as well as the structured interviews. Subsequently, the pilot study outcome yielded an acceptable and satisfactory Cronbach's Alpha of 0.76.

2.3. Data Analysis

The current study used the mixed methods analysis technique to analyze qualitative and quantitative data collected from Mafarana village in Tzaneen. Given the dynamic nature of the research data that were collected from Mafarana village, the current study used qualitative coding to analyze the qualitative data and questioners to analyze quantitative data. The researcher assessed all the administered questionnaires, and the interviews were transcribed to get a general sense of the whole of the data presented and the content to be analyzed. This practice followed Combs and Onwuegbuzie's [32] mixed analysis framework which suggests that in an instance where the study design is quantitative and qualitative, the first part of the data to be analyzed are qualitative data. This is important as it allows the qualitative data to be translated into a quantitative format. In line with this premise to unravel the significant findings in the perceptions of communal farmers regarding bush encroachment management, the thematic data analysis was conducted first. The collected data, in the form of texts from the Mafarana community, were systematically

categorized into excerpts. That is, the qualitative data were first transcribed in Microsoft Excel 2019. Subsequently, the data were grouped according to themes. Moreover, at a later stage, the simple descriptive statistics analysis was integrated in the current study. Subsequently, in line with this, observation of data from the questionnaires, such as the demographic information, was carried out using IBM Statistical Package for the Social Sciences (SPSS) version 26, which is software used for editing and analyzing of data [33] which ensures meaningful and symbolic content of qualitative and quantitative data [34].

3. Results and Discussion

3.1. Demographics

The data provided for Table 1 below consist of four different demographic variables: Gender, Age Range, Level of Education, and How long has the respondent been living in the community. Each variable is tabulated with its corresponding frequencies, percentages, valid percentages, and cumulative percentages. Table 1 reveals that a significant portion of the individuals interviewed in Mafarana village were female (66.6%), while a smaller portion (33.4%) consisted of males. These data suggest a gender imbalance in the current sample, reflecting a female-dominated composition, which aligns with the findings of the 2011 statistics indicating that 55% of the community comprised females while 45% comprised males.

Table 1. Illustrates the demographics specification of the research participants/respondents at Mafarana community.

Variable	Frequency	Percent	Valid Percent	Cumulative Percent
Gender				
Female	233	66.6	66.6	66.6
Male	117	33.4	33.4	100.0
Total	350	100.0	100.0	
Age Range				
<18	1	0.3	0.3	0.3
18–24	52	14.9	14.9	15.1
25–34	70	20.0	20.0	35.1
35–44	60	17.1	17.1	52.3
45–54	44	12.6	12.6	64.9
55 and above	123	35.1	35.1	100.0
Total	350	100.0	100.0	
Level of Education				
No formal education	37	10.6	10.6	10.6
Primary education	63	18.0	18.0	28.6
Secondary education	166	47.4	47.4	76.0
Post-secondary	84	24.0	24.0	100.0
Total	350	100.0	100.0	
How long you have been living in this community				
5 years	18	5.1	5.1	5.1
10 years	11	3.1	3.1	8.3
15 years	27	7.7	7.7	16.0
20 years and above	293	83.7	83.7	99.7
5.00	1	0.3	0.3	100.0
Total	350	100.0	100.0	

The largest segment of participants falls within the "55 and above" age bracket, making up 35.1% of the total respondents. On the other hand, the "<18" age category represents the smallest group, comprising only 0.3% of the respondents. It is noteworthy that the majority of respondents are adults over the age of 35, constituting more than half of the total sample. This demographic profile contrasts with the findings from Stats SA [28] regarding Mafarana village, which showed that most of the population there was composed of youth, accounting for 65.85% of the total population. This discrepancy can be attributed to the fact that the research samples only included one individual below the age of 18 years.

Most respondents have secondary education (47.4%), followed by post-secondary education (24%). Primary education and no formal education represent 18% and 10.6% of the respondents, respectively. The data indicate a relatively high level of education among the community members, with most having at least a secondary education background. The majority of respondents (83.7%) have resided in the community for 20 years or more. The categories of 5 years, 10 years, and 15 years represent a relatively smaller proportion of the respondents. These data demonstrate that a significant portion of community members have strong and long-standing ties to the community, with a large number of them having lived there for an extended duration.

3.2. Community Perceptions toward Bush Encroachment

The knowledge of bush encroachment in Mafarana villagers is reflected in Table 2. The Table 2 dataset indicates that most of the respondents (90.3%) are aware of what bush encroachment is, and sickle bush was identified as the dominant species, while a small percentage (9.7%) indicated that they do not know what bush encroachment is. These findings imply that sickle bush is widely recognized within both the surveyed population and the broader community. Given the education level/ literacy level indicated in Table 1, this does not come as a surprise because most of the participants have a formal qualification. This coincides with a study conducted by Chepane et al. [35], which focused on verifying the local use and knowledge of fodder trees and shrubs that livestock graze upon in the Bushbuckridge area of South Africa. The study's findings highlighted that sickle bush was the most known shrub species, as confirmed by both genders and individuals of all age groups involved in the research. General patterns from the above theme revealed that the majority of the respondents viewed sickle bush as a problem. This co-relates with data from Table 2 below. This recognition facilitated the identification of the most encroaching species based on indigenous knowledge. The majority of those that viewed it as a problem indicated that the plant destroys the natural environment while competing with grass and tree species, and easily spreads or invades and is difficult to control, as seen in Appendix A:

> *"Yes, it destroys grass and leaves the ground bare. The plant is invasive and destroys indigenous plants. It also prevents livestock from browsing and grazing".*
>
> *"Because the plant grows fast and is uncontrollable".*
>
> *"Livestock like to feed on the plants' flowers and seeds then spread it through the dung".*

Contrary to this perception, those that hold different views mentioned that the plant is not a problem because it is a beneficial plant that is used for firewood, medicinal purposes, shade, and fencing. Furthermore, a study conducted by Bussa and Shibru [36] examined the impact of sickle bush encroachment on the flora and vegetation structure in the semi-arid Savannah. The study clearly demonstrated that the indigenous knowledge of the Mafarana villagers was relevant in understanding the pressure faced by native plant species in the savannah plains as a result of sickle bush encroachment. This assertion validates the indigenous knowledge of villagers. Equally, as echoed by the villagers in Mafarana, while the plant has detrimental effects to the environment, grasses, and other surrounding plants, it has proven to also have beneficial uses (i.e., medicinal, animal feed, and firewood, as scientifically corroborated by numerous scholars [36–38]). This observation validates the space and need for co-existence of these knowledge systems within society.

Table 2. Representation of the community's awareness/knowledge regarding sickle bush.

Do You Know What Sickle Bush Is?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Yes	316	90.3	90.3	90.3
	No	32	9.1	9.1	99.4
	I do not know	2	0.6	0.6	100.0
	Total	350	100.0	100.0	

3.3. Perceptions of the Presence of Sickle Bush in the Environment across Different Age Groups

The data presented in Figure 3A show that most respondents across all age groups have used the plant. However, it is noteworthy that the majority of the people in the 55 and above age group have prior experience with the plant. This suggests that this age group has the highest knowledge of the sickle bush, possibly indicating that younger generations are less familiar with the sickle bush compared to older generations, meaning this is indigenous knowledge. Sickle bush has been used in communities for several uses ranging from medicinal, livestock forage, and fencing poles to fuelwood [39–42]. However, the majority of individuals that make use of it in many rural communities are the elderly due to reasons that elderly members of a community often possess more traditional knowledge about local flora, including the identification and uses of plants like the sickle bush [43,44]. This knowledge may have been accumulated through years of experience and exposure to the environment. The elderly in Mafarana village still collect firewood as a source of energy, in contrast to the youth who prefer using electricity for cooking and lighting. Further answers to the question of sickle bush usage from the elderly or adults indicated more detailed usage of the plant which ranged from firewood, to fencing, and for medicinal purposes. This was not evident in answers provided by the youth, which were limited to firewood collection.

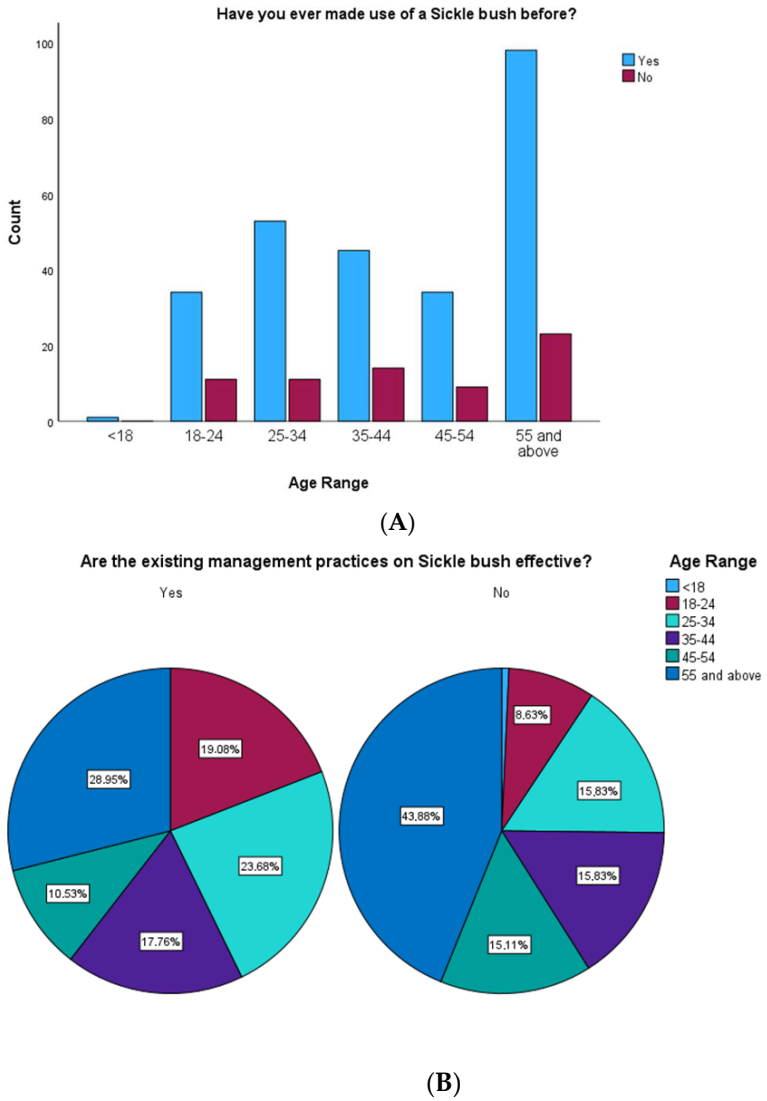

Figure 3. (**A**,**B**) An illustration of sickle bush usage per age group and an illustration of communities' perception of the effectiveness of existing management practices on sickle bush, respectively.

On the other hand, the data presented in Figure 3B reveal the perception of the effectiveness of current management practices for handling sickle bush, which include cutting of the plant, uprooting, and burning of the biomass. This is reported to be a more effective way of managing sickle bush as an encroacher plant. Among the respondents who answered "yes" to this question, a significant proportion of individuals aged 55 and above expressed agreement with the current management practices' effectiveness. This discovery aligns with a study by Tenagyei [45] which found that farmworkers in semi-arid Ghana perceive indigenous techniques to be effective for managing farmlands. Although certain studies indicate that methods of managing problematic plants through cutting, uprooting, and burning are highly effective and successful, they also highlight the challenge associated. Invasive and encroacher plant species tend to invade freshly cleared or burnt areas easily due to exposure of the dormant seed to direct sunlight, water, and veld fires that stimulate the germination of seeds [46,47]. Moreover, the method has been proven to have detrimental long-term environmental implications for the soil as it causes soil erosion and environmental degradation [48].

Interestingly, most respondents in the 55 and above age group disagreed with the existing management practices for sickle bush, accounting for 43% of this group, which also happens to be the largest age group surveyed, as shown in Table 2. These data from the

55 and above age group clearly suggest that a substantial portion of the respondents have reservations about the effectiveness of the current management practices for sickle bush.

3.4. Indigenous Knowledge Systems and the Management of Bush-Encroaching Species

Figure 4 illustrates divergent perspectives between male and female participants aged 55 and above about the use of indigenous knowledge in controlling sickle bush and other encroacher species. Among individuals in this demographic, males have a greater understanding of indigenous knowledge systems and the management of sickle bush, as compared to females. However, overall, this age group exhibited more participation in responding to this question compared to other age groups. The other age groups exhibited little engagement with the indigenous knowledge systems, resulting in a conspicuous absence of responses to these inquiries. These findings indicate that individuals aged 55 and above had a greater understanding of the indigenous knowledge systems and management of sickle bush. This can be due to respondents from this age group acquiring knowledge in managing sickle bush as an encroacher plant through self-teaching, from previous generations, from neighboring farms, and/or local extension officers. These findings are consistent with the results of two studies, which indicate that older participants, particularly those aged 55 and above, had a greater understanding of the indigenous knowledge systems and the management of sickle bush [49]. Sickle bush has been used across all age groups, with the 55 and above age group showing the highest usage rate. The effectiveness of current management practices, including cutting, uprooting, and burning of the biomass, is generally perceived positively. However, there is a notable disagreement among the 55 and above age group, suggesting reservations about the efficacy of these practices. The challenge of invasive species regrowth after management actions is also acknowledged. The data also reveal a significant understanding of indigenous knowledge systems and their application in controlling sickle bush, especially among individuals aged 55 and above. This knowledge is likely acquired through self-teaching, intergenerational transfer, and interactions with neighboring farms or local extension officers. Overall, both genders tend to have confidence in the effectiveness of indigenous knowledge systems, though there may be some differences in the degrees of agreement and uncertainty. Notably, there is a gender disparity in opinions regarding the incorporation of communal-based approaches and indigenous knowledge systems in sickle bush management. A higher percentage of females advocate for these approaches, while a notable proportion of males express uncertainty or disagreement. This finding underscores the importance of considering gender perspectives in environmental management initiatives.

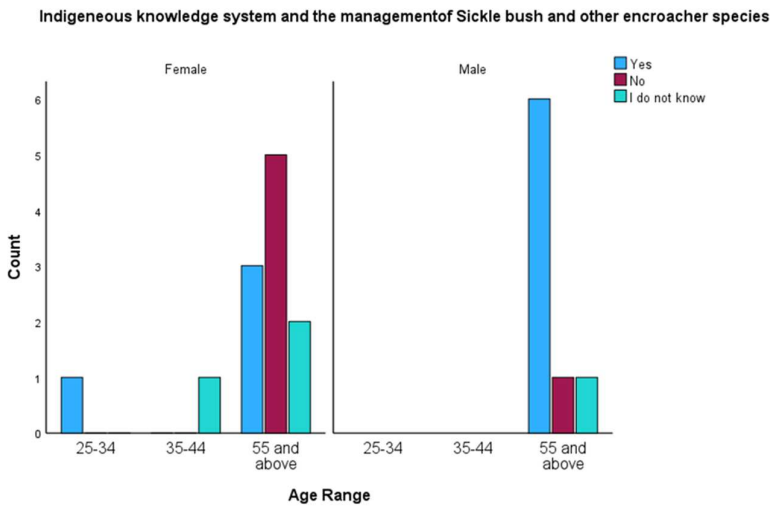

Figure 4. The above graph shows indigenous knowledge systems and methods in management of sickle bush per age category.

3.5. The Efficacy of Indigenous Knowledge Systems and Methodologies in the Management of Sickle Bush

Based on the results shown in Figure 5, it is apparent that indigenous knowledge systems have a track record of success in effectively managing sickle bush. Analysis of the responses reveals a significant gender-based difference in perceptions. Among female participants, a substantial 80% expressed confidence in the efficacy of these indigenous methods, while only 20% disagreed. Conversely, male respondents displayed slightly varied opinions, with 75% believing in the success of indigenous knowledge methods, 10% expressing disagreement, and 15% remaining uncertain or without a clear stance. While both genders predominantly perceive the effectiveness of indigenous methods, the levels of agreement and uncertainty differ noticeably. These findings align with Tanyanyiwa's [50] findings that indicated that indigenous knowledge systems play a crucial role in managing forest resources, particularly in controlling invasive species like sickle bush. For sickle bush, leveraging indigenous knowledge systems could offer sustainable and effective management strategies. Furthermore, indigenous communities have a rich body of traditional ecological knowledge that includes information about plant and animal species, their interactions, and the overall functioning of ecosystems. This knowledge is often passed down orally from one generation to the next. Indigenous people are often the first to notice changes in their environment [51]. Their close connection to the land allows them to identify invasive species and other problem plants like sickle bush early on, facilitating prompt intervention before the invaders cause significant ecological damage.

Furthermore, the data indicate that a higher percentage of females, specifically 60%, advocate for the incorporation of communal-based approaches and indigenous knowledge systems in sickle bush management. In contrast, only 40% of males support this approach. Negative responses predominantly come from females, constituting 83.33%, while males account for 16.16%. Notably, a group of respondents, mainly females (75%), expressed uncertainty or chose not to respond, with males making up the remaining 25%. Table 3 shows results from the general logic using a two-input data structure with age range being a target. The input data structure for the probability distribution: multinomial a) In your own knowledge, have these indigenous knowledge methods of managing sickle bush been successful in the past? (intercept (a)), (b) Are there any indigenous knowledge systems that you know of or have used to assist you in management of sickle bush? (intercept (b)). They indicated that the ages from 35–44 have a significant indigenous knowledge about the different methods used in managing bush encroachment at $p < 0.012$ (Table 3). These data underscore a gender disparity in opinions and awareness regarding the inclusion of communal-based approaches and indigenous knowledge systems in sickle bush management. Contrary to this, Brodt [52] and Lake [53] highlight the mixed nature of knowledge use, emphasizing the integration of information from various sources into local bodies of knowledge. This suggests that the management of sickle bush should adopt a holistic approach, combining formal and informal knowledge systems. These approaches not only offer effective strategies for bush encroachment management but also make substantial contributions to the ecological sustainability of these semi-arid rangelands, particularly within the South African context. They present a unique viewpoint on the synergy between human activities and the natural world, a fundamental tenet of indigenous cultures in this region [54–56].

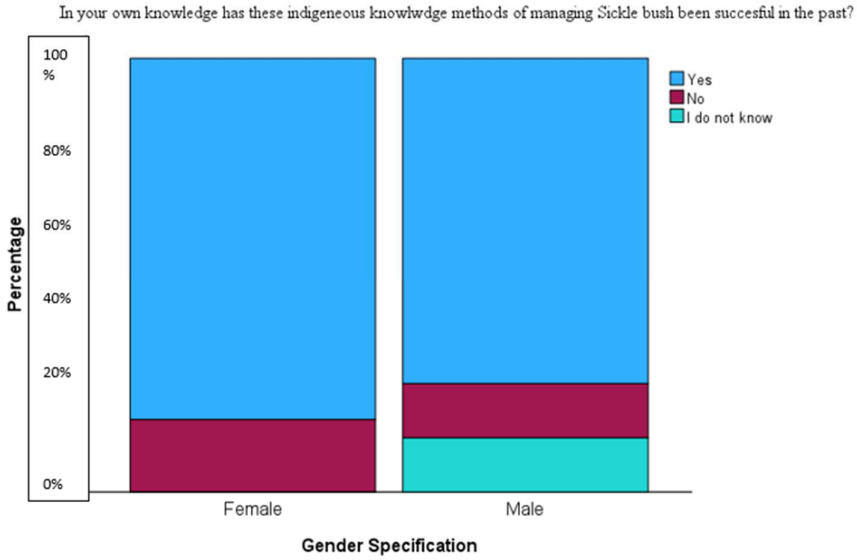

Figure 5. Graph illustrating the success of indigenous knowledge systems and methods in management of sickle bush per gender category.

Table 3. Probability distribution: multinomial with age target and link function generalized logit.

Age Range	Model Term	Coefficient	Std. Error	t	Sig.	95% Confidence Interval		Exp (Coefficient)	95% Confidence Interval for Exp (Coefficient)	
						Lower	Upper		Lower	Upper
25–34	Intercept (a)	−2.698	1.7978	−1.501	0.151	−6.475	1.079	0.067	0.002	2.942
35–44	Intercept (b)	−2.890	1.0274	−2.813	0.012	−5.049	−0.732	0.056	0.006	0.481

4. Conclusions

In conclusion, the data provided offer a comprehensive insight into the demographic characteristics, awareness, perceptions, and management practices related to sickle bush within the surveyed community of Mafarana village in the Greater Tzaneen Municipality of Limpopo province. Here are the key points derived from the data. The sample exhibits a gender imbalance, with a higher proportion of females (66.6%) compared to males (33.4%). This aligns with the 2011 statistics for the community, which also showed a higher percentage of females in the overall population. The respondents show a diverse age distribution, with the majority falling within the "55 and above" age group (35.1%). A significant portion of the respondents have secondary education (47.4%), followed by post-secondary education (24%). The high education level aligns with the community's awareness of sickle bush, with 90.3% recognizing it. The general perception of sickle bush is varied, with a majority considering it a problem due to its impact on the natural environment, competition with grass and tree species, and its invasive nature. However, there are contrasting opinions, particularly from those who view the plant as beneficial for purposes such as firewood, medicinal use, shade, and fencing. This dichotomy reflects the complexity of the relationship between communities and their natural surroundings.

The study provides valuable insights into the multifaceted relationship between the Mafarana community and sickle bush while emphasizing the importance of considering indigenous knowledge systems and implementing interventions related to sickle bush management. Therefore, the study suggests that a holistic approach, integrating both formal and informal knowledge systems, may be crucial for sustainable and effective management strategies. Additionally, recognizing the diversity of perspectives within the community, particularly regarding gender differences, is essential for developing inclusive and community-driven environmental management initiatives. For bush encroachment to be effectively combated, local communities and government departments should actively encourage and integrate traditional grazing practices, such as controlled burning

or rotational grazing, into contemporary land management strategies. To enhance the effectiveness of indigenous practices, the dissemination of indigenous knowledge among community members should be promoted

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Appendix A

Figure A1. Sickle bush plant harvested for firewood.

Figure A2. Farmers only remove the encroaching vegetation in the specific areas where they cultivate.

Figure A3. Farmers harvest sickle bush for fencing as a management approach.

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