



## Research article

# Indigenous agricultural practices employed by the Vhavenda community in the Musina local municipality to promote sustainable environmental management

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## ABSTRACT

Indigenous knowledge offers insights into preserving natural resources and further contributes towards improving rural livelihoods. Incorporating this knowledge into agriculture can therefore increase acceptance and innovation of sustainable technologies. In support of this argument, rural small-scale farmers have globally proven the significance of indigenous knowledge in the agricultural sector by incorporating their local strategies and practices for both commercial and subsistence agriculture. This article demonstrates the various indigenous farming practices employed by the Vhavenda Community and how these practices promote sustainable environmental management. It reflects the essential aspects crucial to indicating the value of indigenous agriculture. Using a mixed-methods approach, we administered face-to-face structured questionnaires to elderly villagers aged 50 years and above from the study area. Our results revealed various agricultural practices such as crop rotations, polyculture, intercropping, livestock farming, ploughing rituals, water harvesting, and seasonal agriculture. The Vhavenda community incorporates local knowledge, which is unique to these agricultural practices, and uses various strategies which contribute to a sustainable environment within their area. This has, in turn, allowed them to improve their livelihoods, reduce poverty, and provide life sustenance. The study's findings demonstrate the significance of indigenous knowledge in the agricultural sector and rural peoples' efforts towards supportable environmental management. The article therefore suggests that local indigenous knowledge should be understood as a collaborative concept within the agricultural industry. Furthermore, it proposes that stakeholders who influence decision-making and progress in rural communities should consider this knowledge and work together with local inhabitants. Additionally, it advocates for acknowledging the understanding of local indigenous peoples in pursuing sustainable environmental management.

## 1. Introduction

Humankind has benefited from the ecological and cultural services provided by indigenous peoples throughout history [1,2]. Moreover, studies conducted across Africa have found out that many people, including those in South Africa, significantly depend on indigenous knowledge for survival [3]. Historically, local people have leveraged indigenous knowledge in adapting to their natural

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environment [4], and have relied on traditional knowledge to handle unforgiving conditions such as dry spells, pests, and poor soil quality [5]. In response to such extreme environmental conditions, indigenous people have developed and adopted agricultural techniques [6]. The Vhavenda, like many indigenous communities, often incorporate indigenous knowledge into their agricultural practices to promote sustainable environmental management [7]. These traditional knowledge and practices can be transmitted orally and passed down throughout generations within a community [8]. Preserving traditional agriculture expertise and techniques contributes to biodiversity conservation, food security, and natural environment protection [9]. Rural farmers have therefore conserved natural resources and planned agricultural production using indigenous knowledge [10].

Traditional farming systems are essential for small-scale farming worldwide, as they are critical in guaranteeing food abundance, economic benefit, community well-being, and climate mitigation [11,12]. In rural areas, indigenous knowledge is applied to various farming practices, including tillage, seed sowing, crop irrigation, and crop gathering [13]. Likewise, in Africa, subsistence agriculture is critical for food abundance, the sustainability of rural areas, and their livelihoods [14,15]. Indigenous communities rely on their intuition, customs, rituals, and taboos to engage in small-scale agricultural production for subsistence and market purposes [16,17]. By tapping into their indigenous knowledge, these African rural communities have developed effective farming practices, including crop production, garden trenching, and rainwater harvesting [18,19]. These farmers collectively own this indigenous knowledge and encompass many practices, including agriculture, storytelling, music, proverbs, cultural values, medicinal practices, taboos, norms, and rituals [20].

The essence of traditional knowledge lies in the interconnectedness between nature, local communities, and their way of life [21, 22]. Consequently, indigenous communities are widely acknowledged as the primary stewards of such ecological knowledge [23]. Through this process, they blend traditional wisdom with modern agricultural techniques that benefit nature and themselves [24,25]. This knowledge is harnessed to support their livelihoods' longevity and safeguard the natural environment and its associated benefits [26]. Nevertheless, the troubling decline of this invaluable knowledge demands immediate action to preserve it worldwide [27], and safeguarding of resilient landscapes, advancement of sustainable agricultural practices and appreciating indigenous agricultural knowledge is essential [24,28]. Our observations of the traditional ways of the Vhavenda people, their connection with nature, and how they use indigenous knowledge prompted this research. Its primary goal was to explore how the Vhavenda people utilise indigenous agricultural knowledge and how it promotes sustainable environmental management. The study goal was to answer questions such as: What are the different indigenous agricultural practices the Vhavenda community employ? What benefits do these practices offer? And how do they contribute to promoting sustainable environmental management?

## 2. Conceptual underpinnings

### 2.1. Indigenous knowledge

Indigenous knowledge is a collection of ideas and experiences passed from one generation to another for an extended period [29–31] and is vital, especially in agriculture, ethnobotany, health, and arts and crafts [32–34]. Multiple mechanisms, including oral transmission of stories, songs, proverbs, myths, cultural values, beliefs, and norms, achieve the conservation of indigenous knowledge [35,36]. Also, use of practices like farming, tools, materials, and taxonomy are essential to maintaining indigenous knowledge [10]. This inheritance is sustained and passed on through generations to the young who continue to practise it [37].

Local adaption of indigenous agricultural practices is primarily informed by traditional knowledge [38]. Furthermore, traditional African communities have applied indigenous knowledge systems to ensure that natural resources are not over-exploited, thus enabling them to avoid ecological disasters [39]. Such practices support the maintenance of ecosystems, biodiversity, and human well-being [13]. Subsequently, they have been identified as a sustainable resource for environmental management [22,40]. Endogenous agricultural knowledge thus represents a pivotal national asset, instrumental in facilitating the attainment of sustainable development objectives [41]. Local communities tap into their indigenous knowledge to maintain sustainable environmental management [42], and such management of natural resources is practised to allow their continuous existence for further use [43].

### 2.2. Global indigenous knowledge treaties

Several globally recognised protocols, treaties, and agreements promote the conservation and utilisation of indigenous knowledge. One example is the Convention on Biological Diversity (CBD), established to protect the world's biodiversity [44]. The CBD's Nagoya Protocol (NP) on Access and Benefit Sharing is another critical agreement which ensures that the benefits derived from genetic resources are shared fairly and equitably [45].

In addition to the CBD and the NP, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) is a crucial agreement which promotes the conservation and sustainable use of plant genetic resources for food and agriculture [46]. The treaty recognises the critical role played by farmers and indigenous communities in preserving and developing plant genetic resources and ensures that these groups are adequately compensated for their contributions [47].

Overall, these treaties are said to provide incentives to conserve biological diversity by promoting the use of genetic resources and associated traditional knowledge, and by improving opportunities for fair and equitable sharing of benefits. Recognising the critical role played by indigenous communities and farmers, these agreements help to foster sustainable development and a more equitable future for all.

### 2.3. Agricultural indigenous knowledge in rural communities

In rural communities, indigenous knowledge systems are critical in protecting agriculture and enhancing yields [48]. However, the depth and breadth of this wisdom significantly varies across different demographic segments, including age, gender, marital status, and levels of farming experience [5]. The implementation of indigenous agricultural practices also varies across communities and is influenced by their unique history of survival [49]. Local communities in developing countries utilise such indigenous knowledge to plan agricultural production for food abundance and sustainable farming [50].

Indigenous agriculture furthermore cultivates food according to the local environment rather than working against it, which is how culture and land are connected [51]. For instance, the Ikaile people in Southwestern Nigeria use shifting cultivation and mixed cropping, which enables them to meet food demands, produce a surplus for trading, and maintain soil fertility [52]. In the Chimanimani District of Zimbabwe, the utilisation of ashes and leaves from indigenous tree species plays a pivotal role in enhancing soil fertility, preserving food, and treating ailments in livestock [48]. This traditional practice underscores the integral relationship between local biodiversity and sustainable agricultural and veterinary practices within the region [53]. Another example would be the Dikgale community in the Capricorn District of Limpopo Province, South Africa, which practices indigenous farming techniques such as planting on different soil types, fertilising the soil, selecting and storing seeds, and maintaining crops [42]. Thus, communities in rural and indigenous settings worldwide rely on agronomic techniques like agroforestry, mixed cropping with legumes, inter-cropping, and terracing [5]. These methods promote biological fertility and are not exclusive to Africa [52]. Such rural communities possess sophisticated perspectives on agrarian and natural resources [54]. Their use of various renewable farm resources as agricultural practices therefore allows them to reduce their dependence on external inputs by retaining a vast pool of indigenous knowledge of livestock management [26].

### 2.4. Indigenous agricultural practices of the Vhavenda community

The Vhavenda people embody a profound intellectual tradition characterised by rigorous observation, experiential learning methodologies, analytical thinking, and a comprehensive understanding of natural resources [55]. This tradition underscores the significance of integrating empirical knowledge with critical analysis within their cultural practices [56]. Their adaptability and success across diverse ecosystems can therefore be attributed to an in-depth comprehension of their natural habitats [57]. Their expertise spans various disciplines, including agriculture, ethnobotany, astronomy, ethology, and horticulture, demonstrating a comprehensive understanding of the natural world and the intricacies of human interaction with nature [58].

Additionally, spirituality and tradition are integral to the Vhavenda indigenous living and agricultural practices [59]. Their indigenous agricultural knowledge provides a holistic view of human existence by profoundly connecting the physical and metaphysical [60]. Furthermore, they retain an extensive understanding of sustainable agricultural methodologies, which has conferred a distinctive economic advantage within their environmental context [61]. For generations, they have developed sustainable agricultural practices such as terracing, crop rotation, polyculture, and water management to increase crop yields and minimise environmental impacts in their communities [60]. Although comparable customs may be observed in other rural and indigenous societies, the Vhavenda people possess a distinct spiritual bond and approach to executing each tradition. As a result, their farming methods are particularly valuable to investigate [7,62].

### 2.5. Limitations in indigenous agricultural methods

Indigenous agricultural methods are adapted to the local environment, working with natural processes, and forming a connection between culture and the land [51]. The application of indigenous knowledge systems in agriculture has nonetheless received mixed feelings. Some scholars argue its use is mainly beneficial under smallholder farming systems [5,42,63]. Other scholars maintain that the use of indigenous farming methods does not only help to eradicate food insecurity of marginalised farmers [6,15,64] but is also sustainable and in harmony with nature [13,28]. Pawlak et al. (2020) further stress that small-scale agriculture bolsters rural communities' economic stability and food security [64]. This form of agriculture not only plays a crucial role in enhancing the livelihoods of these communities but also acts as a safeguard, ensuring the availability and abundance of food resources [15]. Indigenous farming technologies offer a promising solution to the challenges presented by modern food systems [65]. However, these methods often lack scientific explanation, making their implementation difficult [63,66]. One major drawback affecting use of indigenous agricultural practices is their lack of documentation [13]. Moreover, younger generations may not appreciate the value of this oral knowledge transmitted from generation to generation [19,67,68]. The absence of such records can result in the extinction of this knowledge, which would be an enormous loss for humanity [69]. Yet, this knowledge can address many problems that have weakened development strategies for decades [5]. The threatened loss of this knowledge jeopardises indigenous agricultural practices, causing their decline and eventual disappearance [13]. Therefore, documenting and preserving this knowledge can help bridge the intergenerational information gap and achieve sustainable environmental management goals for future generations [70].

### 2.6. The study area

Musina Local Municipality falls within the Vhembe District [71], and is located in the northernmost part of the Limpopo Province and borders Zimbabwe, Mozambique, and Botswana. The boundaries of the municipality extend from the confluence of the Mogalakwena and Limpopo rivers in the west to the confluence of the Nwanedi and Limpopo rivers in the east. They include Tshipise and

Mopane in the south and extend to the Botswana/Zimbabwe borders in the north and Mozambique along the eastern side of the Kruger National Park [72,73].

The municipal area primarily comprises commercial farms and rural settlements shared among the community [74]. The Musina Local Municipality is also renowned for its diverse collection of formal protected areas, comprising nature reserves, conservation areas, and national parks [75]. This natural heritage includes the Baobab Reserve, Nwanedi Nature Reserve, Honnet Nature Reserve, Musina Nature Reserve and Mapungubwe National Park [76]. The northern Limpopo region is also a hot, semi-arid climate [77]. For example, Musina typically receives around 350 mm of rainfall yearly, with most rainfall occurring mid-summer [78]. However, the region experiences the lowest rainfall in the winter months, 0 mm in June and the highest, 55 mm in January [79].

The area is moreover experiencing local warming with decreased rainfall and increased risk of water stress, and which can be due to human activities like mining, agriculture, deforestation, and urbanisation [80]. The Musina Local Municipality terrain is primarily flat, with four types of vegetation, the majority being Musina Mopane Bushveld [81]. The municipality is involved in four key economic sectors, namely mining, tourism, agriculture, and transportation [80]. Notably, the agricultural sector is the most significant employer, providing employment up to 50 % of the population and contributing approximately 35 % to the Vhembe District Municipality’s agricultural sector [82]. There is a mixture of traditional authority and local governance within the municipality and of the district as a whole [83]. The area is predominantly rural, with around 90 % of the population relying primarily on agriculture to secure their livelihoods and generate income [84].

The study targeted nine [6] closely situated villages within the Musina Local Municipality, as illustrated by Fig. 1. The nine villages are Masisi, Duluthulwa, Bileni, Tshikuyu, Dovho, Tshilamusu, Mukomawabani, Mutele, and Sanari. These villages share similar characteristics (prevalence of indigenous knowledge, agriculturally based, rural and remote) as they are close to each other. The study sites were selected on the advice of the traditional authority’s council of the areas.

### 2.7. Methodology

The graphic representation of the research methodology logic is depicted in Fig. 2, which illustrates the comprehensive series of processes involved in conducting the research. The diagram shows the data collection methods and data analysis techniques employed. Additionally, the chart highlights the two types of analysis used in the research, which helped ensure the results’ accuracy and validity. Overall, the diagram provides a valuable resource for understanding the research process and flow.

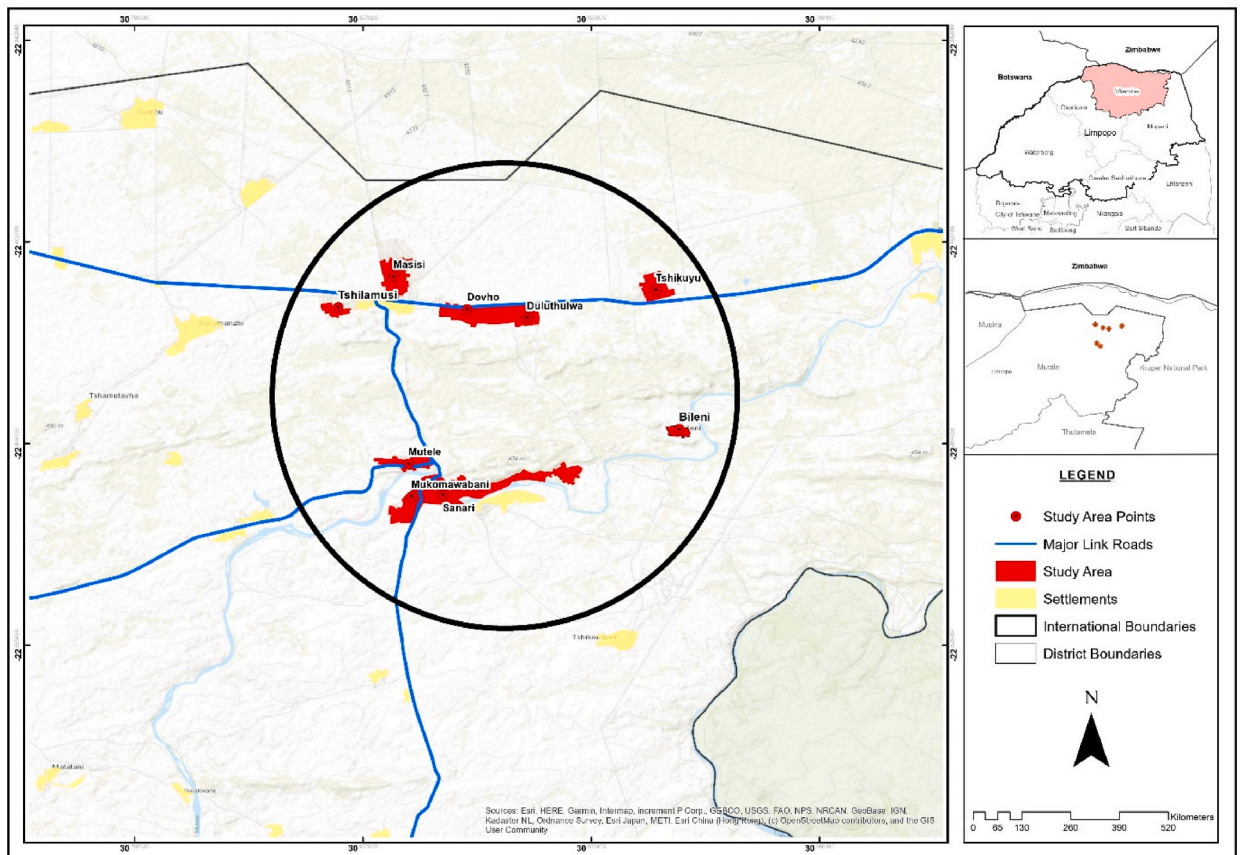


Fig. 1. Study area Map indicating all the villages where data was collected in the Musina Local Municipality.

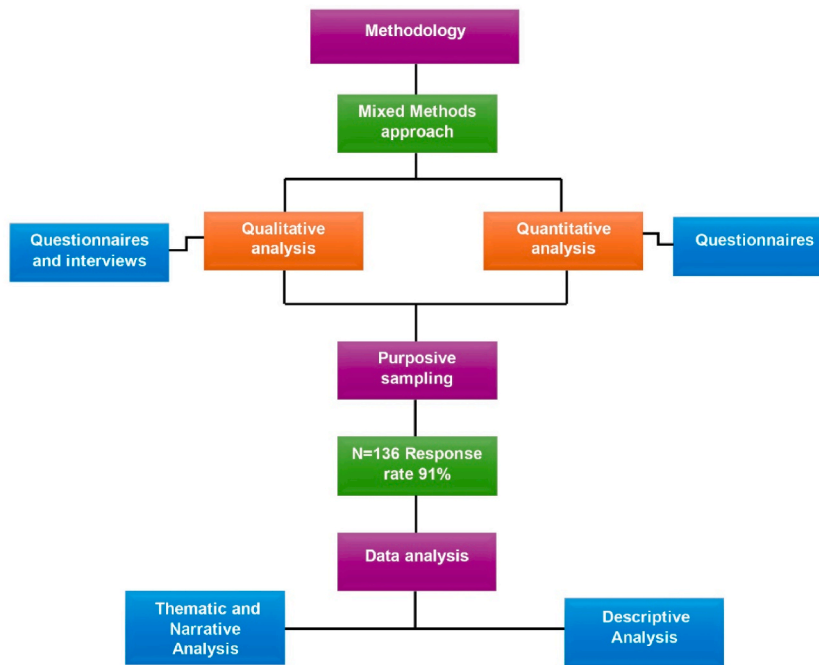


Fig. 2. Research logic flow diagram.

The research adopted a mixed-methods approach, collecting and analysing quantitative and qualitative data. This versatile methodology involves combining, integrating, linking, and utilising multiple research methods simultaneously to provide a more inclusive comprehension of a study question [85,86]. This approach allowed augmentation of the study findings by delving into how the Vhavenda Community integrates indigenous knowledge into their agricultural practices and strategies, thus promoting sustainable environmental management [87]. The study also employed purposive sampling to select participants based on age, experience, indigenous knowledge, and agricultural knowledge. Purposive sampling involves deliberately choosing participants based on their experiences, knowledge, or other criteria they share [88]. The participants were identified with the assistance of data collectors and the traditional council, and consent was obtained before data collection. Purposive sampling employs the snowball technique, where cases of interest are selected by sampling individuals who know others with similar characteristics [89,90].

### 2.8. Data collection

For data collection, the study utilised field assistants who stayed in the targeted villages, making data collection easy and accessible. Additionally, this gave the participants a reason to trust and feel comfortable about participating in the research. The data were collected in September 2021 following the training of field assistants on the data collection protocol and response capturing. The questions were translated into the local dialect of Tshivenda, the responses were transcribed in English as clearly as possible, and the interviews were administered face to face. The sample size was  $n = 150$ , and 136 responses were received, providing a 91 % response rate. Questionnaires contained qualitative and quantitative data comprising open-ended and closed-ended questions.

### 2.9. Data analysis

The collected data were captured in Google Forms and saved in an Excel spreadsheet. The quantitative data, such as demographic and socioeconomic aspects, were coded and used for the descriptive analysis. Demographic data such as gender, income source, education, and employment were analysed using MATLAB software to create statistical graphs. Frequencies and simple percentage distributions were used for the analyses. The qualitative data were coded, and a thematic and narrative analysis was conducted to identify themes, repeated patterns, and statements from the responses. Lengthy response statements were read through, and frequent terms, words, and patterns were identified to form themes. Topics, and patterns were identified and categorised to draw meaning from the data collected and to produce understandable results and arguments to support the study. The indicators used to organise the data were understanding indigenous knowledge, livelihood types, farming strategies, and methods.

### 2.10. Ethical considerations

The study was approved by the Research Ethics Committee of the Faculty of Engineering and the Built Environment at the University of Johannesburg with ethics number UJ\_FEBC\_FEBC\_00343 on the 27th of August 2021. All COVID-19 protocols were followed

per the guidelines provided by the Department of Health of the Republic of South Africa. No ethical principles were violated, before the initiation of data collection, formal written informed consent was procured from all participants. This process ensured that participants were comprehensively informed of their unequivocal rights, including the ability to participate in the study voluntarily and to withdraw their participation at any given moment without any repercussions.

### 3. Results

Fig. 3, presented below, delineates the array of indigenous agricultural practices employed within the study locale. These encompass crop rotation, polyculture, livestock farming, intercropping, the observance of ploughing rituals, seasonal farming, and the implementation of water harvesting techniques.

Table 3 provides the descriptions and benefits of the above-mentioned indigenous agricultural practices in the study area in Fig. 3.

Fig. 4 presents a comprehensive strategic framework, which provides an in-depth overview of the indigenous agricultural practices that the Vhavenda people have adopted. The framework highlights the unique characteristics of indigenous knowledge and how these practices benefit the natural environment. It explains how these practices are instrumental in promoting sustainable environmental management by contributing to soil fertility, biodiversity conservation, and water resource management.

### 4. Discussion

Table 1 provides a summary of the socioeconomic characteristics of the study area. Here, it can be observed that the study area has a higher population of females compared to males. This trend is common in South Africa and has been established in previous research. In rural areas, such as Masisi village, the phenomenon is even more pronounced and can be attributed to males often relocating to urban areas for better job prospects. At the same time, females remain behind in managing household duties and caring for children. This assertion is corroborated by other studies and statistical evidence [91].

The number of educated men in the study region passes that of women. This trend is particularly pronounced in rural areas, where conventional gender norms often require women to assume the role of primary caregivers for their children. Consequently, illiteracy rates among women in rural regions are notably higher. This is corroborated by statistical research from reputable sources like Statistics South Africa and other relevant studies. Regrettably, it appears that women residing in rural areas do not have the same access to education as their male counterparts [92].

There is a notable prevalence of unemployment within the study area, particularly among females. Over 60 % of female participants and roughly 54 % of male participants reported being unemployed. This pattern is more pronounced in rural regions, and it's important to acknowledge that South Africa currently faces an alarming rate of unemployment which should be regarded as a national crisis [93,94].

Upon careful analysis, it has become evident that the study area is experiencing a significant challenge with unemployment. This is a primary concern as it associates with a low household income level. The socioeconomic results that men and women in the study area earn less than R3 000 per month, which is alarming as it suggests that many participants live below the poverty line. This low income can be attributed to the types of livelihoods prevalent in the study area, where most rural residents rely on subsistence farming or work as farm labourers [95].

The most common livelihoods in the study area were farming followed by fuelwood collectors, traders, village leaders, herbalists, and traditional healers as indicated in Table 2. This indicates that rural households rely heavily on land-based income sources such as crops, livestock, and environmental products to sustain their livelihoods [96]. Historically, rural communities have depended on such land-based activities, such as agriculture, livestock rearing, and resource gathering, directly linked to local ecosystem services [97]. Furthermore, the environment provides easily accessible products like timber, wild plants and herbs, edible insects, and rainwater which supports these livelihoods [98]. These organic items are traded, significantly contributing to the economic value of families'

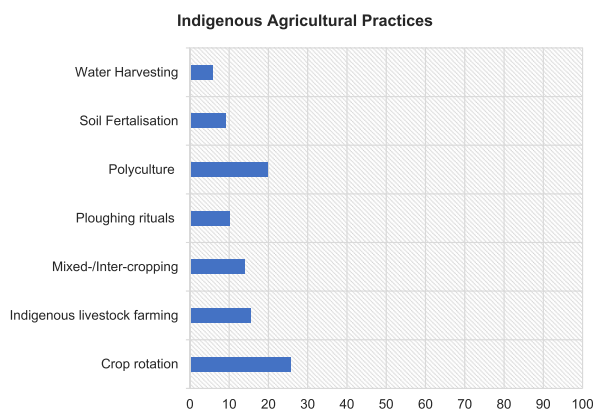


Fig. 3. Type of indigenous agricultural practices used in the study area.

## Indigenous Agricultural Knowledge Framework

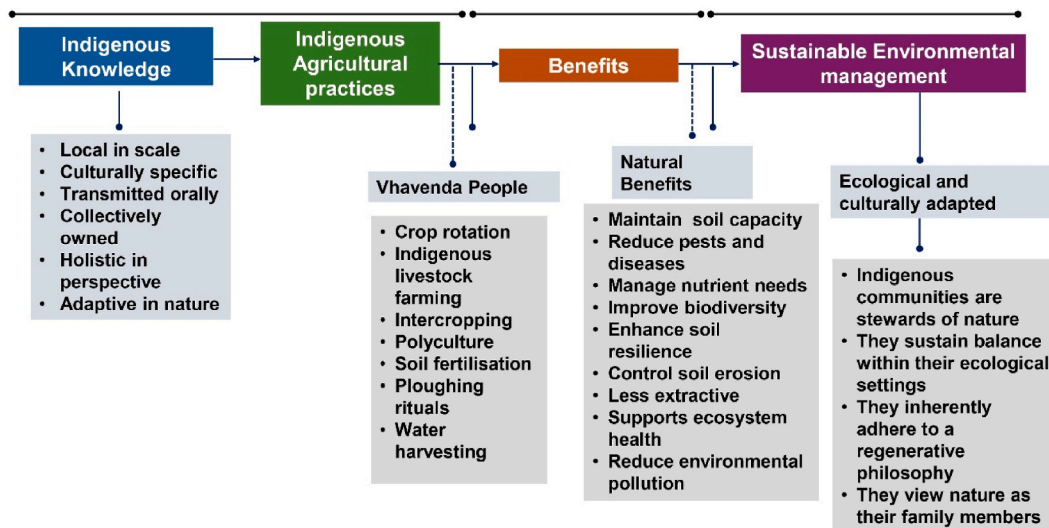


Fig. 4. Indigenous agricultural knowledge framework for sustainable environmental management.

**Table 1**  
Socio-demographic characteristics.

Gender	%	Age	%	Educational Level	%	Employment Status	%	Income Leve	%
<b>Male</b>	40	50–54	33	Never attended school	25	Unemployed	67	<R 3000	89
		55–59	20	Primary level	33	Employed	42	R 3001 – R5000	5
		6064	44	Secondary level	36	Pensioner	20	R10 001 – R 15 000	4
		70–74	4	Tertiary level	5	Self Employed	9	R15 001 – R 20 000	2
<b>Females</b>	60	50–54	19	Never attended school	36	Unemployed	54	<R 3000	89
		55–59	5	Primary level	31	Employed	6	R 3001 – R5000	6
		6064	58	Secondary level	22	Pensioner	28	R10 001 – R 15 000	4
		70–74	7	Tertiary level	11	Self Employed	11	R15 001 – R 20 000	1
		80+	1						

**Table 2**  
Types of livelihoods found in the study area.

Livelihoods	Percentage (%)
Farmers	40 %
Traders	12 %
Herbalists	11 %
Village Leaders	12 %
Hunters	1 %
Fuel wood collectors	15 %
Wood cravers	2 %
Traditional Healers	5 %
Other	1 %

livelihoods [99,100]. Furthermore, these livelihoods are linked with indigenous agricultural practices that promote ecologically sustainable management.

The study’s participants were also asked to identify the prevalent indigenous agricultural practices in the area under investigation and their positive impact on the environment. As depicted in Fig. 3, the most utilised agrarian practices comprise crop rotation, polyculture, indigenous livestock farming, intercropping, ploughing rituals, seasonal farming, and water harvesting. Table 3 elucidates the rationale behind participants’ adoption of specific agricultural methodologies, alongside their implications for promoting sustainable natural resource management. From the results in Fig. 3 an indigenous knowledge strategic framework was developed illustrating the significant role of these indigenous agricultural practices in promoting sustainable environmental management. The framework further highlights the vital role of indigenous communities, characteristics and the natural benefits of using these practices. This framework, coupled with the participants’ expertise, offers a comprehensive understanding of the indigenous agricultural

**Table 3**  
Prevalent indigenous agricultural practises in the study area.

Indigenous Agricultural practices	Description	Benefits	Participant statements
Crop rotation	Participants reported growing one crop in the same field during one growing season and growing another in the same field the following season	Maintains soil capacity for production, reduces pests and diseases, uses fewer chemicals, and manages nutrient needs, all contributing to increasing yield and adding to the sustainability and management of the environment	<i>"We still use indigenous crop rotation on our fields, where we grow and cultivate one crop on the same field for one growing season, and the following season."</i>
Polyculture	Allows the growing of many plants from different species in the same yard and at the same time, often in a way that allows nature to increase the variety	Improves weed management by using open areas and gaps between rows, promotes biodiversity and enhances ecological resilience, nutrient leaching, water pollution, and pest and weed proliferation	<i>"Another method we use that might be similar to intercropping is polyculture. It allows the growing of many plants from different species in the same yard and at the same time, often in a way that allows nature to increase the variety."</i>
Indigenous livestock farming	Participants in the study area mentioned that they keep and breed different livestock for commercial and consumption purposes	Helps keep corridors open for wildlife, prevents the spread of weeds, and promotes the growth of local vegetative species	<i>"I have goats, cattle, and chickens and they increase by breeding which increases my livestock numbers, I keep them for commercial and cultural purposes."</i>
Intercropping	Many small-scale farmers in our area practice intercropping, which involves growing two or more crops close	Creates biodiversity, helps control pests, and increases soil organic matter. As a result, intercropping can suppress weed growth and improve overall crop quality	<i>"Many small-scale farmers in our area practice intercropping, which involves growing two or more crops close. This practice creates biodiversity, helps control pests, and increases soil organic matter."</i>
Ploughing rituals	In Tshivenda culture, certain agricultural rituals are observed before and after each farming season	Brings good luck for rain, increase productivity and favours higher yields	<i>"In Tshivenda culture, certain agricultural rituals are observed before and after each farming season. The royal family, particularly VhoMkhadzi and Maine (royal diviner), conduct a sacred ritual called the thevhula to honour the royal ancestors and God (Modzimo)."</i>
Soil fertility	Participants indicated they relied on animal manure to fertilise their gardens and fields. Farmers in the study area also burn their fields to produce ash, which helps distribute nutrients and improves soil fertility.	Soil regains fertility, retains moisture, avoids pests, and improves soil moisture conservation	<i>"We collect dry livestock dung to spread in our gardens and farms as fertilisers; we also use leftover food as manure. This helps in soil health and formation, which leads to healthier crop yield."</i>
Water Harvesting	A commonly employed method in the study area involved gathering rainfall from rooftops and storing it in buckets, tanks, and basins. Rainwater harvesting participants also utilise trench-bed gardening, which involves digging 1-m-deep beds and filling them with organic material, compost, manure, and soil.	This system mimics wetlands, as the soil retains high moisture levels and is incredibly fertile for crop production. Control soil erosion	<i>"We collect rainwater through our rooftops into bucks; we use the water for various activities such as gardening, washing laundry, drinking, and cooking."</i>

practices used by the Vhavenda people and their contribution to sustainable environmental management.

Moreover, the participants emphasised the critical nature of these practices, particularly in the context of climate change. Their cost-effectiveness, promotion of biodiversity, and minimal impact on the natural environment make them indispensable tools for sustainable agricultural development. Additionally, these practices enhance soil nutrition and moisture, which are particularly important in areas where water scarcity is a significant challenge.

The participants also underscored the importance of safeguarding indigenous knowledge through these agricultural practices. They stressed that these practices have been passed down through generations and must be protected to ensure they continue to benefit future generations. By promoting these practices, we can ensure the sustainability of our agricultural systems and foster a deeper appreciation for indigenous knowledge and its vital role in environmental management.

#### 4.1. Study Limitations

The use of purposive sampling methods in the research study may have introduced bias in the results, as the sample population was limited to elderly residents with an age group restriction from 50 to 80 years old. This approach of selecting participants based on specific criteria, such as age, could have influenced the study's outcome and may not represent the broader population. Furthermore, this restriction could have excluded individuals who contributed valuable insights to the research questions, potentially losing essential data.



## 5. Recommendations and conclusion

As it is known, indigenous knowledge is passed from generation to generation within a community. This knowledge encompasses information about the local environment, including farming patterns, soil types, weather patterns, and other natural resources. Such indigenous agricultural practices are valuable methods, and these communities have illustrated the effectiveness, adaptability, and ways in which these adopted methods promote sustainable environmental management. These indigenous communities utilise this knowledge and effectively manage their land while preserving the environment. The practices include using local plants for medicinal purposes, adopting traditional farming techniques that promote soil health and conservation, and incorporating local weather patterns into crop management strategies. Overall, recognising the potential of indigenous knowledge in agriculture can lead to more sustainable and environmentally friendly practices. Furthermore, indigenous communities have indicated their harmonious relationships with nature; their practices and beliefs therefore reflect a deep understanding of the interdependence between humans and nature. They have a unique way of maintaining and preserving nature using sustainable natural resources, which is the key to their daily survival. Moreover, rural communities rely on a combination of various survival strategies and methods that assist them in dealing with global environmental challenges. This inherited knowledge includes crop rotation, rainwater harvesting, and ploughing rituals, improving land productivity, preserving natural resources, and enhancing soil fertility. They have proven that these indigenous agricultural practices are part of their daily livelihoods; they are less exacting on the environment and are cost-effective. In conclusion, these communities have developed unique ways of living that reflect their respect for the environment and their understanding of its importance. By sustainably preserving and utilising natural resources, they ensure their survival while contributing to the planet's preservation.

### Data availability section

Data on Indigenous knowledge practices is available on Mendeley Data: <https://data.mendeley.com/datasets/825rhsxhj5/1> under <https://doi.org/10.17632/825rhsxhj5.1>.

### Ethical approval

The study was approved by the Research Ethics Committee of the Faculty of Engineering and the Built Environment at the University of Johannesburg with ethics number UJ\_FEBC\_FEPC\_00343 on the 27th of August 2021. All COVID-19 protocols were followed per the guidelines provided by the Department of Health of the Republic of South Africa.

### Informed written consent

All participants provided written informed consent to participate in the study and for their data to be published. This process ensured that participants were comprehensively informed of their unequivocal rights, including the ability to participate in the study voluntarily and to withdraw their participation at any given moment without any repercussions.

### CRedit authorship contribution statement

**Olgah Lerato Malapane:** Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Walter Musakwa:** Writing – review & editing, Validation, Supervision, Software, Project administration, Data curation. **Nelson Chanza:** Writing – review & editing, Visualization, Supervision, Conceptualization.

### Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Olgah Lerato Malapane reports financial support was provided by Council for Scientific and Industrial Research. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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