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The role of underutilized indigenous and traditional food crops in enhancing rural livelihoods and food security in South Africa

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South Africa's agricultural sector faces a deep economic divide, with small-scale and subsistence black-owned farms struggling while white-owned commercial farms are well-resourced. Despite this polarization, rural farming communities have shown remarkable resilience, which can be leveraged to address socioeconomic disparities. However, in this context, there is limited information on the role of indigenous and traditional foods, particularly underutilized indigenous and traditional food crops (UITFCs). Despite their full significance to rural livelihoods, the agricultural policy has yet to incorporate UITFCs. This paper addresses this gap by analyzing themes related to UITFCs, gender, the environment, and rural livelihoods using a mixed-methods approach, including surveys and interviews. The findings confirm that UITFCs play a vital role in rural farming communities, offering readily available and accessible food sources that align with the FAO's food policy on food security. The cultivation and use of UITFCs are crucial in addressing food security at the household level while preserving dignity. UITFCs are a critical livelihood strategy for many rural people, helping them improve their socioeconomic status. Therefore, there is a need for these crops to be overtly integrated into South Africa's national agricultural policy.

KEYWORDS

agricultural policy, food security, indigenous crops, rural development, sustainable agriculture

1 Introduction

Across the African continent, underutilized indigenous and traditional food crops (UITFCs) hold significant importance within agricultural systems, farming practices, and household consumption patterns (Jansen van Rensburg et al., 2004). These crops are valued not only for their cultural heritage but also for their numerous nutritional benefits. UITFCs are consumed worldwide to enhance nutrient and vitamin intake, being highly nutritious. They contain a variety of essential macro and micronutrients, including vitamins A and C, as well as critical minerals such as Iron and Calcium (Jansen van Rensburg et al., 2004; Van der Hoeven et al., 2013). In South Africa, where many rural households are burdened by poverty and social exclusion due to limited access to necessities, UITFCs offer hope. As Street and Prinsloo (2013) noted, these plants also possess medicinal properties and have been utilized by various cultures for generations to meet primary healthcare needs. Leveraging UITFCs for

medicinal purposes presents a cost-effective alternative for economically challenged communities, allowing them to allocate financial resources toward other basic needs, such as food and clothing.

Jansen van Rensburg et al. (2004) highlight that many indigenous vegetable plants, particularly leafy greens, often grow spontaneously in the wild or as competitors to cultivated crops (commonly called weeds). UITFCs are ideally suited for cultivation in marginalized areas, requiring minimal inputs when domesticated. Moreover, they are resilient, thriving in conditions where the cultivation of exotic species might prove difficult. However, despite these advantages, there is significant concern about integrating UITFCs into agricultural policy. Mabhaudhi et al. (2018) argue that while South African agricultural policy acknowledges smallholder farmers, it remains largely silent on the role of UITFCs. This omission poses a risk to the preservation and value of these crops. There is an urgent need to promote and recognize UITFCs within the national agricultural policy framework. By doing so, we can ensure that these vital crops are not excluded from mainstream food systems. Promoting UITFCs through policy initiatives would empower primary users to cultivate and conserve them, strengthening agri-food systems and improving rural livelihoods in South Africa. Drawing on lessons from Kenya, it has been proclaimed that UITFCs form part of people's dietary needs and have, over the years, played a critical role in food and nutrition security (Onawo and Adeka, 2024). Of the same accord, Bokelmann et al. (2022) enshrine the agroecological significance of UITFCs and their role in biodiversity and livelihood strengthening.

By UITFCs being readily available and accessible at all times, both Bokelmann et al. (2022) and Onawo and Adeka (2024) align this with the Food and Agriculture Organization's definition of food security, which is anchored to constant availability and accessibility of food that meets people's dietary needs. The same applies to Ghana and Nigeria, where smallholder farmers drive the agricultural economy mainly by placing value on UITFCs. However, it is worth noting that in as much as countries like Kenya, Ghana, and Nigeria leverage indigenous crop varieties, they are not exempt from the food insecurity challenge, especially at a household level. Although the production of UITFCs is generally perceived to be superior to their non-indigenous counterparts, they are also associated with production challenges, which (in some regions) include the 'limited seed access for growers, limited capabilities and capacity of growers, the competition with subsidized conventional production and limited distribution options' (Zhang and Dannenberg, 2022). Nevertheless, UITFCs continue to gain popularity due to their ability to withstand harsh environmental conditions such as droughts and other climate-related challenges. Thus, we make a case for the potential role of UITFCs in improving livelihoods and alleviating hunger in alignment with the second sustainable development goal (SDG 2).

1.1 The complex interplay of agriculture and poverty in rural South Africa

A rural livelihood is a simple structure and a complex web of strategies and circumstances, primarily revolving around agriculture while diversifying into non-farm activities to sustain a living (Mphande, 2016). Agriculture has been the cornerstone of South Africa's rural livelihoods for many decades. However, this reliance on agriculture is not necessarily a matter of choice but a consequence of historical injustices. The Natives Land Act of 1913 inflicted severe socioeconomic imbalances by dispossessing black South Africans of their land, leading to widespread poverty. As defined by the Encyclopedia Britannica, poverty is lacking a usual or socially acceptable amount of money or material possessions when people cannot meet their basic needs. Understanding what constitutes these basic needs within the rural context requires an approach marked by empathy and sensitivity.

1.2 Linking basic human needs with agricultural food systems and UITFCs

Humans have four core basic needs essential for survival, identified and documented by philosophers over the decades. These needs, rooted in the work of Maslow (1954), who explored human motivation and personality through a holistic, dynamic, and cultural lens, have become foundational to understanding livelihood development. Section 27(1) of the South African Constitution further enshrines health care, food, water, and social security as fundamental rights for all citizens (South African Constitution, 1996). The focus on agricultural food systems is particularly relevant to rural communities regarding sustainable livelihood development. Underutilized indigenous and traditional food crops (UITFCs) are critical in this framework. By enhancing food security and providing nutritional and medicinal benefits, UITFCs directly fulfill these basic needs, especially in marginalized areas where access to conventional food sources may be limited. Integrating UITFCs into agri-food systems supports rural livelihoods and aligns with the constitutional mandate to ensure food security and overall well-being for all South Africans.

1.3 Socioeconomic status (SES) and its role in promoting UITFCs for rural livelihoods

Socioeconomic status (SES) represents the social and economic position of an individual, household, or community about others, often measured by unifying factors such as education and income. The American Psychological Association defines SES as an individual or group's social standing or class. In this study, the focus is on communities that were historically disadvantaged and characterized by low SES. These communities, marked by gravel roads, inadequate infrastructure, and poor transport systems (despite some governmental interventions), face significant challenges that impact their livelihood strategies. Understanding the SES of the municipalities involved in this study is crucial to exploring the correlation between their socioeconomic conditions and the study's overarching objective. This objective is to promote underutilized indigenous and traditional food crops (UITFCs) as a vital tool for strengthening agri-food systems and enhancing rural livelihoods. By addressing the SES of these communities, we can better comprehend the barriers and opportunities for integrating UITFCs into their agricultural practices. This approach supports the improvement of socioeconomic conditions and aligns with the broader goal of sustainable rural development.

In South African rural areas, disparities exist to varying degrees. According to Nyathi et al. (2024), these disparities are marked by poverty and high unemployment. Added to this is inequality, which is

deeply rooted in the legacy of apartheid. Fofana et al. (2024) allude to the interconnectedness of poverty, unemployment, and inequality as the triple challenge. In the fourth quarter of 2024, the unemployment rate was 31,9% (Statistics South Africa, 2025). Vulnerable groups, such as the rural poor with a lack of access to quality education, access to resources, and other basic services, are often at the receiving end of the existing disproportionalities, defaulted entrapping them in the triple threat challenge. Within the agricultural context, two different groups of farmers dominate two opposite ends of the sector; the first are smallholder farmers that operate on a small scale in the former homeland areas, primarily for subsistence purposes and sometimes sell the surplus.

On the other hand, there are privileged commercial farmers, mainly dominated by whites and a small group of privileged blacks in the commercial space. Due to this stark divide, Sihlobo (2023) describes South Africa's dual agricultural sector as a state of two agricultures whose disparities are anchored in the historical context of apartheid (before democracy), as well as systemic factors and lack of effective land reform (post-1994). These challenges worsen the socioeconomic status of rural farmers, synonymously known as smallholder or subsistence farmers, whose livelihoods are often characterized by access to quality education (if any at all), lack of job opportunities, poor infrastructure, and underdevelopment. It is worth noting that the SES of communities also determines their ability to improve their farming enterprises. By understanding the socioeconomic status of rural communities under investigation, we can better comprehend the barriers and opportunities for integrating UITFCs into their agricultural practices. This approach supports the improvement of socioeconomic conditions and aligns with the broader goal of sustainable development.

1.4 Food security and the deprivation trap in rural South Africa

Despite South Africa being recognized as food secure at a national level, the country continues to face significant challenges, including hunger, malnutrition, disease, and persistent rural poverty (Fanzo, 2023). This paradox of food insufficiency has been extensively studied and confirmed in various research, such as Mavengahama et al. (2013), which highlights its close ties to hunger, poverty, and micronutrient deficiencies. As Havas and Salman (2011) point out, food is not just sustenance but a vital energy source, and limited access directly impacts health outcomes. In South Africa, the rural poor are disproportionately affected by food insecurity and poverty, conditions closely linked to household socioeconomic status, as indicated by factors like food expenditure, income, and employment status (Chakona and Shackleton, 2019).

Poverty, as articulated, can be understood from two perspectives: the insufficiency of monetary resources and the chronic lack of essential resources needed to meet basic human needs, such as nutrition. The second perspective is powerlessness, where individuals are subject to forces beyond their control, such as oppressive authorities. Similarly, Chambers (2013) describes how the rural poor often find themselves caught in the 'deprivation trap,' a concept that encapsulates five clusters of disadvantages that converge to confine people in enduring hardship. Among these clusters, poverty is narrowly defined as the lack of assets, while powerlessness, physical weakness, vulnerability, and isolation – broaden the scope of poverty's impact. Although the deprivation trap is relevant in various contexts today, it was initially conceived to represent the unique challenges faced in rural settings.

2 Materials and methods

2.1 Study location

The study was conducted in the northern region of KwaZulu-Natal (KZN) Province. KZN is known for its diverse agricultural landscape, including commercial farming (such as sugarcane and cash crops) and small-scale farming practices. This diversity makes it an ideal location to study different farming systems and the integration of underutilized indigenous and traditional food crops (UITFCs). KZN province spans approximately 94,361 km^2, making it nearly the size of Portugal. Three district municipalities were selected for their distinctive farming systems, which prominently feature the cultivation of sugarcane, cash crops, and indigenous food crops. These municipalities include Ilembe, King Cetshwayo, and uMkhanyakude.

Table 1 provides an overview of the existing socioeconomic conditions within the three district municipalities studied. An analysis of the developmental models used to assess these municipalities reveals significant challenges, particularly in delivering satisfactory services to residents, especially those in rural areas. High crime rates are prevalent, likely exacerbated by the high unemployment levels exceeding 30% in each district municipality, compared to the national rate of 32.9% (SAGNA, 2024). Despite these challenges, agriculture remains a primary economic driver across all three districts. In the uMkhanyakude District Municipality, unemployment rates are alarmingly high, with poverty rates between 72.1 and 88.6% (Mthembu and Hlophe, 2020). This severe economic hardship compels many rural residents to rely heavily on subsistence agriculture and government support grants. The district's population is predominantly illiterate, unemployed, and impoverished, placing the municipality among the top 10 in South Africa with the highest

TABLE 1 Summary profile of the selected district municipalities.

	Umkhanyakude district	King Cetshwayo district	Ilembe district
Population (2019)	689,090	982,726	678,048
Households	151,245	225,798	191,369
Unemployment rate	31.0%	34.7%	30.9%
Main economic sector	Agriculture and tourism	Mining and agriculture	Agriculture
Service delivery (rural communities)	Poor	Poor	Poor
Sanitation management	Poor	Good	Poor
Crime	High	High	High

multi-dimensional poverty index (MPI). The King Cetshwayo District Municipality, which has the third-largest population in KwaZulu-Natal and the highest gross domestic product (GDP) after eThekwini Metro, is a growing economic hub. This district's Richards Bay Industrial Development Zone (RBIDZ) has attracted significant international investment, particularly in the mining and agricultural sectors. According to COGTA (2020), agriculture in King Cetshwayo is dualistic, consisting of both subsistence and commercial farming. Commercial farms primarily focus on sugarcane and forestry, the mainstay of emerging and established farmers. In contrast, subsistence farming dominates the Traditional Council Lands, primarily occupied by the economically disadvantaged. Ilembe, the smallest district municipality in KwaZulu-Natal, covers an area of 3,269 km^2. Much of the land in Ilembe is under the jurisdiction of tribal authorities and is characterized by commercial and subsistence farming. Agriculture is the primary economic sector in this area, providing livelihoods for a significant portion of the population (as shown in Table 1).

2.2 Methodology

The study employed a mixed-methods approach, integrating qualitative and quantitative data collection to understand the research topic comprehensively. This approach is based on the premise that combining these techniques enhances the depth of knowledge and strengthens the validity and credibility of the findings (Creswell, 2014). In line with the recommendations of Saunders et al. (2012), individuals were selected for the study based on their knowledge and experience in agriculture, as their insights are crucial for addressing the research objectives. A simple random sampling technique was employed to ensure that all participants had an equal chance of selection. The total population across the district municipalities was 2,286,620, and the sample size was determined using the online survey tool Calculator.net.

Sample calculation:

$$\text{Unlimited population } n = \frac{z^2 \times \hat{p}\left(1-\hat{p}\right)}{\varepsilon^2}$$

$$\text{Finite population } n' = \frac{n}{1+\frac{z^2 \times \hat{p}\left(1-\hat{p}\right)}{\varepsilon^2 N}}$$

Where:
z is the z score.
ε is the margin of error.
N is the population size.
$\hat{p}$ is the population proportion.
Confidence level = 95%.
Margin of error = 5%.
Total population = 2,286,620.
Sample size needed (min) = 195.

Glasow (2005) defines a survey as a systematic data collection method from a sample of units. To achieve a 95% confidence level that the actual value falls within ±5% of the measured value, at least 195 measurements were required. Accordingly, this study employed a survey to gather quantifiable data, distributing 195 questionnaires to participants. The survey design was designed as a structured questionnaire and was developed to collect quantitative data on the socioeconomic status of rural households, their patterns of use, and knowledge of underutilized indigenous and traditional food crops (UITFCs). In addition to the survey, the researchers utilized focus group discussions (FGDs) to explore participants' lived experiences with underutilized indigenous and traditional food crops (UITFCs) within their agri-food systems. The design of the FGDs was to gather in-depth qualitative insights into the lived experiences of rural farmers regarding UITFCs. An interview schedule allowed flexibility in discussion while ensuring consistency across groups. The guiding questions for the FDGs centered on the significance of UITFCs on livelihood development, extension services, and the hunger question. FGDs are based on the premise that reality is subjective, with experiences varying across individuals and over time, and that perceptions hold significance only within specific contexts (Burns and Grove, 2007). Six FGDs were conducted as part of this study. A descriptive analysis presented the findings without making inferences based on probability theory. A Pearson Chi-Square test was conducted using Microsoft Excel (v.2016) to support statistical inference regarding associations between selected variables, with significance evaluated at the 0.05 probability level ($p \leq 0.05$). A thematic analysis was conducted using WebQDA software to identify patterns in the theoretical claims derived from participants (rural farmers). WebQDA is recognized as a user-friendly, cloud-based solution that facilitates coherent organization and management of qualitative data, offering rapid and reliable analytical clarity (Machado and Vieira, 2020).

2.3 Operationalization and measurement of key concepts

To operationalize and measure socioeconomic status (SES) and the integration of UITFCs, the following mixed methods-aligned measurement, indicators/variables, and tools were used in the study:

The various quantitative SES indicators presented in Table 2 were gathered through survey questionnaires and summarized in Table 3. The analytical tools employed include descriptive statistics and cross-tabulations. A conceptual correlation matrix (Table 4) was also developed to highlight key relationships between the SES variables and UITFCs.

TABLE 2 Quantitative indicators for the socioeconomic status (SES).

SES component	Measurement	Indicators/ variables
Education	Categorical	Primary, secondary, tertiary, never went to school
Employment	Categorical	Employed, self-employed, unemployed
Monthly income	Nominal	Range between R1001 to >R4001.00
Household head	Categorical	Age and gender of household head

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TABLE 3 Status of underutilized indigenous and traditional foods crops (UITFCs).

Variable of interest	Possible answer	Percentage
UITFCs grown in the household	Grown	98%
	Not grown	2%
Wild vegetables collected from forests	Collected	98%
	Not collected	2%
Preferences between vegetable categories	Indigenous vegetables	74%
	Exotic vegetables	26%
Use of UITFCs as substitutes for conventional foods in times of food scarcity	Substitute use	97%
	No substitute	3%
Availability of UITFCs	All year	100%
Accessibility of UITFCs	Easily accessible	92%
	Not easily accessible	8%
Nutritional Value of UITFCs	Known nutritional value	99%
	Unknown nutritional value	1%
Challenges related to cultivation	Easy to grow UITFCs	47%
	Not easy to grow UITFCs	53%
Information support by extension agents on UITFCs	Information provided	92%
	No information provided	8%
Effectiveness of information	Helpful	92%
	Not helpful	8%
Effect of climatic conditions on production	Negative effect	51%
	Does not affect the production	49%
Growth and yield concerning climatic factors	UITFCs	77%
	Exotic crops	21%
	Both	2%
Cultural value of UITFCs	Cultural significance	97%
	No cultural significance	3%
Use of UITFCs for income generation	Monetary value	96%
	No monetary value	4%
Perceptions of the younger generation	Appreciation for UITFCs	24%
	No appreciation for UITFCs	76%

3 Results and discussion

Table 5 presents underutilized indigenous and traditional food crops (UITFCs) found in King Cetshwayo, Ilembe, and uMkhanyakude District Municipalities. Some UITFCs are cultivated, while some occur naturally in the wild.

3.1 Demography

In the context of livelihoods, it is vital to know the demography of the unit of analysis to fully comprehend the characteristics and socioeconomic conditions of the inferred population. Table 6 summarizes the results collected from respondents across the three district municipalities.

The findings presented in Table 3 revealed a gender balance among household heads in the sampled population, contrasting existing literature on the cultivation of underutilized indigenous and traditional food crops (UITFCs). Previous studies, such as those by Onomu et al. (2023), have highlighted a strong correlation between UITFCs and women, typically emphasizing their predominant role in cultivating these crops. However, the equal involvement of men and women in UITFC production in this study challenges the conventional belief that women are the primary cultivators of UITFCs. This finding also raises important, yet often overlooked, questions about the accessibility of resources such as land between men and women involved in UITFC farming. A similar study conducted in the Vhembe District of South Africa found that women were primarily responsible for the production and utilization of UITFCs (Ntlanga et al., 2023). The contrast in findings suggests a need for further research into gender dynamics and resource allocation in the context of UITFC cultivation. Approximately 72% of household heads were over 40, while 27% were 39 or younger. Most individuals had low literacy levels, typically limited to primary school education. This low level of education can be understood in the context of South Africa's history, where systemic injustices historically denied many people of color access to educational opportunities. Corroborating this finding is Sihlobo (2023) and Fofana et al. (2024), who have stressed the historical injustices as one of the contributing factors to the many socioeconomic challenges South Africa's smallholder farmers face. The combination of inadequate education and restricted resource access likely explains why these participants rely on cultivating underutilized indigenous and traditional food crops (UITFCs) as a livelihood strategy. This situation is further evidenced by the high unemployment rate, with over 50% of the population unemployed and 64% earning less than R4000.00 monthly.

3.2 Cultivation and utilization of UITFCs

Table 3 presents data from the three districts where the research was conducted, revealing that 98% of household heads reported growing underutilized indigenous and traditional food crops (UITFCs). This finding contrasts with the assertion in studies such as Shelembe et al. (2024), which often describe UITFCs as "overlooked and underutilized by households and farmers despite their potential contribution to household food security" in rural KwaZulu-Natal (KZN). The sociodemographic factors detailed in Table 3 suggest that UITFC cultivation is a strategic response by subsistence farmers in rural communities to address household-level hunger. This strategy challenges the common stigma associated with UITFCs, which are often disparaged with terms like 'food for the poor' and 'low status.' Such stigmatization is particularly noted with wild vegetables such as Amaranthus and *Bidens pilosa*, which, despite their nutritional benefits, are frequently regarded as weeds. Contrary to these negative perceptions, our findings indicate that 99% of farmers recognize the

TABLE 4 Conceptual correlation matrix, SES, and UITFC integration.

SES variable	UITFC cultivation	UITFC substitution use	Income from UITFCs	Knowledge of nutritional value	Youth Appreciation
Employment status	+ + +	+ + +	+ + + +	+ –	-
Education level	+ –	+ + +	+ + +	+ + + +	-
Monthly income	+ + +	+ + + +	+ + + +	+ + +	+ –
Age (hh)	+ + + +	+ + +	+ + +	+ + +	-

++++ = strong positive correlation; +++ = moderate positive correlation; + – = weak positive correlation; – = negative correlation.

TABLE 5 Examples of UITFCs in the study area.

Common name	Scientific name	Production type
Bambara groundnuts	*Vigna subterranea* (L.) Verdc.	Cultivated
Black nightshade	*Solanum retroflexum* Dunal	Wild occurring
Blackjack	*Bidens pilosa* (L.)	Wild occurring
Cassava	*Manihot esculents* Crantz	Cultivated
Cowpea	*Vigna unguiculata* (L.) Walp.	Cultivated
Lambsquarters/tree spinach	*Chenopodium giganteum*	Wild occurring
Pigweed	*Amaranthus*	Wild occurring
Sweet potato	*Ipomea batatas* (L.)	Cultivated
Taro/Madumbis	*Colocasia esculenta* (L.) Schott	Cultivated
Wild cucumber	*Momordica foedita*	Wild occurring

TABLE 6 Sociodemographic analysis.

Variable of interest	Possible answer	Percentage
Gender	Male	50%
	Female	50%
Age of household head	20–39	27%
	40–59	39%
	60–79	31%
	>80	3%
Educational level	Primary	30%
	Secondary	37%
	Tertiary	15%
	Never went to school	18%
Employment status	Employed	17%
	Self-employed	29%
	Unemployed	54%
Monthly income	<1,000	19%
	R1001 – R3000.00	28%
	R3001 – R4000.00	17%
	>R4001.00	17%
	No response	19%

nutritional value of wild vegetables. Munialo et al. (2024) highlight the significant nutrient contributions of various UITFCs. Furthermore, 74% of farmers preferred UITFCs over exotic crops (26%). This preference is attributed to several factors: UITFCs are perceived as highly nutritious, require fewer production inputs compared to exotic crops, and are generally available year-round, although some are seasonal. The consistent availability, easy access (92%), and nutritional benefits of UITFCs align with the Food and Agriculture Organization's (FAO) pillars of food security (FAO, 1996). According to Munialo et al. (2024), diversifying crops to include UITFCs can enhance sustainable food systems within African communities.

3.3 Challenges and opportunities in UITFC production

Despite the growing recognition of the benefits of underutilized indigenous and traditional food crops (UITFCs), it can be deduced from the findings presented in Table 3 that there are concerns surrounding their production. Approximately 53% of participants reported difficulties growing UITFCs, noting that they are more challenging and take longer to cultivate than exotic crops. In contrast, the remaining 47% found UITFC cultivation relatively easy. The literature on UITFC production challenges is limited, as research has predominantly focused on integrating these crops into mainstream agri-food value chains. For instance, Zhang and Dannenberg (2022) explored the opportunities and challenges indigenous food plant farmers face in integrating into agri-food value chains in Cape Town. An interesting finding from this study is the role of extension services in promoting UITFCs across the three district municipalities. Results indicate a positive trend, with 92% of farmers reporting valuable information from extension officers on UITFCs. This support is crucial, given that extension services in South Africa are tasked with advancing agricultural development through science, technology, innovation, and indigenous knowledge in alignment with Agenda 2063 (African Union Commission, 2015) and the Academy of Science of South Africa's (ASSAf) report on revitalizing agricultural education and training (ASSAf, 2017).

3.3.1 Climatic conditions

A noteworthy concern for global food production sustainability is the impact of varying climatic conditions on food security. In recent years, KwaZulu-Natal (KZN) Province has experienced severe weather patterns, including heavy winds, floods, and droughts. Despite these challenges, rural farmers cultivating underutilized indigenous and traditional food crops (UITFCs) have reported that their production systems have not been critically disrupted. However, they acknowledge

that harsh climatic conditions do negatively affect their yields. Notably, 77% of farmers stated that although UITFC production is slower, the yields are generally better than exotic crops. This resilience suggests that UITFCs can withstand adverse weather conditions better than many other crops. Corroborating this is Bokelmann et al. (2022), who highlight the positive response of UITFCs to the climate crisis and their ability to thrive under various conditions with minimum inputs.

3.3.2 Food sovereignty

Food sovereignty emphasizes the importance of local food systems, traditional knowledge, and prioritizing food for people. In this context, UITFCs are deemed culturally appropriate, with 97% of farmers recognizing a strong cultural connection to these crops. Gutierrez et al. (2023) argue that indigenous food sovereignty is intrinsically linked to culture and land, serving as a means for communities to enhance their ability to combat food insecurity. Besides their cultural significance, indigenous foods support sustainable livelihoods. Most farmers (96%) noted that UITFCs can be sold for cash, providing opportunities to acquire other necessary assets for the household. A consistent finding in the literature is the younger generation's diminished appreciation for UITFCs. Many farmers observed that younger people do not fully recognize the value and benefits of these crops. If this trend continues unaddressed, it could jeopardize the preservation and continued use of indigenous food crops valued by the older generation.

A conceptual correlation matrix was developed to illustrate further the interplay between SES and the integration of UITFCs. This matrix underscores the crucial role of UITFCs in responding to SES deficits and demonstrates the varying degrees of correlation observed between different variables. To validate these findings, a Pearson Chi-Square test was performed using Microsoft Excel, with statistical significance assessed at a 0.05 probability level (p-value ≤ 0.05).

Table 4 shows the connection between SES and the observed practices, knowledge and behavior, and uses of UITFCs. A moderate positive correlation exists between employment status and the cultivation of UITFCs. This can be justified by the recorded high unemployment rate (54%). Similarly, a moderate positive correlation existed between using UITFCs as substitute crops for relish or a staple. The Pearson Chi-Square test revealed a statistically significant relationship between employment status and the use of UITFCs as substitutes during periods of food scarcity ($p = 0.00074$). This result suggests that the likelihood of this association occurring by chance is extremely low. Therefore, individuals' employment status influences their reliance on UITFCs in times of need, with unemployed or informally employed individuals possibly turning to these crops as a coping mechanism to ensure food security. Akinola et al. (2020) highlight the stigma often associated with the cultivation and use of UITFCs, and the observation of the two variables (employment and use of UITFCs in times of food scarcity) in this study is congruent with their association with the destitute.

While UITFCs are often perceived to play a crucial role in livelihood development, there are also existing negative undertones surrounding them, such as the assumption that they are poor people's food. It was interesting to observe a weak positive correlation between the knowledge of the nutritional value of UITFCs and employment status. The observation of the weak positive correlation was further strengthened through a Chi-Square test, which yielded a p-value of 0.77, indicating no statistically significant relationship between the known nutritional value of UITFCs and employment. The corresponding coefficient of 0.06 further supports this finding, suggesting a negligible association between the two variables. The weak positive correlation is indicative of a likelihood that the lack of appreciation of the nutritional value offered by UITFCs is proportional to both the social and economic status of the people. Creating awareness about the nutritional value of indigenous crops can lead to greater appreciation, driving both demand and supply. This increased interest presents a potential opportunity for job creation. To fully harness this potential, further studies on the value proposition of these crops are necessary to develop sustainable and marketable business models. Another interesting observation was the strong positive relationship between the high unemployment rate and income generated through UITFCs. This reaffirms an opportunity for these crops in the market space. It was not surprising to learn that there was no appreciation of UITFCs among the unemployed youth. Several scholars have pointed out that there is a huge generational gap between the older generation and the younger generation. Preference for the younger generation aligns with Westernized diets rather than indigenous cuisines. Another opportunity for research and active promotion lies in this area. Over the years, the stigmatization of UITFCs by the younger generation has been a constant theme, which serves as a concern for many as UITFCs strongly align with culture and heritage. Another interesting observation was the weak positive correlation between literacy levels and the cultivation of UITFCs. The 98% representation of households that cultivated and utilized UITFCs also challenges the current belief that these crops are for the illiterate and those of low SES. Corroborating this finding was a Chi-Square test of independence, which indicated no statistically significant relationship between the use of UITFCs and literacy levels ($p = 0.18$). This finding was further supported by the Pearson correlation coefficient (r = 0.13), which suggests a weak positive association between the variables, though not statistically significant. This also aligns with the finding on the cross-cutting positive relationship between monthly household revenue against the cultivation of UITFCs, their use as substitute crops for income generation, and knowledge of nutritional value. This observation points to a need to debunk the myths surrounding UITFCs and disadvantaged groups. There was a moderate positive relationship between the use of UITFCs as substitute crops and income generation when contrasted with education. On the contrary and worth further investigation, the analysis revealed no statistically significant link between the use of UITFCs and income generation ($p = 0.19$). Furthermore, the Pearson correlation coefficient (r = 0.09) reinforces this result, indicating no significant relationship between UITFCs and income generation. This can also be attributed to a low appreciation of their nutritional value, which leads to low demand and, consequently, less motivation to produce them.

3.4 Rural identities and livelihoods as an intersect of inequality

Understanding the reality of many South Africans requires a consideration of the historical injustices wrought by apartheid. Apartheid created a profound socioeconomic divide, leading to the persistent triple challenges of poverty, unemployment, and inequality (Tregenna and Tsela, 2008). To elucidate the complexity of rural farmers' experiences, we examine rural livelihoods through the following themes revealed in our focus groups: the deprivation trap, hunger and poverty, Agricultural

Innovation Systems (AIS), research development, and co-creation of knowledge. These themes are illustrated in the causal loop diagram shown in Figure 1. The causal loop diagram synthesizes the qualitative themes from the focus group discussions (FGDs). The components of the causal loop diagram were thematically derived from recurring patterns and narratives shared by participants during the FDGs.

3.4.1 Deprivation trap

Farmers in rural communities strive to survive under the deprivation trap's constraints. Swanepoel and De Beer (2013) outline a five-point cycle of deprivation affecting rural populations, three of which were evident in this study. These include poverty resulting from a lack of assets. Although land is available for cultivating underutilized indigenous and traditional food crops (UITFCs), illiteracy (Table 6) hinders access to funding and support. As noted by Qange and Mdoda (2020), this lack of resources and poor infrastructure results in diminished motivation and innovation among farmers. One participant expressed frustration with the lack of support:

> *"We have sat like this with many officials. However, like you, they come here, make empty promises, and disappear. We need help, but no one is willing to assist us".*

Another aspect of the deprivation trap, closely linked to low literacy levels, is the exclusion of farmers from vital systems and structures due to geographical isolation. Poor connectivity and transport links further exacerbate these barriers, diminishing the livelihood status of rural farmers and contributing to their sense of powerlessness, compounded by a lack of social and economic influence.

3.4.2 Hunger and poverty

When farmers are ensnared in the deprivation trap, they face multiple dimensions of poverty that impede their well-being and livelihoods. This includes difficulties affording necessities such as food products, farm implements, education, clothing, data, shelter, and energy. In this context, while promoting the inclusion of underutilized indigenous and traditional food crops (UITFCs) in agri-food systems is valuable, it is crucial to recognize that investing in UITFCs alone cannot ensure a sustainable livelihood. Supporting this is a claim made by an elderly female participant:

> "*Even though we produce these indigenous crops, we still have a lot to deal with. Electricity is costly, getting to town is expensive, school uniforms and other daily needs for the children are also financially demanding—the list is endless*".

For UITFCs to contribute effectively to improving rural livelihoods, a comprehensive approach is needed that addresses the broader socioeconomic factors affecting these communities. This means tackling issues such as access to education and training, enhancing infrastructure, securing funding and resources, and improving overall economic opportunities. Without these critical elements, the potential benefits of UITFCs may be significantly diminished, as they cannot compensate for the lack of fundamental

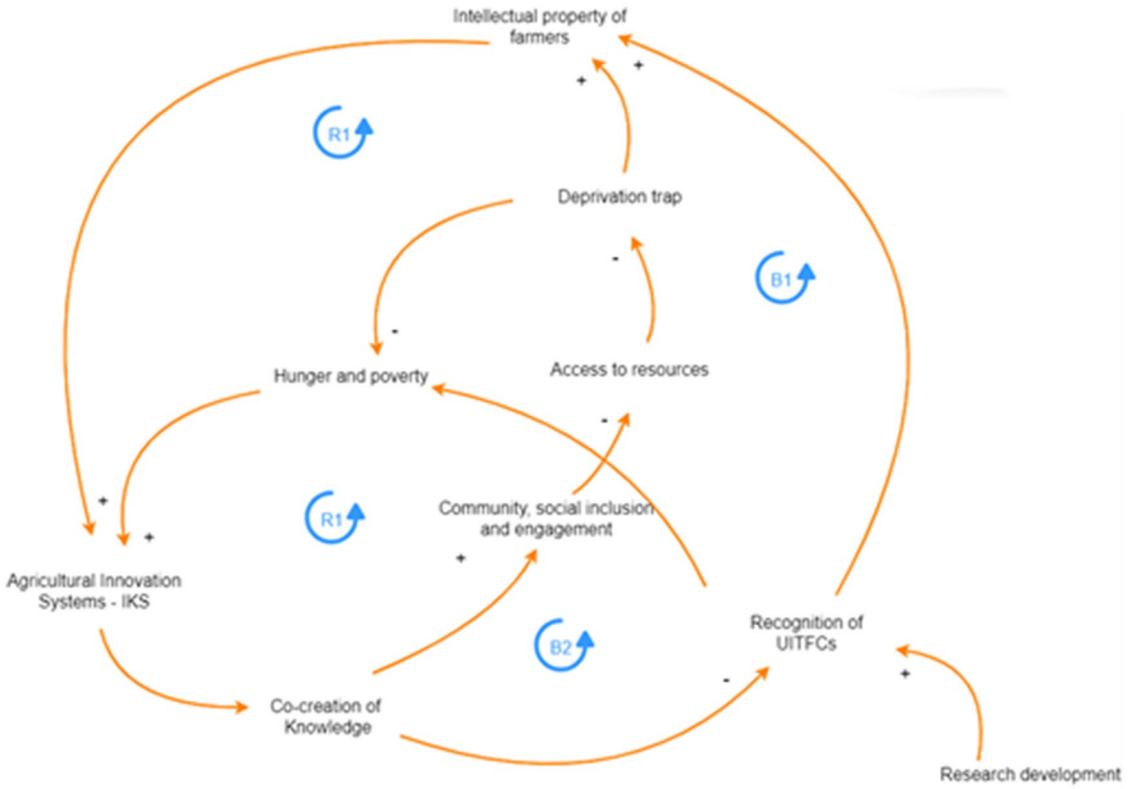

FIGURE 1
Causal loop diagram illustrating emergent themes from focus group discussions.

support and resources necessary for a sustainable and resilient livelihood. By integrating UITFCs into a broader strategy that addresses these socioeconomic challenges, we can work toward a more holistic and sustainable approach to improving food security and economic stability for rural farmers.

3.4.3 Agricultural innovation systems (AIS), research development, and co-creation of knowledge

Rural farmers possess a wealth of indigenous knowledge that can drive agricultural innovation. When effectively harnessed, Indigenous Knowledge Systems (IKS) related to farming can significantly contribute to advancements in agricultural practices. For example, some farmers have demonstrated the ability to extract fibers from the leaves of *Colocasia esculenta* (L.) Schott, which can be used to produce paper for artistic purposes. This is similar to research conducted in the Philippines, where scientists have explored the development of hydrophobic paper bags using *Colocasia esculenta* and *Musa acuminata* leaves (Sanchez et al., 2023). Such innovations highlight the potential of IKS and underutilized indigenous and traditional food crops (UITFCs) to drive creative solutions within agricultural systems. However, realizing this potential requires substantial investment in research and development and providing accessible resources. A mutually beneficial partnership between research institutions and farmers is essential for this to happen. Such collaboration would recognize and respect farmers' intellectual property and facilitate the synthesis of new knowledge and co-creating innovative solutions. By integrating traditional knowledge with scientific research, we can unlock new opportunities for agricultural advancement and enhance the overall effectiveness of UITFCs in contributing to sustainable livelihoods.

3.4.4 Policy implications

While South Africa's agricultural policy frameworks recognize the importance of smallholder and subsistence farming, indigenous crops remain underrepresented in mainstream agricultural support programs, research funding, and market development strategies. This is because policy support mainly focuses on a few crops, including maize, wheat, sugarcane, fruits, and non-indigenous vegetables. There have been a few incidences where indigenous crops such as sorghum, millet, amaranth, and cowpeas have been recognized in South African policy, such as in the National Development Plan (NDP) (National Planning Commission, 2013), the Agricultural Policy Action Plan (APAP), and the Draft National Policy on Indigenous Knowledge Systems (Department of Science and Technology, 2004). The few recognized crops are mainly due to their strong association with traditional production methods, drought resistance, and nutritional benefits. Although UITFCs are frequently mentioned in policy discussions as solutions to food insecurity and climate change, they rarely give explicit, actionable support in policy documents. Instead, they are lumped together under general headings like "climate-resilient crops," "indigenous crops," and "under-utilized crops" and do not have explicit statements, strategies, and action plans to support their production. For example, although the Strategic Plan for Agriculture (2020–2025) mentions crop diversification and climate resilience, it fails to outline specific targets, budgets, or support programs for indigenous crops.

Furthermore, although the National Policy on Food and Nutrition Security (Republic of South Africa, 2017) recognizes the importance of traditional crops, no detailed implementation framework exists for promoting indigenous crop production at scale. While the Agricultural Research Council (ARC, 2016) conducts some research on indigenous crops, it lacks a national mandate or coordinated strategy to integrate these crops into mainstream farming systems. The limited representation of indigenous crops in South Africa's national policy frameworks results in missed opportunities these crops could offer. These include the potential to contribute to sustainable food systems, income generation and livelihoods, climate resilience, and the preservation of cultural heritage. Explicit policy support and targets in national plans on indigenous crops are needed, along with funding for research considering the food systems value chain, seed systems, and extension services. Other measures to promote indigenous crops will include market development initiatives and public awareness campaigns to enhance consumer demand and cultural appreciation. Deliberate support from the government remains fundamentally lacking in South Africa. At the policy level, there is a pressing need for policymakers and government stakeholders to actively promote and invest in the development of the UITFCs value chain.

4 Conclusion

The omission of underutilized indigenous and traditional food crops (UITFCs) from mainstream agri-food systems has intensified food insecurity and undermined the sustainability of rural livelihoods. As global attention increasingly shifts toward integrating these crops into agricultural practices, it is imperative for stakeholders, including policymakers, research institutions, and academia, to prioritize investment in UITFC-related research and development. The South African government is also crucial in fortifying its agri-food systems and fostering sustainable rural livelihoods. While this study reveals a balanced participation of men and women in the cultivation and use of UITFCs, it is important to recognize that women face numerous socioeconomic challenges rooted in systemic patriarchy. These challenges adversely affect their development and access to resources. Thus, we recommend that national agricultural policy explicitly address UITFCs with a gender-sensitive approach. This step is essential for advancing agricultural development in alignment with Agenda 2063, the United Nations Sustainable Development Goals, and the South African Constitution.

Furthermore, the production and utilization of UITFCs are deeply intertwined with indigenous knowledge systems. To drive progress, it is vital to integrate this traditional knowledge with scientific research, technology, and innovation. By merging these elements, we can create a comprehensive strategy that strengthens agri-food systems and fosters a sustainable future for previously disadvantaged rural farmers.

5 Study limitations

While this study offers valuable insights into the relationship between socioeconomic status and the integration of UITFCs in rural KwaZulu-Natal, several limitations must be acknowledged. First, the geographic focus on three district municipalities in northern KwaZulu-Natal (uMkhanyakude, King Cetshwayo, and Ilembe) limits the generalisability of the findings to other regions of the broader South Africa, where socioeconomic and agroecological conditions

may differ. There may also be a risk of respondent bias, particularly social desirability bias, where participants may overreport positive behaviors (such as nutritional knowledge and cultivation of UITFCs) or underreport challenges due to perceived expectations. Additionally, the study employed a cross-sectional design, capturing data at a single point in time. This design limits the ability to infer causality or account for seasonal variations in UITFC availability and use, which are relevant in agricultural contexts. Future studies employing longitudinal or comparative designs, broader geographic coverage, and triangulated data sources could strengthen the robustness and applicability of findings.

Data availability statement

The datasets presented in this article are not readily available because sharing the dataset is prohibited by university policy and ethical guidelines. Access is restricted to authorized users for research purposes only, and any distribution or sharing of the data outside of this framework is not permitted. Requests to access the datasets should be directed to qinisani.qwabe@mandela.ac.za.

Ethics statement

Ethics was granted from the University of the Free State General/Human Research Ethics Committee (GHREC). Ethical clearance number: UFS-HSD2020/0080/0604. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

QQ: Writing – review & editing, Writing – original draft. SM: Writing – original draft, Conceptualization, Validation, Writing – review & editing. FS: Validation, Writing – review & editing, Supervision, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. A Premium Grammarly account was used to improve grammar and the style of writing. No automated text or any unethical act was performed during the preparation of the manuscript.

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