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Determinants of consumers' acceptance of indigenous leafy vegetables in Limpopo and Mpumalanga provinces of South Africa

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Abstract

Indigenous leafy vegetables (ILVs) do not only play a significant role in ensuring livelihoods for households in South Africa but can also contribute in enhancing the consumption of diversified foods for improved micronutrient intake. However, these plants are underutilized and their consumption is determined by ILVs' regional cuisines accepted in certain ethnic groups. This study was set out to assess the acceptance of indigenous leafy vegetables by consumers in Limpopo and Mpumalanga provinces. The study used secondary data that were collected by the South African Vulnerability Assessment Committee in 2016. A total of 1520 respondents were selected from the two provinces using a multistage stratified sampling method. The results of the descriptive statistics showed that blackjack was the least consumed leafy vegetable as compared to amaranth and cleome, which were, respectively, most consumed. Seemingly unrelated regression (SUR) model was employed to analyse the determinants of consumers' acceptance of ILVs. The results of SUR showed that gender of the household head, marital status, HIV status, wages/salary, and grants were statistically significant in influencing the acceptance of ILVs by consumers. Education and marital status had a negative influence on the acceptance of all leafy vegetables being investigated in this study. Policy makers need to consider the inclusion of ILVs into the school curriculum and national food and nutrition security policy.

Keywords: Agriculture, Indigenous leafy vegetables, Consumer's acceptance, Regional cuisine and policies

Introduction

Agriculture in Southern Africa is one of the most critical sectors of economic development. In this region, agriculture is responsible for economic growth since it contributes to the GDP of most African countries. This is evident in that the agricultural sector in South Africa accounts for around 2.3% of the country's GDP, 40% of export earnings, and 4.6% of employment in the country [1]. In South Africa, Statistics South Africa reported that

13.8% of the households are heavily reliant on agriculture to improve their livelihoods, many of them situated in rural areas [1]. Yeboah and Jayne [2] further pointed out that agriculture is the main source of livelihood for more than two-thirds of the population. Therefore, it is without a doubt that agriculture is the most powerful tool for eradicating hunger and unemployment, especially in rural areas.

However, the findings of the South African National Health Examination Survey reported that only 45.6% of South Africans are food secure. The findings of the study further reported that food insecurity is found to be more prevalent in rural areas (37%) than urban areas (32,4%) [3]. In addressing the issue of food insecurity, Mbheyane [4] stated that policies on food and

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nutrition security propose the promotion of indigenous leafy vegetable that contains more micronutrients such as amaranth and cleome than conventional vegetables (cabbage and lettuce). However, these policies are not proactive in ensuring that indigenous leafy vegetables contribute to household food and nutrition security and form part of a formal market. This is because their focus is on cash crops than indigenous leafy vegetables [5]. Therefore, the potential of ILVs to contribute to food and nutrition security is minimized and overlooked by food and nutrition policies.

These policies indirectly resulted to less consumption of these plants, especially urban people who rarely produce these crops. Therefore, it is crucial to promote the consumption of these plants as they serve as a good source of micronutrients such as vitamin A, C, iron, zinc, and magnesium [6]. They also contain significant levels of micronutrients that are essential for health such as Amaranth. However, these leafy vegetables are less available in the market. Their less availability in the market has proliferated micronutrient deficiency diseases and disorders such as obesity, diabetes, and stunted growth in children [4].

The less availability of ILVs in the market also led to questionable acceptance of these plants by people. As authors have reported that some people consider them as old-fashioned food, poor people's food, food for animals, unhygienic foods, regard them as weeds and as food related to the concept of social backwardness [7]. These negative perceptions of people towards ILVs have limited the exposure of these plants, which then minimize their contribution on household food security. On top of that, little research has been carried out, especially on the factors determining the acceptance of indigenous leafy vegetables [7].

This study sought to close the gap between the availability of indigenous leafy vegetables and exotic cash crops. It will do so by providing insight to policymakers that their policies are not in favour of indigenous leafy vegetables. Thereafter, they will review their existing policies on ILVs and raise awareness. This will not only increase their availability in the market but will also increase opportunities for the uses of indigenous leafy vegetables. Furthermore, their availability in the market will help consumers to get rid of negative critics that people hold against these leafy vegetables such as old-fashioned food, poor people's food, food for animals, unhygienic foods since it grows in the wild [4]. Therefore, it is against this backdrop that this study sought to analyse the determinants of consumers' acceptance of indigenous leafy vegetables in the study area.

Ethnic-geographic and historical understanding of ecological diversity and sustainability of ILVs

In Mpumalanga and Limpopo provinces, cultural beliefs determine which ILVs are consumed by different ethnic groups residing within these provinces. Even the decline in the production and consumption of ILVs in these places is associated with cultural beliefs held by different ethnic groups [8]. For instance, the Shangaan and Pedi ethnic group located in Mpumalanga and Limpopo prohibit woman who is on the fertility cycle (menstruation, pregnancy, and lactating women) to take part in agriculture and production of ILVs. This has somewhat contributed to the limited contribution of ILVs on household food security. Mavhengama et al. [9] further stated that there is a belief among ethnic groups (Pedi, Shangaan, and Zulu) that certain ILVs can only be planted by women. For instance, bambara groundnuts can only be planted by women. This belief is still prevalent in relatively old Zulu and Pedi smallholder farmers located in KwaZulu Natal and Limpopo. This implies that male-headed households are rarely involved in the production of ILVs as it is perceived as something done by women.

Other factors such as climate change and indigenous knowledge determine which ILVs are preferred by certain ethnic groups. This implies that ILVs can be grown by different groups, yet it might not be consumed by a particular ethnic group due to practices associated with the production and utilization of ILVs that might be contrary to their cultural beliefs. For instance, there are many ILVs grown in Limpopo, yet most Pedi people prefer cleome and Akaka, which they deem as the most nutritious and delicious crops. This has resulted in certain ILVs being scarce and extinct over time. Consequently, the indigenous knowledge associated with the use of those ILVs disappears such as blackjack.

The study conducted by Mavhengama et al. [9] showed that the production of ILVs in the Zulu and Pedi ethnic groups is highly dependent on the biophysical conditions (soil, climate, and the availability of water). For instance, In Limpopo (Pedi), crops such as maize and pumpkin, are most cultivated during dry seasons since they can adapt to the dry climate. While, cowpeas, cleome, and amaranth are cultivated mostly by Zulu and Shangaan people since they are located in warm, full sun, and well-drained soil. Mahlangu [5] further alluded that socio-economic conditions and indigenous knowledge determine the reason for consuming ILVs. It also determines which part of ILVs is consumed the most by people (seed, leaves, stalks, growth points, flowers, and fruits). Mabhaudi [8] alluded that different ethnic groups of South Africa are aware of the detrimental effect of overharvesting of one product (leaves) on the subsequent product (seed). In these villages, food shortage has been associated with

unsustainable harvesting practices mechanisms, which ultimately leads to the decline of ILVs. In this light then, there is a need for the development of seed systems of uncultivated ILVs.

Literature review on various determinants of consumers' acceptance of indigenous leafy vegetables

South African indigenous leafy vegetables are plants that have their origin in South Africa. These crops are sometimes introduced to the country through various natural processes that cause them to evolve overtime. They are either cultivated or grow in the wild under different climatic conditions. Indigenous leafy vegetables such as Bambara groundnut, cowpea, cleome, jute melon, amaranth typically grow in Mpumalanga, North-west, Gauteng, KwaZulu Natal and Limpopo provinces in South Africa. ILVs are often eaten as boiled, dried, and as roasted vegetables [10]. Furthermore, most of these leafy vegetables are drought and heat-stress-tolerant and require minimal inputs for growth and adaptation in arid and semi-arid conditions [11]. These leafy vegetables are mainly grown by smallholder farmers in rural areas and are an essential source of food for rural poor households. However, despite their importance, people are not aware of the nutritional benefits associated with consuming these leafy vegetables particularly those residing in urban areas [11]. This is due to many factors that determine consumers' acceptance of indigenous leafy vegetables including attitudes, socio-demographic factors, and perceptions.

Cloate [12] noted that indigenous leafy vegetables are obtained by collection from the wild /fields rather than cultivation. These leafy vegetables, especially amaranth and blackjack, are pioneer plants that emerged naturally when soils are disturbed and hence people regard them as weeds. This notion has contributed to them being regarded as poor people's food that is related to the concept of social backwardness. Since people in the past heavily relied on them to diversify their food intake in the household. Therefore, indigenous leafy vegetables' consumption is shaped and governed by food sources references of the past. Cloate [12] further stated that territory contributes significantly in determining the kind of foods people consume. This is somehow in line with Mabhaudi et al. [13] who indicated that the link between food and territory has been eroded over time, since there have been changes in food production, technologies, urbanization, and consumers' exposure to non-local experiences through travel and media. This means that in recent years these leafy vegetables are consumed by everyone including those in urban areas. However, the connotations linked with sociocultural backgrounds still exist; hence,

these leafy vegetables are still perceived as poor people's food that grow in rural areas.

These leafy vegetables are also regarded as old-fashioned because it is believed that older people consume them more often [14]. After all, they know the skills required to prepare and cook them. On the other hand, youth has more diverse food purchasing and consumption patterns selected based on preferences for novelty and convenience foods. Therefore, they prefer fast foods over ILVs, which they deem as unhygienic due to little stone detected when eating them [15]. Furthermore, consumption of other foods other than traditional foods such as amaranth has been encouraged by massive urbanization of African consumers, leading to change in food preferences of the household. This has caused people to consume other foods other than indigenous leafy vegetables, especially young people [9]. On the contrary, Van Hoeven et al. [7] stated that the factors that led people to consume these plants in the past have triggered people to consume them in the twenty-first century for health and cultural purposes. For instance, Amabele (a final product of Sorghum) is a traditional food that was once underutilized as people fell for western food. However, their consumption has increased as people go back to their roots because of medical advice [9].

It is further revealed that the consumption of indigenous leafy vegetables is influenced by socio-economic factors such as age, gender, education, distance to the market, and income. As far as income of consumers is concerned, Omotayo [16] stated that middle- and average-income earners consume these leafy vegetables because they fear risking their health. Mthombeni [17] pointed out that the consumption of these plants is determined by livelihood sources, in the sense that unemployed people and casual labour people are consuming indigenous leafy vegetables more than their employed personnel counterparts. The study concluded that the livelihood sources determine the time spent preparing and cooking these plants. Furthermore, monthly income was reported to affect the extent at which people consume indigenous leafy vegetables [17]. This indirectly implies that poor people consume these leafy vegetables more than rich people. Therefore, the consumption of ILVs is determined by household level of income; however, the majority of consumers are low-income earners.

The less availability of indigenous leafy vegetables in the market is also triggered by institutions and policy frameworks that pay less attention to indigenous leafy vegetables. Mabhaudi et al. [18] stated that these policies focus on cash crop production, which advocates eradicating any other plant that grows in the field as weeds. This implies that they support the eradication of indigenous leafy vegetables as they are regarded as weeds. These

findings are somehow in line with that of Tudge [19], who stated that the less consumption of these leafy vegetables emanate from the fact that the dominant food system policies focus on the production and marketing of exotic cash crops while leaving the indigenous leafy vegetables behind. This, therefore, proves that the policies are inclusive of exotic cash crops production and their marketing; hence, there has been a minimal availability of indigenous leafy vegetables in the market. In order to increase awareness of these plants, they must be included in the dominant food system, the policymakers and government should develop a transformative approach inclusive of smallholder farmers who produce and sell these crops. By so doing, they will be advocating not only the inclusion of these leafy vegetables in the database of South Africa, but also the recognition and consumption of ILVs by many people in urban and rural areas.

Methods

Description of the study area

The study was carried out in two out of nine provinces of South Africa, Limpopo, and Mpumalanga. These provinces were selected for the study because they consist of smallholder farmers who are heavily involved in the production of indigenous crops. These provinces consist of smallholder communal farmers who depend on agriculture and livestock farming as their livelihood source. Limpopo is located in the Northern part of South Africa, covering 125 754km² of the area, which is 10, 2% of the total area of the country. Limpopo consist of several ethnic groups distinguished by race, language, and culture: Sepedi (57%), Tsonga (23%), Venda (12%), Afrikaners (2.6%) and the English (1/2%). This province consists of 5, 8 million population situated in five districts known as Mopani, Vhembe, Capricorn, Waterberg, and Sekhukhune [5]. Mpumalanga province consist of different ethnic groups distinguished by culture and language: Siswati (27.67%), Zulu (24.14%), Xitsonga (10.42%), Isindebele (10.10%), Afrikaans (7.24%), Sesotho (3.47%), and English (3.12%) These are the districts where the data collection for the study was carried out as people in these areas are heavily reliant on agriculture. This is also evident in that 89% of the population in this province works within the agricultural sector. Mpumalanga is one of the provinces heavily reliant on agriculture as it produces a wide variety of fruits, vegetables, cereals, tea, and sugar. The production of these crops plays a significant role in the economic growth and development of Limpopo province (Hlatshwayo et al. [20]). It also comprises 167 existing irrigation schemes with small-scale farmers operating on these schemes [8]. These small-scale irrigation schemes have about 10,150 farmers with an average individual land holding of about 1.5 hectares per farmer.

Mpumalanga province is formerly known as Eastern Transvaal. This province is located in the north-eastern part of South Africa. It is bounded by Limpopo province to the North and Swaziland to the east of KwaZulu Natal. It covers about 6.5% of the country's land area. It also consists of a 4.04 million population where 72% of the population is heavily involved in agriculture [8]. The overall rainfall received by Mpumalanga is 1000 mm annually and also experiences warm weather conditions as it is 665 above sea level. It also produces indigenous crops such as amaranth, cowpea, African eggplant, okra, and pumpkin. The other foods farmers produce in Mpumalanga include corn, sugar, cotton, groundnuts, potatoes, other vegetables, and a wide variety of fruits, including oranges and mangoes in the subtropical Lowveld and peaches in higher elevations. Mpumalanga is also involved in the production of dairy cattle, beef, and wool production.

Data collection method and technique

The study used a quantitative method to collect data on key food and nutrition security indicators. A multistage stratified sampling technique was used to select the participants for the study. This technique divides the population into homogenous, mutually exclusive strata. It also enables individuals in the population to have equal chances of being selected to participate in the study. This method increases the trustworthiness of match rate estimates, inexpensive, and quite easy to implement. It also allows a large sampling of the population, which helps researchers to draw an accurate conclusion about the study, whereas small sampling produces less accurate results, which then lead to wrong conclusion being made about that particular population [21].

In each site, farmers were grouped based on the similar characteristics they share such as socio-economic factors, household size, institutional factors, and sales. The study used secondary data that was collected by the South African Vulnerability Assessment Committee (SAVAC) in 2016. The total number of respondents that participated during the research in Limpopo and Mpumalanga provinces was 1520. Data collected from these two provinces were analysed in a statistical manner using a software program known as Statistical Package for Social Science (SPSS).

The determinants of indigenous leafy vegetables were modelled using seemingly unrelated regression (SUR) model, which assumes that the error terms between components are expected to be correlated. This model is an efficient estimator of coefficients compared with ordinal least square (OLS) especially when the error terms between equations are correlated. SUR model estimates more than two equations simultaneously.

The parameters of each equations take information provided by the other equation into account [22]. This model is employed in this study because when interdependence between dependent variables was assumed, the common underlying determinants were well estimated using simultaneous equations of SUR model.

Furthermore, this model was employed in the study because of its three main advantages, firstly, it was used to gain efficiency in estimation by combining information on different equations. Secondly, it imposes test restrictions that involve parameters in indifferent equations. Thirdly, it leads to improved tests of hypothesis of regression coefficient and other parametric values [22]. This model has been used by scholars such as [23–26] to determine the production and utilization level of indigenous leafy vegetables.

With respect to the study, demographic factors and socio-economic factors were modelled to attain a comprehensive understanding of the extent at which different variables have affected the acceptance of these leafy vegetables. Furthermore, consumers’ determinants of indigenous leafy vegetables are multidimensional; their acceptance relies on a combination of characteristics such as household size, gender of the household head, education level, main economic activity, wage/salary, HIV status, social grants, and irrigation type. Therefore, SUR was seen as ideal model to analyse the study.

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Table 1 Results of crop and non-crop producers

Variables	%	Freq
Crop production of Indigenous leafy vegetables		
Crop producers	25	386
Non-crop producers	75	1134
Overall	100	1520

Results

Demographic and socioeconomic characteristics of farm household

The descriptive statistics results in Fig. 2 for the socio-economic and demographic characteristics of Indigenous Leafy Vegetables (ILVs) reported that there were 386 crop producers and 1134 non-crop producers. These results show that indigenous leafy vegetables producers were low when compared to that of non-crop producers. This is because ILVs have been replaced by major cash crops that do not require much time to cook. Hence, the producers of ILVs were few when compared to that of non-crop producers (Table 1).

Figure 1 reveals that 62% of these leafy vegetable consumers were females, while 38% were males. The logical explanation for this could be that females are the ones with a wealth of knowledge about the preparation, cooking, and storage of indigenous leafy vegetables, while males do not know much about them. In fact, males prefer foods that require less time to cook.

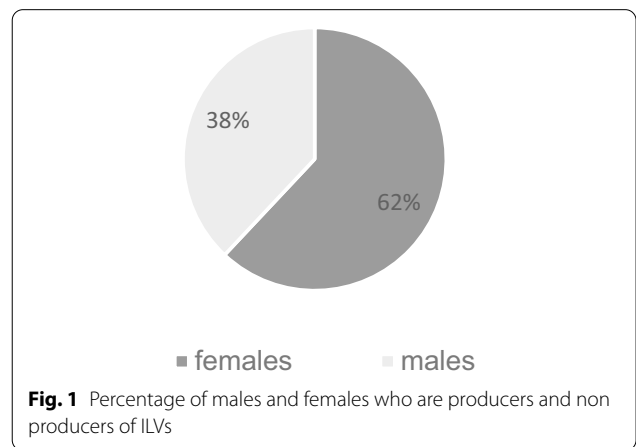


Fig. 1 Percentage of males and females who are producers and non producers of ILVs

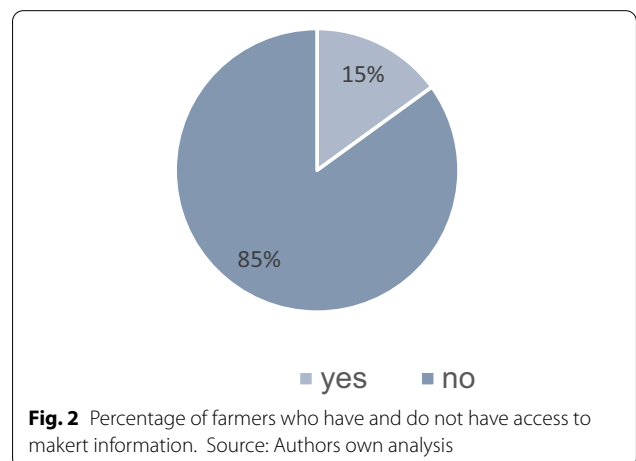


Fig. 2 Percentage of farmers who have and do not have access to makert information. Source: Authors own analysis

Figure 2 shows that 15% of consumers of ILVs had access to the market information, while 85% did not have access to market information. This implies that a large number of ILVs consumers do not have access to market information. Hence, they often produce ILVs for their own consumption. The other reason is that ILVs are often sold by vendors who form part of informal markets where there is no straightforward, succinct knowledge about market access information of ILVs' consumers (Table 2).

Table 3 shows the demographic information of ILVs' consumers in the Limpopo and Mpumalanga provinces. This table shows that the mean age of ILVs' consumers was 1.24, while for non-consumers of ILVs was 1.29. As for education, it was found to be statistically significant at 5%. The mean number of years spent by consumers at schools is 35.36 while spent by non-consumers of ILVs is 33.41. This simply means that ILVs' consumers are more

educated than non-consumers of these crops. The total output of crop production of these leafy vegetables was 2242.64 kg, while for non-consumers of ILVs was 717 kg. This means that the total output of ILVs was more than that of other crops. The possible explanation could be that they are easily available as they grow in the wild and uncultivated areas. Hence, their yield is high.

Discussion

Determinants of consumers' acceptance of indigenous leafy vegetables

As evident by the nonzero cross-correlation coefficients of the estimated equations' error terms, the use of seemingly unrelated regression (SUR) is suitable for estimating the three equations than estimating each of the equations independently. The results of the seemingly unrelated regression model revealed that different factors

Table 2 Socio-demographic and socio-economic characteristics of ILVs' consumers

Demographic characteristics of ILVs consumers in Limpopo and Mpumalanga provinces	ILVs production/ consumption	Mean	F	Df	P value
Age of the household head	Yes	1.24	1.009	129	0.317
	No	1.29		21.62	
Education of the household head	Yes	35.36	0.000	102	0.989
	No	34.41		17.14	
Total output of crops (kg)	Yes	2242.60	25.622	818	0.000
	No	717,17		134	

Table 3 Determinants of consumer acceptance of indigenous leafy vegetables: seemingly unrelated regression model

Variables	Amaranth			Cleome			Blackjack		
	Coef	Std. Err	P value	Coef	Std. Err	P>z	Coef	Std. Err	P value
Household size	-0.007	0.005	0.130	0.004	0.002	0.055*	0.003	0.002	0.134
Gender of household head	0.129	0.064	0.044**	-0.091	0.029	0.002***	-0.063	0.031	0.042**
Household headage	0.001	0.001	0.231	-0.001	0.000	0.153	0.000	0.000	0.734
Household head area of resident	0.038	0.161	0.815	0.017	0.074	0.818	0.187	0.077	0.015**
Education level of household head	-0.063	0.177	0.721	-0.073	0.082	0.369	-0.355	0.085	0.000***
Marital status of household head	0.075	0.147	0.613	0.607	0.068	0.000***	-0.071	0.071	0.314
Main economic activity	-0.046	0.074	0.532	-0.005	0.034	0.889	-0.091	0.035	0.010**
Farm income	0.254	0.131	0.053*	0.040	0.061	0.514	-0.005	0.063	0.931
HIV status of the HH head	-0.049	0.137	0.718	-0.008	0.063	0.899	-0.143	0.066	0.030**
If HH head receives grant	0.142	0.125	0.253	0.016	0.058	0.783	-0.121	0.060	0.043**
GRANTS	-0.167	0.070	0.017**	0.087	0.032	0.008***	0.234	0.034	0.000***
WEATHINDEX	0.078	0.054	0.149	-0.031	0.025	0.220	-0.005	0.026	0.843
Irrigation type	-0.052	0.111	0.636	0.031	0.051	0.544	0.236	0.053	0.000***
Constant	0.334	0.229	0.145	0.294	0.106	0.006***	0.900	0.110	0.000***
Equation	Obs	Parms	RMSE	R-sq	chi2	P-value			
Amaranth	1,427	13	0.48147	0.013	19.9	0.0977*			
Cleome	1,427	13	0.222565	0.786	5239.79	0.000***			
Blackjack	1,427	13	0.231646	0.768	4742.47	0.000***			

*, **, *** represent 10%, 5%, 1%, Authors own analysis, HH- household

affected the acceptance of indigenous leafy vegetables. The hypothesized and tested independent variables were included in the model as shown in Additional file 1: Table S4.

The three indigenous leafy vegetable (amaranth, cleome, and blackjack) variables had a mixture of negative and positive coefficients. However, blackjack had more negative coefficients in all the variables measured than other leafy vegetables (amaranth and cleome). This implies that the acceptance of blackjack is low when compared to that of other leafy vegetables in the study. Furthermore, this might have been proliferated by the fact that this crop has a bitter taste. Hence, consumers prefer other leafy vegetables other than blackjack. Mabhaudi et al. [13] identified blackjack to be among the underutilized indigenous leafy vegetables in South Africa whose acceptance among the society needs to be promoted through research and policy interventions.

Education had a negative effect on the acceptance of indigenous leafy vegetables (amaranth, cleome, and blackjack) and was statistically significant at 5%. This implies that as the household members become more educated, their food preferences tend to change and, in most cases, they draw towards fast foods which they deem as appetizing. Similarly, Ayanwale et al. [24] found education to have a negative effect on the acceptance of ILVs. The findings of the study concluded that people tend to change their food preferences as they become more educated; as a result, they consume less of ILVs as they are deemed as poor people's food. These findings are contrary to that of Sanlier and Karakus [27], who found that educated people are adopting these leafy vegetables since they are aware of the benefits they have on their health.

Household size for amaranth had a negative effect on consumers' acceptance of this crop and was statistically significant. This is because as the household size increases, the household members may be reluctant to diversify the crops that they consume. They may decide to stick with major stable crops than indigenous leafy vegetables since people dislike them especially young people. This is in line with Ayanwale et al. [24], who found that when household member purchases vegetables, they consider those that would meet the preference of most household members. Therefore, only a few members of the household are likely to accept ILVs for consumption. Gido et al. [28], on the contrary, stated that less consumption of these leafy vegetables is exacerbated by the fact that more time is required to pluck sufficient quantities of leaves from ILVs' stalks in readiness for cooking, thereby reducing consumption intensity in large households due to the tedious process of vegetable preparation.

Gender of the household was positively correlated to the acceptance of indigenous leafy vegetables (amaranth) and was statistically significant at 5%. The increase in the acceptance of this crop was triggered by females who have a wealth of knowledge about the preparation, cooking, and storage of these crops. While, males, on the other hand, may decide whether ILVs are for their own consumption or commercial purposes. This is in line with Gido et al. [28], who found that urban males and rural young people resent indigenous leafy vegetables because they lack knowledge about the preparation and cooking techniques of these leafy vegetables. As pointed out by Voster et al. [29] that females are fond of these leafy vegetables than their male counterparts. Cleome, on the other hand, had a negative coefficient. The possible explanation is that cleome grows naturally in the wild; therefore, it is possible that most people regard it as a weed, especially males who are particularly not fond of ILVs.

Although household age revealed that there was no statically significant for these leafy vegetables, there was a positive correlation between age and the acceptance of (amaranth and blackjack). This implies that as household members age increases, they tend to become fonder of these leafy vegetables especially because of the nutritional benefits attached to them. These findings are similar to that of Ayanwale, et al. [24], which stated that rural elderly people were more likely to accept amaranth due to that there are familiar with cooking and preparation techniques and nutritional benefits attached to ILVs. Taleni [14] stated that young people resent ILVs just because their taste buds get replaced as they grow. Ayanwale et al. [24], on the contrary, stated that a majority of ILVs' consumers were relatively young people and indicated that factors that encouraged young people to consume ILVs must be investigated.

Results revealed that having a member in the household that is HIV positive had a negative effect on the acceptance of all leafy vegetables being analysed (amaranth, cleome, and blackjack) and were statistically significant at 5%. This means that HIV-positive consumers may not have enough time to prepare and cook ILVs. Therefore, they choose other crops that take less time to cook as they may have other commitments such as exercising and having a doctor's appointment. These findings are in line with that of Ruel et al. [30], who found that there is a perception that more time is required to prepare and cook indigenous leafy vegetables. However, Van der Lans et al. [31] findings begged to differ as they stated that low-income consumers who might be HIV-positive and poor at the same time regard them as luxurious foods.

Wages/ salary was found to be positively correlated to the acceptance of indigenous leafy vegetables and were all statistically significant at 10%. This means that as the

wage or salary increases also the acceptance of indigenous leafy vegetables increases. This is most likely to happen in urban areas where household members do not have sufficient space to practice subsistence farming; therefore, they often buy them from vendors. These findings were found to be contrary to that of Gido et al. [28], who stated that as the urban consumers' salary increases, the consumption of ILVs decreases as consumers may prefer to buy conventional vegetables in the market such as lettuce, cucumber and spinach since they do not demand much time to prepare and cook.

Conclusion and recommendations

The consumption of indigenous leafy vegetables can play a significant role in households' livelihoods through improving food and nutrition security. The acceptance of ILVs was affected by factors such as education of the household head, gender, main economic activity, HIV status, age, grants, and wages or salary. The HIV status and education variables were found to have a negative effect on all leafy vegetables being investigated in the study. The study further found that amaranth and cleome were the most accepted leafy vegetables, while blackjack was the least accepted one. These findings show that research and policy intervention as well as extension workers need to educate people about the importance of ILVs and the nutritional benefits attached to them. There is a need to promote the consumption of ILVs through awareness and campaigns. This information must be imparted to young people who resent the bitter taste found in leafy vegetables especially blackjack. Policymakers need to consider the inclusion of ILVs into the school curriculum and national food and nutrition security policy. The HIV-positive people should be encouraged to consume these leafy vegetables more so that their immune system can be strengthened.

Abbreviations

GDP: Gross domestic income; HIV: Human immunodeficiency virus; ILVS: Indigenous leafy vegetables; SAVAC: South African Vulnerability Assessment Committee; SUR: Seemingly unrelated regression.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s42779-022-00128-5>.

Additional file 1: Table S4. Definitions and summary statistics of variables used in the SUR model.

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Author contributions

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Data availability statement

Restriction apply to the availability of these data. Data were obtained from the Department of Agriculture, Land Reform, and Rural Development (DALRRD) and are available from South African Vulnerability Assessment Committee (SAVAC) secretariat with the permission of Department of Agriculture, Land Reform, and Rural Development (DALRRD).

Declarations

Competing interests

The authors declare that they have no competing interests.

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References

- Baiphethi MN, Jacobs PT. The contribution of subsistence farming to food security in South Africa. *Agrekon*. 2009;48(4):459–82.
- Yeboah K, Jayne T. Employment trends in Sub-Saharan Africa: the evolving role of agriculture. International Development Working Paper, Michigan State University, East Lan; 2015.
- Van Pittius NC, Mbhenyane E, Volmik X, Blitz J, Chikte U. Indigenous crops can contribute to food security. In: Stellenbosch UO, editor. *Medicine and health science*; 2016.
- Mbhenyane XG. Indigenous foods and their contribution to nutrient requirements. *S Afr J Clin Nutr*. 2017;30(4):5–7.
- Mahlangu SA. Production and commercialisation potential of indigenous leafy vegetables: case study of Capricorn District in the Limpopo Province, South Africa. University of Limpopo; 2014.
- Nesamvuni C, Steyn N, Potgieter M. Nutrients analysis of selected western African foods. *S Afr J Sci*. 2001;97:51–4.
- Van der Hoeven M, Osei J, Grieff M, Kruger A, Faber M, Smuts CM. Indigenous and traditional plants: South African parents' knowledge, perceptions and uses and their children's sensory acceptance. *J Ethnobiol Ethnomed*. 2013;9(1):1–12.
- Mabhaudhi T, Chimonyo VG, Modi AT. Status of underutilised crops in South Africa: opportunities for developing research capacity. *Sustainability*. 2017;9(9):1569.

9. Mavengahama S, McLachlan M, De Clercq W. The role of wild vegetable species in household food security in maize based subsistence cropping systems. *Food Secur.* 2013;5(2):227–33.
10. Cloete PC, Idsardi E. Consumption of indigenous and traditional food crops: Perceptions and realities from South Africa. *Agroecol Sustain Food Syst.* 2013;37(8):902–14.
11. Mabhaudhi T, O'Reilly P, Walker S, Mwale S. Opportunities for underutilized crops in southern Africa's post–2015 development agenda. *Sustainability.* 2016;8(4):302.
12. Taleni V, Goduka N. Perceptions and use of indigenous leafy vegetables (ILVs) for nutritional value: a case study in Mantusini community, eastern Cape Province, South Africa. In: Proceedings of the international conference on food and agricultural sciences, Melakaelaka, Malaysia. 2013.
13. Maseko I. African leafy vegetables: a review of status, production and utilization in South Africa. *Sustainability.* 2017;10(1):1–16.
14. Akinola R, Pereira LM, Mabhaudhi T, de Bruin FM, Rusch L. A review of indigenous food crops in Africa and the implications for more sustainable and healthy food systems. *Sustainability.* 2020;12(8):3493.
15. Omotayo AO, Aremu AO. Underutilized African indigenous fruit trees and food–nutrition security: opportunities, challenges, and prospects. *Food Energy Secur.* 2020;9(3):220.
16. Mthombeni DL. Impact of vegetable sales on household income of hawkers in the Limpopo province of South Africa. University of South Africa; 2013.
17. Mabhaudhi T, Chibarabada TP, Chimonyo VGP, Murugani VG, Pereir LM, Sobratee N, Govender L, Slotow R, Modi AT. Mainstreaming underutilized indigenous and traditional crops into food systems: a South African perspective. *Sustainability.* 2019;11(1):172.
18. Tudge C. Agroecology and biodiversity: the kind of farming we need to secure our food supply is also wildlife friendly. *Biodiversity.* 2014;15(4):290–3.
19. Maponya P, Mbili MI, Dube ZP, Nkuna T, Makhwedzhan M, Tahulela T, Mongwaketsi K, Isaacs L. Perceptions on the constraints to agroforestry competitiveness: a case study of agrosilviculture community growers in Limpopo and Mpumalanga Provinces, South Africa. *Circ Econ Sustain.* 2021;1:1413–21.
20. Hlatshwayo SI, Modi AT, Hlahla S, Ngidi M, Mabhaudhi T. Usefulness of seed systems for reviving smallholder agriculture: A South African perspective. *Afr J Food Agric Nutr Dev.* 2021;21(2):17581–603.
21. Tashakkori A, Teddlie C. *Handbook of mixed methods in social & behavioral research.* Thousand Oaks, Calif: SAGE Publications. 2013.
22. Cadavez VA, Henningsen A. The use of seemingly unrelated regression to predict the carcass composition of lambs. *Meat Sci.* 2012;92(4):548–53.
23. Quansah JK, Escalante CL, Kunadu APH, Saalia FK, Chen J. Pre-and post-harvest practices of urban leafy green vegetable farmers in Accra, Ghana and their association with microbial quality of vegetables produced. *Agriculture.* 2020;10(1):18.
24. Ayanwale AB, Amusan CA, Adeyemo VA, Oyedele DJ. Analysis of household demand for underutilized indigenous vegetables. *Int J Veg Sci.* 2016;22(6):570–7.
25. Mnzava NM, Dearing JA, Guarino L, Chweya JA, de Koeijer H. Bibliography of the genetic resources of traditional African vegetables. Neglected leafy green vegetable crops in Africa. Vol. 2. International Plant Genetic Resources Institute, Rome, Italy. 1999.
26. Mdluli F, Thamaga-Chitja J, Schmidt S. Appraisal of Hygiene Indicators and Farming Practices in the Production of Leafy Vegetables by Organic Small-Scale Farmers in uMbumbulu (Rural KwaZulu-Natal, South Africa). *Int J Environ Res Public Health.* 2013;10(9):4323–38. <https://doi.org/10.3390/ijerph10094323>.
27. Sanlier N, Karakus SS. Evaluation of food purchasing behaviour of consumers from supermarkets. *British Food J.* 2010;112(2):40–150.
28. Gido EO, Ingasia O, Owour G. Consumer acceptance of leafy African indigenous vegetables: comparison between rural and urban dwellers. *Int J Veg Sci.* 2017;23(4):346–61.
29. Vorster H, van Rensburg WS, Stevens JB, Stey GJ. The role of traditional leafy vegetables in the food security of rural households in South Africa. In: International symposium on underutilized plants for food security, nutrition, income and sustainable development 806. 2008.
30. Ruel MT, Minot N, Smith L. Patterns and determinants of fruit and vegetable consumption in sub-Saharan Africa: a multicountry comparison. WHO Geneva; 2005.
31. Van Der Lans CJM, Snoek HM, de Boer FA, Elings A. Vegetable chains in Kenya: production and consumption of vegetables in the Nairobi metropolis. Wageningen UR: Greenhouse Horticulture; 2012.

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