www.jard.edu.pl http://dx.doi.org/10.17306/J.JARD.2023.01473

Journal of Agribusiness and Rural Development

pISSN 1899-5241
eISSN 1899-5772

1(67) 2023, 79–92
Accepted for print: 14.03.2023

ANALYSING CONTRIBUTION AND DETERMINANTS OF INDIGENOUS LEAFY VEGETABLES (ILVS) TO HOUSEHOLD INCOME OF RURAL HOUSEHOLDS IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

Anele Mayekiso✉, Abenet Belete, Jan Hlongwane

University of Limpopo, South Africa

Abstract. This study aimed to analyse the determinants of Indigenous Leafy Vegetables (ILVs) and their contribution to the household income of rural households in the Eastern Cape Province, South Africa. The study covered three district municipalities within the province. Multistage Sampling and Proportional Random Sampling techniques were used to select rural households, with the household heads as the unit of analysis. A sample size of 407 households was considered for the study and a questionnaire was used to collect data. Regression estimates discovered that the amount spent on ILV production and the price of ILV per kg positively influence the income generated from ILVs.

Keywords: Eastern Cape Province, gross margin, household income, multiple linear regression

INTRODUCTION

Indigenous leafy vegetables (ILVs) are given many names by researchers, for instance, Neugart et al. (2017) refer to them as African leafy vegetables, while Essack et al. (2017) refer to them as traditional leafy vegetables (TLVs). On the other hand, Kansiime et al. (2018) describe these vegetables as African indigenous vegetables (AIVs). Van der Hoeven et al. (2013) explain that many rural households have used ILVs as a major source of food in recent years. However, the existence of commercial/conventional vegetables has caused lower production and consumption of ILVs, which has led to changes in the dietary patterns of many rural households (Van der Hoeven et al., 2013). Furthermore, Seeiso and Materecha (2014) claim that in South Africa, ILVs are underutilised and have received little attention from stakeholders in the fight against malnutrition and to improve food security. Although there has been notable use of ILVs for their nutritional value in recent years, Seeiso and Materecha (2014) further argue that these vegetables are not extensively produced and consumed on a large scale compared to conventional vegetables in South Africa. This could be a result of the fact that the production of ILVs is highly influenced by taste, preferences, and the high production of commercial vegetables, amongst other things (Mayekiso, 2016). On the other hand, the consumption patterns of ILVs in many rural communities globally and in South Africa are highly inconsistent and are subjected to factors such as poverty status, degree of urbanisation, distance to fresh produce markets and season (Mbhenyane, 2017).

Although ILVs have been found to be good as conventional vegetables that provide essential nutrients to sustain human health (Van der Hoeven et al., 2013), the production of these vegetables is limited to specific communities of the Limpopo and KwaZulu-Natal provinces in South Africa, with inferior production in

✉Anele Mayekiso, Department of Agricultural Economics and Animal Production, University of Limpopo, Sovenga, South Africa, e-mail: anelemayekiso@ymail.com, https://orcid.org/0000-0002-9969-262X

some districts of the Eastern Cape Province (Uusiku et al., 2010; Mayekiso et al., 2017). This trend seems to be continuous even now since there is a notable decline in the production of ILVs, particularly in rural settings (Maseko et al., 2017; Nyaruwata, 2019). This could be one reason why ILVs have been largely overlooked by commercial farming, research, and development, meaning that ILVs are less competitive than commercial vegetables, and that these vegetables are gradually losing their diversity and the associated traditional knowledge (Mbhenyane, 2017). Mbhenyane (2017) further contends that regardless of the value of ILVs, these vegetables and their resulting food products are omitted from official statistics on economic values of natural resources.

In light of the information provided above, it has been noted that the consumption and cultivation of ILVs has significant potential to improve food security and boost income generation in households, particularly those in rural communities (Mungofa et al., 2018). Shonshai (2016) further explains that the contribution of ILVs in relation to income generation should not be underrated. This could be one reason why most households have constant income benefit from the sales of ILVs which may cover costs such as hospital bills and educational fees (Shonshai, 2016). In addition, Mulaudzi et al. (2019) have pointed out that there is currently a growing interest and awareness of ILVs due to their nutritional benefits and massive potential to generate farm incomes. The study by Mulaudzi focused on analysing the technical efficiency of AIV production in the Vhembe district of Limpopo province, South Africa. Regardless of the economic recognition observed from the production of ILVs, there are various factors which may inhibit households from benefiting from the marketing of ILVs. These factors include ILV production along the supply chains of value addition (Senyolo et al., 2018; Mulaudzi et al., 2019).

Different ILVs are popularly used to generate income within African countries such as South Africa, Kenya, Zimbabwe, Ethiopia, and Nigeria, to mention but a few. These vegetables include *C. olitorius* (jute mallow), Amaranthus *cruentus* (pigweed), *Citrullus lanatus* (bitter melon), *Vigna unguiculata* (cowpea), *Cleome gynandra* (spider plant), *Cucurbita* spp. (pumpkin), *Brassica rapasubsp*, and *Chinensis* (Chinese cabbage) (Wemali, 2015). Amaranth is also one of the most commonly grown ILVs in South Africa (Wemali, 2015). Shonshai (2016) further emphasises that various studies in South Africa have indicated that ILVs play a dual role. Firstly, they provide money to poor households and, secondly, households that sell these vegetables can also save money by consuming ILVs rather than purchasing exotic vegetables.

With the given background information, only inferior research has been conducted at both local and international levels concerning the contribution of ILVs to household income and the income of rural farmers. The available information about ILVs mainly focuses on production, marketing, consumption, value addition, and perception, amongst others. Regarding relatable available reviews, Mahlangu et al. (2021) state that indigenous vegetables, in alignment with their high nutritional value and hardy attributes, could offer potential trade opportunities for rural farmers and households in South Africa. This is because there is a functional market that can be explored for ILVs, particularly with the growing demand for high nutritional value food in the country. On the other hand, Nyaruwata (2019) conducted a study on the contribution of selected indigenous vegetables to household income and food availability in the Wedza District of Zimbabwe. The study concludes that ILVs can be a possible source of reliable income, and reliability can only be observed when the production, commercialisation, and consumption of these vegetables is not overlooked by many stakeholders, including rural households and farmers (Nyaruwata, 2019).

For further elaboration, ILVs are an essential part of the diet in many Sub-Saharan African (SSA) countries. This is because previous reviews have indicated that the market for these vegetables will continue to grow (Ngugi et al., 2006; Pichop et al., 2016; Rampa and Knaepen, 2019). For example, in Nairobi, approximately 30% of all vegetables sold are ILVs grown around the city (Bokelmann et al., 2022). In addition, low capital requirements for entry enable even the poorest households and farmers to participate in the production and marketing of ILVs (Weinberger et al., 2011). Recently, Vivas et al. (2022) stated that ILVs have remained underutilised despite their potential benefits in Sub-Saharan African countries, although the demand for these vegetables is currently growing due to a recognition of their contribution to employment and incomes. In addition, several studies, including ethnobotanical ones, have shown that indigenous vegetables continue to play an essential role in the livelihoods of rural communities, particularly on the African continent, including in South Africa (Chivenge et al., 2015; Mabhaudhi et al., 2019; Mashile et al., 2019).

Recently, ILVs have been acknowledged for their commercial value by many reviews, and these vegetables are now facing a sudden strong market demand (Gido et al., 2016; Mahlangu et al., 2021; Vivas et al., 2022). To be precise, seed companies are beginning to explore and develop ILVs and their products, thus establishing the formal seed sector for ILVs, particularly within the African continent (Gido et al., 2016). If the demand for ILVs and their products suffices, this may also improve the livelihoods of rural households and farmers. Thus far, lower participation in the production and marketing of ILVs has inhibited the benefits from ILV sales that could be vital to households and farmers through income generation. Hence, this study aimed to analyse the determinants of indigenous leafy vegetables (ILVs) and their contributions to household income in rural households in the Eastern Cape Province (ECP), South Africa, by addressing the following objectives:

1. To identify and describe the socioeconomic characteristics of rural households in ECP.
2. To identify and describe the ILVs grown by rural households in the ECP.
3. To estimate the contribution of ILVs to the household income of rural households in ECP.
4. To determine factors influencing the income generated from the ILV sales of rural households in ECP.

MATERIALS AND METHODS

The study area and justification for the selection of the study area

The study was conducted in the Eastern Cape Province (ECP) of South Africa, which is classified as the second largest province in the country. It is located in the south-eastern part of South Africa. According to ECDC (2018), the ECP is divided into six district municipalities, namely OR Tambo, Alfred Nzo, Chris Hani, Amatole, Joe Gqabi, and Sarah Baartman, as well as two metropoles of Nelson Mandela Bay and Buffalo City, and has a population of about 7 million. In 2004, the South African Department of Agriculture informed people that many in the province depended mainly on the land and its natural resources, which include ILVs to supplement their household needs, and this tendency does not seem to have changed, even now (ECDC, 2018). The study focused on three district municipalities within the province, including OR Tambo (OTRDM), Alfred Nzo (ANDM), and Joe Gqabi (JGDM). These three district municipalities were selected because the ECDC (2018) reported that these three district municipalities are among the districts that are affected by poverty and food insecurity within the province. These districts are also rich in several ILVs which could assist households and individuals in sustaining their livelihoods.

Data collection methods

Every local municipality within the three selected district municipalities was considered for the study. The ORTDM consists of five local municipalities, with ANDM covering four, and JGDM three, making a total of 12 local municipalities within these three district municipalities. The study employed Multistage Sampling (MSS) and Proportional Random Sampling (PRS) techniques to select rural households, with household heads as the unit of analysis. The MSS is used to divide a large population into groups to make the sampling process more practical. A combination of stratified sampling or cluster sampling and simple random sampling is usually used when employing the MSS procedure (Statistics handbook, 2018). For this study, the first stage divided the ECP population into its six district municipalities and its two metros. From the three district municipalities, those where ILVs are mostly grown were selected for the purpose of the study, thus making the second stage of dividing the large population of the ECP. The third stage divided the three district Municipalities into their local municipalities and ward areas. A PRS was used up to the household level to select the households to participate in the study. This means that ward areas that are classified as rural were used to select the households for the study.

For consideration of the sample size for the study, the ORTDM has five local municipalities with 248,075 rural households, ANDM has four local municipalities with 107,102 rural households, and JGDM has three local municipalities with 31,402 rural households. To calculate the sample size, the following formula (according to Kothari, 2004) was used:

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2(N-1) + z^2 \cdot p \cdot q} \quad (1)$$

where:

n – desired sample size,

z – value of standard deviation at 95% confidence level (in this case 1.96),
e – desired level of precision (±5%),
p – sample proportion in target population,
$q - 1 - p$,
N – size of population.

This gave a total sample size of 407 households for the study, comprising 136 households in each of the ORTDM and ANDM districts respectively, and 135 households in JGDM. From the sample size, a proportional random sampling technique was used to select the households to participate in the study in each local municipality.

Data analysis tools

To address the first objective (identifying and describing socioeconomic characteristics of households) and the second objective (identifying and describing the ILVs grown in the study areas) of the study, descriptive statistics were used in the form of percentages, frequencies, means, and standard deviations. To estimate the contribution of ILVs to household income, a gross margin analysis was used. For the study, a gross margin analysis modelled the costs and returns of ILVs per production cycle. This means that a physical amount of each ILV (per kilogram) was multiplied by the unit price of ILV sold to estimate the returns.

The total revenue (TR), which is equivalent to the gross income from each ILV, was calculated as:

$$TR_i = P_i \times Q_i \quad (2)$$

where:
P_i – is the farmgate price of ILVs,
Q_i – is the total amount produced for each ILV.

Total variable cost (TVC) was calculated using the following expression:

$$TVC = \sum_{i=1}^{2}(K + S + L) \quad (3)$$

where:
K – is fertiliser expenditure,
S – is total expenditure on seeds/seedlings,
L – is total labour expenditure in ILVs.

The gross margin analysis of selling ILVs was expressed as:

$$GM = TR - TVC \quad (4)$$

where:
GM – is gross margin,
TR – is total revenue,
TVC – is total variable cost, as gross margin analysis considers only variable costs.

To determine the factors influencing the income generated from the sales of ILVs by households, a multiple linear regression model was used. This model was used to estimate the association between the socio-economic characteristics of the households and related factors linked to income generated from ILVs by the households. According to Bremer (2012), a multiple linear regression model is an extension of a simple linear regression model and is used to measure the association between two or more independent variables and a single continuous dependent variable. For this study, the gross income obtained by each household from selling ILVs was treated as a continuous dependent variable and regressed against explanatory variables, as shown in Table 1.

The multiple linear regression equation is as follows:

A multiple linear regression model can be expressed as follows (Bremer, 2012):

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \beta_{13}X_{13} \quad (5)$$

where:
Y – income generated from ILV sales,
β_0 – intercept term,
β_1 to β_{13} – regression coefficients,
X_1 – age of household head,
X_2 – gender of household head,
X_3 – education level of household head,
X_4 – household size,
X_5 – farm income per month,
X_6 – employment status of household head,
X_7 – size of land for production of ILVs,
X_8 – quantity of produce marketed,
X_9 – hiring of labour,
X_{10} – irrigation of ILVs,
X_{11} – seasonal production of ILVs,
X_{12} – costs of production per season,
X_{13} – price of ILVs per kg.

RESULTS AND DISCUSSION

This section gives a detailed description of the observed results for the socioeconomic characteristics of the

Table 1. Description of the hypothesized variables specified in the multiple linear regression model

Dependent variable	Description of variable	Anticipated sign
Y = Income generated from ILVs sales (ZAR)	Continuous	
Explanatory variables		
X_1 = Age	Actual age of a household head (years)	+
X_2 = Gender of a household head	Dummy: 0 – male; 1 – female	+/–
X_3 = Education level for a household head	Categorical: 0 – never went to school; 1 – primary education; 2 – secondary education; 3 – tertiary education	+/–
X_4 = Household size	Actual size of household members (numbers)	+/–
X_5 = Farm income per month	Actual income earned (ZAR)	+
X_6 = Employment status of a household head	Dummy: 0 – employed; 1 – otherwise	+/–
X_7 = Size of land for ILVs' production	Actual size of land (hectares)	+/–
X_8 = Quantity of produce marketed	Amount sent for marketing purposes in kilograms (continuous variable)	+/–
X_9 = Hiring of labour	Dummy: 0 – hire labour; 1 – otherwise	+/–
X_{10} = Irrigate ILVs	Dummy: 0 – irrigate ILVs; 1 – otherwise	+
X_{11} = Seasonal production of ILVs	Dummy: 0 – production of ILVs is seasonal; 1 – otherwise	+/–
X_{12} = Costs of production per season	Cost of production in ZAR (continuous variable)	+/–
X_{13} = Price of ILVs per kilogram	Selling price of ILVs in ZAR (continuous variable)	+/–

Source: own compilation, 2021.

households in ORTDM, ANDM, and JGDM. The section also provides a description of the ILVs grown and produced based on the observed results from ORTDM, ANDM, and JGDM respectively.

Socioeconomic characteristics of the households

When comparing the three district municipalities in terms of age, both the oldest and youngest respondents were recorded at ORTDM, as indicated in Table 2. Regarding the household size, the descriptive results revealed that, from the three district municipalities, ORTDM has the largest number of household members, as shown in Table 2. This could be why ORTDM is described as the largest district municipality in the ECP (ECDC, 2018). The descriptive results indicate that women dominate in the sampled households in all the three district municipalities regarding the production of ILVs. Maseko et al. (2017) also share similar findings, stating that the availability of ILVs depends on the means of collection rather than cultivation, and women commonly collect ILVs. With reference to the level of education in the three district municipalities, the results revealed that most household heads who are participating in the production of ILVs are educated up to primary level education in all the districts. However, ORTDM recorded the highest number of household heads holding tertiary level education.

Concerning farm income generated by the households, in all three districts, the majority of households are not earning adequate farm income. Those households that earn farm income focus more on exotic vegetable production and livestock farming. As stated by the households, this is because these two enterprises seem to generate more income than ILVs. Regarding the employment status of the household heads, the descriptive results revealed that in all three district municipalities, the household heads are unemployed, with ANDM having the highest unemployment rate. Regarding the production status of ILVs, the descriptive results

Table 2. Descriptive statistics of socioeconomic characteristics in ORTDM, ANDM, and JGDM

	ORTDM, ANDM & JGDM	ORTDM	ANDM	JGDM
Variable	Age	Household size	Household size	Household size
N	136	136	136	135
Mean	52, 51 & 53	7	7	7
Std deviation	14, 13 & 12	3	2	2
Minimum	21, 28 & 27	3	3	3
Maximum	78, 77 & 76	15	14	13
Index	Outcome	Percentage (%)	Percentage (%)	Percentage (%)
Gender	Male	36.2%	42%	42.3%
	Female	63.8%	58%	57.7%
Level of education	Never went to school	28.3%	23.2%	17.5%
	Primary education	46.4%	54.3%	48.9%
	Secondary education	16.7%	18.1%	29.2%
	Tertiary education	8.7%	4.3%	4.4%
Farm income	No income	43.5%	67.4%	56.9%
	R1000-R3000	14.5%	5.8%	3.6%
	Income from exotic vegetable sales	15.2%	7.2%	10.2%
	Income from livestock sales	3.6%	1.4%	2.2%
	>R3000	23.2%	18.1%	27%
Employment status	Employed	27.5%	23.9%	29.2%
	Unemployed	72.5%	76.1%	70.8%
ILVs production status	Produce ILVs.	63.8%	61.3%	64.2%
	Do not produce ILVs	36.2%	38.7%	35.8%
Size of land for ILV production	0.1 ha to 0.5ha	52.8%	57.4%	56.2%
	0.6ha to 2ha	11.6%	3.7%	8.8%
	Exotic vegetable production land size	35.5%	38.8%	35%
Reasons for not producing	Do not eat ILVs	32.7%	37.7%	27.1%
	ILVs grow naturally	63.3%	62.3%	72.9%
	Old to participate in ILV farming	4.1%		
Source of seedlings/seeds	Purchase ILVs seeds	1.1%	57.6%	1.1%
	Harvest seeds freely	51.7%	42.4%	41.6%
	Purchase and harvest seeds	47.2%		57.3%
Irrigation of ILVs	Irrigate ILVs	16.9%	18.8%	14.6%
	Do not irrigate ILVs	83.1%	81.2%	85.4%
Sources of water	Community tap	81.2%	13%	46.2%
	Community taps and river	12.5%	53.8%	23.1%
	Community taps and dam	6.3%	33.2%	30.8%
Reasons for not irrigating	Require no irrigation	46.6%	43.3%	43.1%
	Rain feed is enough to grow ILVs	50.7%	56.7%	55.6%
	Scarcity of water	2.7%	–	1.4%

Source: research survey, 2019.

revealed a higher production of ILVs in all three district municipalities, with an observed higher production rate in JGDM. When it comes to land size for production of ILVs in the three district municipalities, the descriptive results established that most of the arable land is used for exotic vegetable production, with many households producing ILVs from less than 0.5 ha. For the households that are not producing ILVs, the descriptive results established that, in most cases, in all three district municipalities, ILVs grow naturally, with JGDM recording the largest amount of ILVs growing naturally.

Regarding the source of seeds/seedlings, the descriptive results revealed that in ORTDM and ANDM, harvesting seeds/seedlings from the wild or home gardens is the major source for acquiring seeds/seedlings. The results also revealed that in JGDM, producers rely highly on both purchasing and harvesting of ILVs seeds/seedlings. Concerning the irrigation of ILVs, the descriptive results in Table 2 show that in all three district municipalities, producers do not usually irrigate ILVs. For households that irrigate ILVs, the results revealed that, in ORTDM and JGDM, producers depend highly on community taps to irrigate ILVs, while in ANDM, most producers rely mostly on community taps and dams to irrigate ILVs. For producers that do not irrigate ILVs, the descriptive results explain that in the three districts, the major reason for not irrigating ILVs is that rainwater is enough to grow these vegetables.

ILVs grown in ECP

This section gives details on ILVs grown within the selected districts of the Eastern Cape Province. The details are provided by ranking the ILVs grown the most to those grown the least in the selected district municipalities of ECP.

Within the 18 ILVs which are produced in ORTDM, the ILVs that are commonly grown are Amaranth, which is the most highly produced vegetable, and Chinese cabbage, Melon leaves, and *Physalis peruviana* L., *Caudatus* L., which are the least produced ILVs, as shown in Table 3. The ILVs produced in the district are ranked in a list, with number one on the list presenting the most highly produced ILV and the last vegetables on the list representing the least highly produced ILVs in the district. For ANDM, Table 3 shows that there are 18 ILVs which are produced in the district. Of these ILVs, Amaranth is the most highly produced vegetable in the district, as is indicated in the table, with Chinese cabbage

Table 3. Indigenous leafy vegetables produced in ORTDM, ANDM and JGDM

Indigenous leafy vegetables	Number of times mentioned	Rank
ORTDM		
Amaranth	84	1
Nightshade, Blackjack	64	2
Pumpkin leaves	41	3
Sonchus asper L. *(Irwabe*)	23	4
Common sow thistle (*Ihlaba*)	21	5
Lambs quarter, Hog plum (*Iyeye*)	18	6
Turnip	13	7
Pigweed	6	8
Sweet potato leaves, *Coriacea Nannfd., Laportea peduncularis*	5	9
Spider plant	2	10
Chinese cabbage, Melon leaves, *Physalis peruviana* L., *Caudatus* L.	1	11
ANDM		
Amaranth	83	1
Nightshade	68	2
Blackjack	43	3
Pumpkin leaves	41	4
Physalis peruviana L.	28	5
Hog plum	23	6
Lambs quarter	20	7
Common sow thistle	17	8
Sweet potato leaves	12	9
Sonchus asper L., *Coriacea Nannfd.*	9	10
Turnip	7	11
Laportea peduncularis	6	12
Cucurbitaceae, Caudatus L.	3	13
Tomato leaves, Pigweed	2	14
Chinese cabbage	1	15
JGDM		
Amaranth	86	1
Nightshade	78	2
Blackjack	55	3
Pumpkin leaves	49	4
Lambs quarter	34	5
Caudatus L.	13	6
Sweet potato leaves	11	7
Turnip	6	8
Pigweed	3	9
Laportea peduncularis	1	10

Source: research survey, 2019.

being the least highly produced ILV in the district. For JGDM, there are 10 ILVs that are commonly grown, as shown in Table 3, and these vegetables are ranked in a list in the table. From the ILVs produced within the district, Table 3 shows that Amaranth is the most highly produced vegetable, with *Laportea peduncularis* being the least highly produced ILV in the district.

Contribution of ILVs to household income

To estimate the income generated from ILVs, a gross margin analysis was used, and the analyses for gross margin and total revenues for ORTDM, ANDM, and JGDM are shown in Table 4. The gross margin was measured per production season as descriptive results observed that many producers are cultivating ILVs on less than one hectare of land, so it was difficult to express gross margin per hectare.

The gross margin analysis revealed that the highest returns per Rand invested in ORTDM are obtained from Amaranth, Nightshade, Lambs' quarter, Pumpkin leaves, Melon leaves, and Blackjack. Amaranth, Nightshade, and Chinese Cabbage are the ILVs observed to have higher returns per Rand invested in ANDM. In JGDM, Amaranth and *Caudatus* L. are noted to have higher returns per Rand invested. In light of the observed results, Amaranth is the ILV which was found

Table 4. Gross margin of ILV marketing per production season in ORTDM, ANDM, and JGDM

ILVs	TVC ZAR	TR ZAR	Gross margin	RRI (GM/TVC)
	per production season			
1	2	3	4	5
Grown in ORTDM				
Amaranth	R 23 545	R 131 438	R 107 839	4.58*
Nightshade	R 4 050	R 49 800	R 45 750	11.29*
Lambs quarter	R 4 800	R 39 000	R 34 200	7.12*
Turnip	R 15 500	R 42 000	R 26 500	1.70
Sonchus asper L.	R 1 800	R 4 375	R 2 575	1.43
Pumpkin leaves	R 15 500	R 136 125	R 120 625	7.78*
Pigweed	R 900	R 2 450	R 1 550	1.72
Common sow thistle	R 150	R 350	R 200	1.33
Laportea peduncularis	R 450	R 1 750	R 1 300	2.88
Melon leaves	R 250	R 1 500	R 1 250	5.00*
Sweet potato leaves	R 5 450	R 15 000	R 9 550	1.75
Hog Plum	R 1 800	R 7 400	R 5 600	3.11
Blackjack	R 150	R 850	R 700	4.66*
Coriacea Nannfd.	R 200	R 700	R 500	2.50
Chinese cabbage	R 750	R 1 500	R 750	1.00
Grown in ANDM				
Pumpkin leaves	R 45 000	R 124 875	R 79 875	1.77
Nightshade	R 24 000	R 148 500	R 124 500	5.18*
Hog Plum	R 7 200	R 27 000	R 19 800	2.75
Sweet potato leaves	R 34 020	R 66 750	R 32 730	0.96

Table 4 – cont.

1	2	3	4	5
Amaranth	R 30 000	R 222 000	R 192 000	6.40*
Lambs quarter	R 3 080	R 14 000	R 10 920	3.54
Blackjack	R 100	R 350	R 200	2.00
Coriacea Nannfd.	R 1 200	R 3 850	R 2 650	2.20
Tomato leaves	R 600	R 1 500	R 900	1.50
Pigweed	R 1050	R 2 100	R 1 050	1.00
Caudatus L.	R 1200	R 2 450	R 1 250	1.04
Common sow thistle	R 150	R 350	R 200	1.33
Cucurbitaceae	R 600	R 1750	R 1 150	1.91
Physcalis peruviana L.	R 4050	R 17 250	R 13 200	3.25
Sonchus asper L.	R 600	R 2 100	R 1 500	2.50
Laportea peduncularis	R 1050	R 3 150	R 2 100	2.00
Chinese cabbage	R 670	R 4 500	R 3 830	5.71*
Turnip	R 13 900	R 31 500	R 17 600	1.26
ILVs grown in JGDM				
Amaranth	R 30 000	R 208 500	R 178 500	5.95*
Nightshade	R 37 405	R 103 000	R 65 595	1.75
Pumpkin leaves	R 101 050	R 228 000	126 950	1.25
Turnip	R 8 000	R 18 000	R 10 000	1.25
Sweet potato leaves	R 21 000	R 46 500	R 25 500	1.21
Lambs quarter	R 20 090	R 49 500	R 29 410	1.46
Pigweed	R 200	R 500	R 300	1.50
Laportea peduncularis	R 150	R 500	R 500	3.33
Caudatus L.	R 1050	R 7 500	R 6 450	6.14*

TVC – total variable costs, TR – total revenue, GM – gross margin, RRI – returns per rand invested. *Denotes higher RRI (> 4.00).
Source: research survey, 2019.

to have high returns in all three district municipalities. This could be explained by the higher demand for this vegetable leading to larger amounts being produced, ultimately triggering higher returns. Again, the higher return observed for Amaranth indicates efficiency in the production of this vegetable, which has the potential to generate income for households.

In addition, in ORTDM, Chinese Cabbage had fewer returns per Rand invested. This could be because of the low demand for this vegetable within the district or possibly the lower production due to the poor resistance of this vegetable to disease and some weather conditions, which therefore prompts inconsistent supply and consequently triggers lower returns. Sweet potato leaves had a minimal return per Rand invested in ANDM and JGDM. The reason for this may be that this vegetable does not grow in large amounts in ANDM and JGDM, which therefore limits its availability. The limited availability of sweet potato leaves may therefore result in a lower demand, hence less returns are realised in comparison with other ILVs sold within the districts.

Determinants of income generated from ILV sales

For determining factors influencing the income generated from ILV sales by rural households in ECP, a multiple linear regression model was used. The estimated results are presented in Table 5. The independent variables that were quantified included socioeconomic and other factors related to the marketing of ILVs. For all the independent variables with a positive coefficient, this means that as any of these variables increases, so does the income from ILV sales, as is indicated in Table 5. For the independent variables with a negative coefficient, it implies that as these variables increase, the income generated from ILVs decreases.

The amount spent on ILV production was found to be positively significant at a 1% level in ORTDM and a 5% level in ANDM, as shown in Table 5. This implies that, as household farmers invest more in ILV production,

Table 5. Factors influencing income generated from ILV sales in the Eastern Cape Province

Variables	B	Std. Error	*T* statistics	Sig.
1	2	3	4	5
ORTDM				
Constant		4.592	–.231	.819
Gender	–.163	1.200	–1.057	.301
Age	.154	4.211	1.012	.322
Education	–.037	7.572	–.241	.811
Household size	–.132	1.805	–.974	.340
Farm income	.025	3.910	.190	.851
Employment status	–.362	1.554	–2.401	.024**
Hiring of labour	.133	1.961	.940	.357
Amount spent on ILV production	.502	.955	3.773	.001***
Irrigation of ILVs	.065	1.068	.474	.640
Seasonal production of ILVs	.199	1.356	1.508	.145
Price of ILV per kg	.315	2.093	2.194	.038**
F value – 4.64, *R* square – 0.680, adjusted *R* square – 0.533, observations – 136.				
ANDM				
Constant		3.888	–.280	.782
Gender	–.184	1.230	–1.339	.195
Education	–.142	8.431	–.990	.334
Household size	.118	2.114	.867	.396
Farm income	.093	4.174	.736	.470
Employment	.016	1.390	.115	.909
Amount spent on ILV production	.305	.843	2.099	.048**
Seasonal production of ILVs	.245	1.141	1.786	.088*
Price of ILV per kg	.377	2.164	2.547	.019**
F value – 6.83, *R* square – 0.723, adjusted *R* square – 0.617, observations – 136.				

Table 5 – cont.

1	2	3	4	5
JGDM				
Constant		1.817	.633	.536
Gender	–.362	1.745	–1.571	.137
Education	.142	1.555	.614	.548
Household size	–.557	4.816	–2.513	.024**
Farm income	–.151	3.035	–.766	.455
Employment	.213	2.010	.894	.385
Amount spent on ILV production	.084	2.279	.331	.745
Price of ILV per kg	.477	2.505	2.421	.029**
Age	.130	8.398	.451	.659
Irrigation of ILVs	.051	2.027	.204	.841
Seasonal production of ILVs	–.296	1.921	–1.248	.231

F value – 2.09, *R* square 0.583, adjusted *R* square – 0.503, observations – 135.
***, ** and * indicate significance levels at 1%, 5%, and 10% respectively.
Source: research survey, 2019.

there is a higher likelihood of increased income from ILV sales. Up to this point, there few if any previous reviews linking the money invested in ILV production with income generation. Again, in ORTDM, employment status had a negative coefficient and was statistically significant at a 5% level. These results could mean that as the number of employed members increases in a household, there is the possibility of decreased income from ILVs. The reason for this could be that household members are likely to participate less in ILV production due to time spent at work, thus triggering inferior production output and ultimately lowering sales. Similarly, Khoza et al. (2019) argue that livelihoods in rural areas are strongly affected by household socioeconomic factors, which in turn influence the economic behaviour within households, thus affecting market participation decisions.

In ANDM, seasonal production of ILVs was statistically significant at a 10% level with a positive coefficient. These results could be explained by the fact that, as ILVs become available on a seasonal basis, there is a higher chance of increased income from ILV sales. This can be further explained by the fact that producers possibly increase prices of ILVs when it is not the season to grow these vegetables, therefore resulting in greater revenues due to higher demand. Mahlangu et al. (2021) also report that the demand for ILVs has the potential to be an essential income stream, especially for rural households.

Regarding the price of ILVs per kg, this variable was statistically significant at a 5% level, with a positive coefficient in all three district municipalities (ORTDM, ANDM, and JGDM). These results reveal that, as the price of ILVs increases per kg, there is a greater possibility of income generated from ILV sales to increase. Lastly, in JGDM, regression estimates confirmed a negative relationship at a 5% level between household size and income generated from ILVs. This implies that, as the number of household members increases, there is a likelihood of decreased income from ILV sales. Mahlangu et al. (2021) also observed similar comparable findings that most ILV producers set their prices based on the market price, with few setting their prices as uttered by buyers, and this is likely to lead to lower income generated. However, producers seemed not to have a problem with the pricing strategy as they managed to sell larger quantities of these vegetables. This means that, regardless of the pricing strategy used, producers can still generate income from ILVs to supplement the family income and provide for the basic needs of the household (Mahlangu et al., 2021).

CONCLUSION

This study concludes that there is high dominance of women in both the production and marketing systems of ILVs, with most of these producers having completed primary education. Sellers generate income greater than R3000 per production season where most ILV producers and sellers are classified as unemployed. Producers produce ILVs from a land size ranging between 0.1 and 2 hectares of land since these vegetables are commonly grown in all three district municipalities covered by the study. All three district municipalities covered in the study either purchase seeds of ILVs or harvest the seeds from home gardens and open fields. In all three district municipalities, ILVs are generally not irrigated since rainwater is sufficient to grow these vegetables.

The study further concludes that in ORTDM, ILVs such as Amaranth, Nightshade, Lambs' Quarter, Pumpkin leaves, Melon leaves, and Blackjack have the potential to contribute significantly to household income. In addition, in ANDM, Nightshade, Amaranth, and Chinese cabbage show the potential to contribute towards household incomes in the district, while in JGDM, Amaranth and *Caudatus* L. show a positive contribution towards income generated from ILV sales. In addition, regression estimates confirmed that, in all three district municipalities covered by the study, the price of ILV per kg has a positive influence on the income generated from ILVs. Again, in ORTDM and ANDM, the amount spent on ILV production has a positive influence on the income generated from ILVs. In ORTDM, the employment status of the household head negatively influences the income generated from ILVs, while in JGDM, household size negatively influences the income generated from ILVs. Lastly, in ANDM, seasonal production of ILVs positively influences the income generated from ILVs.

POLICY RECOMMENDATIONS

The Department of Agriculture in the Eastern Cape Province should empower women with training and workshops on the production of ILVs for improved participation in ILV production because women are found to dominate in both the production and marketing systems of ILVs. This can lead to improved production output and ultimately attract larger markets for ILVs. For this to be successful, stakeholders involved in the food production system in South Africa should also strengthen the policy for ILVs as a valid food source and source of income. Indigenous Leafy Vegetables like Amaranth, Pumpkin leaves, and Nightshade seem to be dominant and highly produced ILVs, this means that improved investment from the department of agriculture could be vital. This can be done by improving both the production value chain and marketing channels for ILVs where government officials disseminate information to both producers and sellers of ILVs about standard procedures which can guide producers to not only sell ILVs at informal markets but to participate at formal markets as well. In addition, the Department of Agriculture should offer workshops to ILV producers on understanding the nature of marketing since the price of ILV per kg and the amount invested in ILV production seem to influence revenues in a positive way. This may assist producers to be innovative in pricing and marketing strategies or even to adopt pricing and marketing strategies which are commonly used with agricultural commodities so as to have a larger market gain for ILVs. Lastly, further research should look at the ILV production value and marketing channels as it is acknowledged that these areas of research are weaker throughout the South African Provinces.

ACKNOWLEDGEMENTS

A special thanks to the National Research Foundation (NRF) for funding the study and the communities of the Eastern Cape Province, South Africa, for sharing their knowledge concerning the subject of the study.

REFERENCES

Bokelmann, W., Huyskens-Keil, S., Ferenczi, Z., Stöber, S. (2022). The role of indigenous vegetables to improve food and nutrition security: Experiences from the project HORTINLEA in Kenya (2014–2018). Front. Sustain. Food Syst., 6, 806420.

Bremer, M. (2012). Multiple linear regression: Math 261 lecture. Wollongong, Australia: Wollongong University.

Chivenge, P., Mabhaudhi, T., Modi, A.T., Mafongoya, P. (2015). The potential role of neglected and underutilised crop species as future crops under water scarce conditions in Sub-Saharan Africa. Int. J. Env. Res. Public Health, 12, 5685–5711.

ECDC (Eastern Cape Development Corporation). (2018). Spatial and rural development review report. Retrieved May 14th 2019 from: http://www.ecdc.co.za

Essack, H., Odhav, B., Mellem, J.J. (2017). Screening of traditional south african leafy vegetables for specific anti-nutritional factors before and after processing. Food Sci. Technol. Retrieved from: https://doi.org/10.1590/1678-457x.20416

Gido, E.O., Bett, H.K., Bokelmann, W. (2016). Importance of African indigenous vegetables in food systems. Afr. J. Hortic. Sci., 10, 34–41.

Kansiime, M.K., Ochieng, J., Kessy, R., Karanja, D., Romney, D., Afari-Sefa, V. (2018). Changing knowledge and perceptions of African indigenous vegetables: The role of community-based nutritional outreach. Dev. Pract., 28(4), 480–493.

Khoza, T.M., Senyolo, G.M., Mmbengwa, V.M., Soundy, P. (2019). Socio-economic factors influencing smallholder farmers' decision to participate in agro-processing industry in Gauteng Province, South Africa. Cogent Soc. Sci., 5(1), 1664193.

Kothari, C.R. (2004). Research methodology: Methods and techniques (2nd revised ed). New Delhi: New Age International Publishers.

Mabhaudhi, T., Chibarabada, T.P., Chimonyo, V.G.P., Murugani, V.G., Pereira, L.M., Sobratee, N., Govender, L., Slotow, R., Modi, A.T. (2019). Mainstreaming underutilized indigenous and traditional crops into food systems: A South African perspective. Sustainability, 11, 172.

Mahlangu, S.A., Belete, A., Hlongwane, J.J., Luvhengo, U., Mazibuko, N. (2021). Identifying potential markets for African leafy vegetables: Case study of farming households in Limpopo Province, South Africa. Int. J. Agronom., 2020, 1–8.

Maseko, I., Mabhaudhi, T., Tesfay, S., Araya, H.T., Fezzehazion, M., Du Plooy, C.P. (2017). African leafy vegetables: A review of status, production and utilization in South Africa. Sustainability, 10, 1–16.

Mashile, S., Tshisikhawe, M., Masevhe, N. (2019). Indigenous fruit plants species of the Mapulana of Ehlanzeni district in Mpumalanga province, South Africa. South Afr. J. Bot., 122, 180–183.

Mayekiso, A. (2016). Production of indigenous leafy vegetables (ILVs) and their contribution to household food security: Evidence from Coffee Bay, Eastern Cape Province of South Africa. Masters Dissertation, University of Fort Hare.

Mayekiso, A., Taruvinga, A., Mushunje, A. (2017). Rural household food security status among indigenous leafy vegetable producers and non-producers: Evidence from Coffee Bay, South Africa. J. Adv. Agric. Technol., 4(2), 190–195.

Mbhenyane, X.G. (2017). Indigenous Foods and their Contribution to Nutrient Requirements. South Afr. J. Clin. Nutr., 30(4), 5–7.

Mulaudzi, V.S., Oyekale, A.S., Ndou, P. (2019). Technical efficiency of African indigenous vegetable production in Vhembe District of Limpopo Province, South Africa. Open Agric., 4, 778–786.

Mungofa, N., Malongane, F., Tabit, F.T. (2018). An exploration of the consumption, cultivation and trading of indigenous leafy vegetables in rural communities in the Greater Tubatse Local Municipality, Limpopo Province, South Africa. J. Consum. Sci., 3, 53–67.

Neugart, S., Baldermann, S., Ngwene, B., Wesonga, J. (2017). Indigenous leafy vegetables of Eastern Africa – A source of extraordinary secondary plant metabolites. Food Res. Int., 100, 411–422.

Ngugi, I.K., Gitau, R., Nyoro, J.K. (2006). Kenya access to high-value markets by smallholder farmers of African indigenous vegetables. London: IIED.

Nyaruwata, C. (2019). Contribution of selected indigenous vegetables to household income and food availability in Wedza District of Zimbabwe. Acta Sci. Agric., 3(3), 170–188.

Seeiso, M.T., Materecha, C.A. (2014). Biomass yields and crude protein content of two African ILVs in response to kraal manure application and leaf cutting management. Afr. J. of Agric. Res., 9 (3), 397–406.

Senyolo, G.M., Wale, E., Ortmann, G.F. (2018). Analysing the value chain for African leafy vegetables in Limpopo Province, South Africa. Cog. Soc. Sci., 4, 1–16.

Pichop, G.N., Abukutsa-Onyango, M., Noorani, A., Nono-Womdim, R. (2016). Importance of indigenous food crops in tropical Africa: case study. Acta Hortic., 1128, 315–322.

Rampa, F., Knaepen, H. (2019). Sustainable food systems through diversification and indigenous vegetables: An analysis of the Southern Nakuru County. Report I. Maastricht, Netherlands: European Centre for Development Policy Management (ECDPM).

Shonshai, V.F. (2016). Analysing South African indigenous knowledge policy and its alignment to government's attempts to promote indigenous vegetables. PhD Thesis., University of Kwa-Zulu Natal.

Statistics handbook (2018). An overview of statistical methods. Available from: https://unctad.org>tdstat43_en. Accessed: 19 November 2018.

Uusiku, N.P., Oelofse, A., Duodu, K.G., Bester, M.J., Faber, M. (2010). Nutritional value of leafy vegetables of Sub-Saharan Africa and their potential contribution to human health: A review. J. Food Compos. Anal., 23, 499–509.

Van der Hoeven, M., Osei, J., Greeff, M., Kruger, A., Faber, M., Smuts, C.M. (2013). Indigenous and traditional plants: South African parents' knowledge, perceptions and uses and their children's sensory acceptance. J. Ethnobiol. Ethnomed., 9(1), 78–89.

Vivas, J., Kim, M., Takagi, C., Kirimi, L. (2022). Adopting African indigenous vegetables: A dynamic panel analysis of smallholders in Kenya. J. Agric. Res. Econ. Retrieved from: https://dx.doi.org/10.22004/ag.econ.316750

Weinberger, K., Pasquini, M., Kasambula, P., Abukutsa-Onyango, M. (2011). Supply chains for indigenous vegetables in urban and peri-urban areas of Uganda and Kenya: a gendered perspective. In: D. Mithöfer (ed.), Vegetable production and marketing in Africa: Socio-economic research (pp. 169–181). Wallingford, Oxfordshire: CABI.

Wemali, E.N.C. (2015). Contribution of cultivated African indigenous vegetables to agrobiodiversity conservation and community livelihood in Mumias Sugar Belt, Kenya. PhD Thesis, Kenyatta University.