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Production and Commercialisation Potential of Indigenous Leafy Vegetables: Case Study of Capricorn District in the Limpopo Province, South Africa

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study analyses the production and commercialisation potential of indigenous leafy vegetables (ILV) in the Capricorn district in the Limpopo Province of South Africa. Specific objectives were to identify the socio-economic characteristics of ILVs producers in rural areas of Capricorn district, investigate constraints faced by farmers in commercialising ILVs in rural areas of Capricorn district, determine the productivity of indigenous leafy vegetables in rural areas of Capricorn district, and to assess different types of marketing channels of ILVs in rural areas of Capricorn district.
Study Design: The study used both qualitative and quantitative, cross-sectional data. The selection of ILV farmers within the study area was done using stratified random sampling procedure the strata being gender. Disproportionate random sampling procedure was used to select individual households.
Methodology: The study used Stochastic Frontier Production Function to determine the productivity and to assess the socio-economic characteristics of producers of Indigenous

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Leafy Vegetables. Bubble chart was also used to assess the marketing channels whilst consumer data was captured into a statistical package.
Results: ILV famer's significant socio-economic factors and production factors that constraint them from commercialising their products were found to be the amount of labor required, cost of hiring tractor service, land devoted to ILVs, gender, age, household size, farming experience, farm size, hired labour, primary occupation and land ownership. Results indicated that the productivity of ILVs in the study area varied among farmers; some farmers had a high productivity but most farmers had a low productivity.
Conclusion: There is a great potential for commercialising ILV but there is a lot of work to be done in assisting farmers, for them to be sustainable and exploitation of these crops.

Keywords: Indigenous leafy vegetables; commercialization; production; South Africa.

1. INTRODUCTION

Indigenous leafy vegetables are important to rural households as they play a vital role in their livelihoods. These crops are nutritious and available during harsh seasons. In Africa, indigenous leafy vegetables (ILVs) production, trade and consumption are expanding [1,2]. South Africans have been using indigenous leafy vegetables for long; these crops are mostly consumed by rural people and form an important part of their staple food. Different communities grow different species mainly for family consumption but little percentage of the produce reach the informal markets (it is the uncontrolled market/ black market) for income generation. However the production and marketing activities of these crops are in a smaller scale and mostly produced by resource-poor households.

ILVs are adaptable to local agro-ecological conditions. These vegetables allow resource poor households to produce food, since they require fewer inputs. However, ILVs are abundant during rainy seasons and mostly found growing in the wild, fallow land, or as weeds in cultivated areas. During the dry seasons, these crops are scarce or available only in limited amounts as processed dried products.

In South Africa indigenous leafy vegetables were not commercialised and most researchers did not pay much attention to do research on possibilities of commercialising ILVs despite their several values such as high micronutrient content, medicinal properties, several agronomic advantages [3,4]. These vegetables often seem to grow easily, resist pests and diseases, and palatable. Farmers have limited information on ILVs commercialisation potential, agronomic practices, postharvest handling, that assure availability of food all year round. Communities are also not aware of all the nutritional and health benefits that ILVs can provide. According to [5,6], it is evident that commercialisation of ILVs provide vulnerable citizens with food security and supplementary income. According to other studies ILVs have a great economic potential and are an instrument for rural development [7,8]. There is also an assumption that there is a market for ILVs, so it is essential to investigate the production and economic potential of commercialising indigenous leafy vegetables in South Africa.

The aim of the study was to analyse the production and commercialisation potential of indigenous leafy vegetables in the Capricorn district of Limpopo Province of South Africa. While the specific objectives were to identify the socio-economic characteristics of ILVs producers in the study areas, investigate constraints faced by farmers in commercialising ILVs, to determine the productivity of indigenous leafy vegetables in the study area and to assess different types of marketing channels of ILVs.

The study is of importance as it shows the production and the marketing of ILV crops. The commercialisation of these crops promises a great deal in rural development, as these regions are the custodians. The information generated will be useful to policy makers and farmers since it will outline the commercial potential of indigenous leafy vegetables. Policy makers will also be able to develop policies that improve the potential production of indigenous leafy vegetables.

1.1 Literature Review

Many African communities had depended on indigenous leafy vegetables for survival before introduction of exotic crops. The use of leafy vegetables during winter helps to address food shortages [3]. In remote rural areas the use of these types of leafy vegetables is still common with a decline in availability particularly in urban areas [9]. Production of ILVs is female oriented, and these vegetables are mostly produced for home consumption. Marketing of these products is very limited and the income generated supplement household income. ILVs are commonly intercropped with maize, and some are uncultivated just harvested from maize and fallow land [10]. According to [11] there is an increase in demand for ILVs in Tanzania, Botswana and Zambia. Indigenous vegetables that are consumed in Botswana are mostly imported from South Africa. The study also indicated that exotic vegetables demand high inputs for production and nutritional quality and yields are often low compared to indigenous vegetables of equal or better nutritional status could perform better under cultivation with relatively low input levels [6].

The commercialisation of Indigenous Vegetables in the African small family farms can play a key role in the value chain especially at international level [12]. According to [13] indigenous leafy vegetables could provide families with alternative sources of nutrients that are cheaper and easily accessible. These crops can help most household in rural areas, which have lower incomes, large families and female-headed households.

Stochastic frontier production model has the computational simplicity, it analyse the technical inefficiency effects. The model has an ability to examine the effects of various specific farm variables on technical efficiency in an econometrical consistent manner. The primary advantage of this technique is that it incorporates farm-specific factors in the estimation of the production frontier on the basis that these factors may have a direct impact on efficiency [14].

2. METHODOLOGY

2.1 Study Area and Data Collection

The study was conducted in the year 2012 in the Limpopo Province, one of South Africa's nine provinces situated in the Northern part of the Republic of South Africa. The province has a population of about 5.56 million, divided into five districts of Capricorn, Mopani, Sekhukhune, Vhembe and Waterberg. The study specifically focused at Capricorn district municipality which is located in the center of the Limpopo Province. The district is the core of the economic development of the province. Its population is approximately 1 409 354 [15], with 637communities [16]. The district has five local Municipalities, namely, Blouberg, Aganang, Molemole, Lepelle-Nkumpi and Polokwane. It is predominantly rural in nature and there are mainly Northern Sotho ethnic group.

The study used both qualitative and quantitative data. Primary data were collected through interviews using structured questionnaire. The secondary data was obtained through textbooks, internet and journals. The selection of ILV farmers within the study area was done using stratified random sampling procedure, the strata being gender. The list of ILVs producers was obtained from the district offices of Department of Agriculture of Limpopo Province. Disproportionate random sampling procedure was used to select shops. Elderly people were regarded as primary sources in the study, especially women. The sample size was sixty (60) households producing ILVs from rural areas with 54 being women and only 6 were men The 60 sample size was chosen as it is representative and unbiased.

2.2 Data Analysis

The study used Stochastic Frontier Production Function to determine the productivity and to assess the socio-economic characteristics of producers of Indigenous Leafy Vegetables. The Stochastic Frontier was engaged to overcome the limitations of the ordinary list square as it outline the measures of technical efficiency for each farmer in the sample. Bubble chart was used to assess the marketing channels. Microsoft Office Excel was also used as a complementary data analysis tool.

2.2.1 The theoretical model

2.2.1.1 Stochastic frontier production function

The model has been widely accepted and applied since its inception by [17]. The model was extended, suggesting that the technical inefficiency effects could be further expressed as a linear function of explanatory variables, reflecting farm-specific characteristics [14]. The model is able to represent the relationship of an output to input as this give an indication to the level of productivity. It decomposes the error term into a two-sided random error that captures the random effects outside the control of the farm and the one-sided efficiency component. The technique suit an agricultural production largely influenced by randomly exogenous shocks.

The model simultaneously estimates the individual technical efficiency of the respondent farmers as well as determinants of technical efficiency [14]. The stochastic frontier production function assumes the presence of technical inefficiency of production. The greater the amount by which the realized production falls short, the greater the level of technical inefficiency. The range of TE is 0 to 1. TE = 1 implies that the farm is producing on its production frontier and is said to be technically efficient.

Stochastic frontier production accommodates the catch in random variations, so that the measure is more consistent. The model incorporates a composed error structure with a two sided symmetric component and a one-sided component. The one-sided component reflects inefficiency, while the two sided error captures the random effects outside the control of the production unit, including measurement errors and other statistical noise typical of empirical relationships [18].

The FRONTIER software uses a three-step estimation method to obtain the final maximum-likelihood estimates. First, estimates of the parameters are obtained by Ordinary Least Square (OLS). A two-phase grid search for γ is conducted in the second step with estimates set to the OLS values and other parameters set to zero. The third step involves an iterative procedure, using the Davidon-Fletcher-Powell Quasi-Newton method to obtain final maximum-likelihood estimates with the values selected in the grid search as starting values [19].

The general Model can be written as:

$$Y = f(X_a; \beta)e^{\varepsilon}$$

Whereby:

Y = The quantity of agricultural product
X_a = A vector of input and other explanatory variables quantities
$\beta =$ A vector of unknown parameter to be estimated
$e =$ Error term
$\varepsilon =$ Stochastic disturbance term consisting of two independent elements U and V ,

Where

$$\varepsilon = U + V$$

$U =$ Are assumed to be independent and identically distributed random errors which have normal distribution with mean zero and unknown variance σ_v^2

$V =$ Are non-negative unobservable random variables associated with the technical inefficiency of production.

The random error represents random variations in the economic environment facing the production units, reflecting luck, weather, machine breakdown and variable input quality; measurement errors; and omitted variables from the functional form [17].
Then the frontier of the farm is given by:

$$Y = f(X_a; \beta)e^{(u+v)}$$

Measures of efficiency for each farm can be calculated as:

$$TE = \exp.\left|E(V|\varepsilon)\right\|$$

Whereby: $V = f(Z_b; \delta)$

$Z_b =$ A vector of farm specific factors, and
$\delta =$ A vector of parameters

The function is linearised so that it can be possible to use the maximum log-likelihood function for. Both parameters of stochastic frontier and the inefficiency effects model can be consistently estimated by maximum likelihood procedure. Frontier 4.1 and Microsoft excel were used for analyzing and editing the data. The MS excel was used to log all of the input data before creating a data file for the program to use.

2.2.2 The empirical model

The function is summarized as follows:

$$InY = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + V - U$$

Whereby: Y is the total quantity of Indigenous leafy vegetables produced, it is measured in kilograms.

In is the logarithm to base e, X_1 is the area of the farms devoted to Indigenous leafy vegetables production, it is measured in hectares.

X_2 is the total labour used, measured in man-days.

X_3 is the cost of tractor, in Rands (cost of hiring tractor services is used as proxy for cost of tractor)

X_4 is the amount of manure used, measured in kilograms.

It is assumed that the inefficiency effects are independently distributed and U arises by truncation (at zero) of the normal distribution with mean and variance, where:

$$U = \delta_0 + \delta_1 InD_1 + \delta_2 InAGEF + \delta_3 InHHSZ + \delta_4 InLVPR + \delta_5 InFSIZ + \delta_6 InD_2 + \delta_7 InD_3 + \delta_8 InD_4 + \delta_9 InD_5 + \delta_{10} InD_6 + \delta_{11} InD_7 + \delta_{12} InD_8 + \delta_9 InDSLM + e$$

The Table 1 above it describes the variables that were engaged in the study. The β and δ coefficients are unknown parameters to be estimated, In is the logarithm to base e.

Table 1. Definition of variables

Variables	Description of variables	Units
	Dependent variable	
U	1, if farmers have high production,0,otherwise	Kilograms per hectare
	Independent variables	
D_1	1,if farmer is a female,0,otherwise	Dummy
AGEF	Age of the farmer	Years
HHSZ	Household size	Numbers
EXP	Experience in ILV farming	Years
LVPR	Amount of leafy vegetables produced per season	Kilograms
FSIZ	Farm size	Ha
D_2	1, if farmer hire labour, 0, otherwise	Dummy
D_3	1, if farmer use manure, 0, otherwise	Dummy
D_4	1, if farmer receive extension services, 0. Otherwise	Dummy
D_5	1, if Farmer own the Land, 0, otherwise	Dummy
D_6	1, if farmer engage in off-farm employment,0, otherwise	Dummy
D_8	1, if farmer have access to transport,0, otherwise	Dummy
D_9	1, if agriculture is the primary occupation of farmer,0, otherwise	Dummy

2.3 Bubble Chart

Bubble chart was used for data presentation as it helped to show the share of each market and the potential of markets that can be targeted in future. The chart indicates the competitiveness and prospect for diversification of supply by farmers for indigenous leafy vegetables. Bubble size was proportional to the current share of each market for indigenous leafy vegetables. The rationale for using this chart was to show the marketing channels of ILVs so as to indicate the gap that exist and the potential that these vegetables hold.

3. RESULTS AND DISCUSSION

3.1 Household Socio-Economic Characteristics

Of the 60 respondents interviewed in this study, ninety percent were females and only ten percent were male. Women dominate the cultivation of indigenous leafy vegetables as compared to men, leading to the crops being considered as “women crops”. Men seemed to be interested in livestock farming as it is perceived to be a store of wealth.

Table 2 below indicates that a majority, 62% of farmers were older than 60 years, followed by those who range between 51-60 years who form 20%, 41-50 years were 16% and 36-40 years were only 7%. Other studies [20] showed that Age distribution was very important for all agricultural productions. According to [21] the education level of the farmers especially in the specific field improves resource use efficiency because when farmers are educated they might know how to optimally use resources improving efficiency. In the study area, most farmers had primary education (43%), 37% had no formal education, 18% had secondary education and only 2% had a tertiary qualification. The high percentage of farmers with low levels of education was due to the ancient believe of Africans that women were not supposed to attend school, as they only belong in the kitchen, which to a greater extent affected production and marketing decisions. Majority of farmers were relying on pension as a main source of income. More than 50% of respondents were married; This gave them an advantage of labourers, as they can use their immediate family. On average the number of people in the household was six, giving farmers a pool of additional labour from family members. Approximately all ILV producers hold locally recognised customary land rights; they have a yearly payment that they made to the chief for the possession of the land. Their scale of production on average was 1.29 hectares, with most of them devoting only about 0.75 hectare to ILVs production.

3.2 Description of Indigenous Leafy Vegetables Production System

Production of ILVs depends on local available resources. Farmers use their innovations and practices that had been developed over the years. The study took interest in the range of three ILVs namely: amaranths (lerotho), spider flower (thepe) and cowpea (monawa) the names in the syntheses are the local names. Two of the crops (Amaranth and spider flower) were not cultivated, are mostly harvested from maize fields, growing as intercrops. Only Cowpea was cultivated, and most farmers consider it to be profitable. Results have showed that some farmers were having one crop other had a mixture of ILVs. The uncultivated crops were mostly in the field were they using manure. These crops are alternative to spinach and they actually require less input as compared to it. ILVs can be produced without any agro-chemicals, this reduce the cost of production.

Table 2. Socio-economic factors

Gender		**N=60**			
				Female	**Male**
				90%	**10%**
Age		36-40 years	41-50 years	51-60 years	>60 years
		2%	16%	20%	62%
Marital status		Single	Married	Windowed	Divorced
		17%	55%	28%	0%
Educational level		No formal education	Primary	Secondary	Tertiary
		37%	43%	18%	2%
Source of income	Own salary	Farming	Pension	Social grant	Hawking
	8%	3%	68%	5%	16%
Number of dependants		1	2-6	7-11	12-16
		8%	82%	10%	0%

According to [8] the production of ILVs was very simple and often requiring very little inputs save for occasional farm yard manure application. Production depends on rainfall, causing unreliability of supply. Sowing was mainly done by broadcast, most farmers used seeds obtained from older plants, dried and stored in a bottle or plastic bag mixed with ashes and others store them in the fridge until being planted during summer after the rains. Voluntary crops self seed but in rare cases farmers go find the seeds and broad casts in their farms. Manure was commonly applied, with the use of fertilizer and other agrochemicals being very limited. Farmers used different types of manure, but the most used was the cattle and chicken respectively. Both part-time and unpaid family members were used as labour, most part-time labourers used were Zimbabweans because they do not ask for higher wage. The production system of ILVs was closely related to local indigenous knowledge system.

3.3 Stochastic Frontier Production Function Results

Table 3 present the statistics of variables used in the stochastic frontier production function.

<u>3.3.1 Production factors are discussed as follows</u>

The gamma coefficient (0.9999) indicates the orderly influences that were unexplained by the production function and the dominant sources of random error. The results suggest that about 99% of the variation in ILVs output among ILV farmers in the study area was due to the differences in their technical efficiencies. The values of the log-likelihood function for the MLE and OLS were -17.6954 and -47.3025 respectively, indicating the model that best suits the data. With MLE function having the highest log likelihood, it shows that the model best fits the data. The results of a likelihood ratio test (LR = 59.2144) confirms that ILV production level relate to the efficient use of available resource.

Table 3. Maximum likelihood estimates of the stochastic frontier production function

Variables	Parameters	Coefficients	Standard errors	t-ratios
Production Factors				
Intercept	β_0	7.6968	0.8341	9.2280
Land devoted to ILVs (X_1)	β_1	0.0917	0.3899	0.2353
Total labour used (X_2)	β_2	0.2424	0.1078	2.2490
Cost of tractor (X_3)	β_3	-0.1554	0.1076	-1.4443
Cost of tractor (X_3)	β_4	0.0122	0.0372	0.3275
Inefficiency Factors				
Intercept	δ_0	2.5705	1.2611	2.0383
Gender	δ_1	-0.1113	0.4556	-0.2444
Age	δ_2	0.3522	0.2538	1.3879
Household size	δ_3	0.1449	0.2230	0.6501
Farming experience	δ_4	0.0741	0.1458	0.5081
ILVs produced per season	δ_5	-0.6299	0.1233	-5.1079
Farm size	δ_6	-0.3007	0.3226	-0.9324
Used of hired labour	δ_7	0.3093	0.3255	0.9503
Use manure	δ_8	0.0269	0.3442	0.0781
Extension service	δ_9	0	1.0000	0.0000
Land ownership	δ_{10}	0.2438	0.4201	0.5803
Off-farm employment	δ_{11}	-0.0498	0.4569	-0.1089
Access to transport	δ_{12}	-0.0512	0.9456	-0.0541
Primary Occupation	δ_{13}	0.1684	0.2193	0.7678
Gamma	G	0.9999	0.3778	0.2647
Log likelihood function		-17.6954	-47.3026	
LR test		59.2144 (1 restriction)		

Production factors had different effect on the production level. Specifically, the coefficients of the land devoted to ILVs (0.0917), total labour used (0.2424), cost of tractor (-0.1554) and manure used (0.01220) each was significant at 1% level of probability. Land devoted had a positive effect on the production level as ILVs farmers were not technological inclined. Statistically the coefficient indicate that a 1% increase in the land devoted will lead to a 0.0917 increase in the level of ILVs output. The results tally with other studies [22,23] which also suggested that farm size or land devoted have an impact on the production level. Labour significance draw from the fact that farming system used by ILV farmers was labour-intensive from land preparation to harvesting. Farmers in the study area didn’t own any farming machine, so labour was the readily available resource. Elasticity of labour indicates that a 1% increase in the labour use will lead to an increase by 0.2424 in output level. The cost of tractor was found to be significant and negative, this was due to the over use of the tractor as the land devoted to ILVs was very small. A 1% increase in the cost of tractor will lead to a 0.1554 decrease in the output levels. The manure coefficient was positive but not that significant. The variable was included because manure was used as the land supplementing input therefore leading to improvement in ILV yield. The same results were supported by other studies that manure application substantially increased crop yield [24]. A 1% increase in the application of manure will lead to 0.0122 increases in the output level.

3.3.2 Return to scale

The results as presented in Table 3, the sum of β's was less than one, indicating a decreasing return to scale. This meant that resources were over-utilised, resulting in ILVs farmers being technically inefficient. Farmers will have to decrease the amount of input used for them to reach the point where the cost per unit of inputs used is equal to output/returns per unit. Then, there would be sufficient room for further production and productivity improvement in ILVs production.

3.3.3 Technical inefficiency estimates

Gender coefficient(-0.1113) was found negative and significant at 5%, indicating that female farmers, who were dominating at about 90%, were more involved in the production of ILVs as compared to their male counterparts. The finding is similar to that of [10] which reported that ILV production is a women oriented agricultural activity. Age coefficient (0.3522) had a significant (5%) contribution to inefficiency use of resources, older farmers were less efficient as compared to their younger counterparts, who were willing to implement new technology and create wealth. Farming experience (0.0741) contributes to inefficiency use of resources. As most ILV farmers were always engaged in subsistence farming never farm for profit, this contribute to their inefficiency use of resources.

It was stated by [20] that the family members of a farming family are the immediate supply of the farm labour force, therefore, the larger the family size the greater the productivity and the more the social status of the farmers. Results indicated that household size (0.1449) is positive and significantly related to technical inefficiency. An increase in the level of household (more adults/workforce) led to an increase in technical inefficiency.

Farm size had a coefficient of -0.3007 which was significant at 5%, implying that the inefficiency use of resources decreases with the farm size. Large farm size allows farmers to use the available inputs efficiently as they will be spread widely. Farmers overused the hired labour, showing positive coefficient (0.3093) in explaining production of ILVs. They tend to use hired labour together with the family labour whereas they cultivate small piece of land. The quantity of ILVs produced per season was negatively related to inefficient use of resources, the coefficient was -0.6299 at 10% level of significant. The coefficient of extension (0) in the inefficiency model was found to be insignificant; this was due to the fact that almost all ILV farmers were never in contact with an extension officer. Land ownership was positively related to the inefficient use of resources with the coefficient of 0.2438. The coefficient was significant at 5%. The off farm employment coefficient of -0.0498 which was significant at a 1% level of probability, indicating the impact of full participating of farmers. Farmers who were not employed off-farm tend to be more technical efficient, since they allocate the best labour time to ILV production. Access to transport was negatively related to the inefficient use of resources with the coefficient of -0.0512, it was significant at 1% level of probability. The availability of transport to farmers was important for them to be able to reach both input and output market. Primary occupation coefficient (0.1684) was positive which was significant at 5%.

The results of the frequency distribution of technical efficiency of ILV farmers were presented in Table 4 below. The estimated technical efficiency varied with minimum and maximum values of 11 percent and 99 percent respectively and an average of 31 percent. It indicated that the average farmer in the study area could save 69% [i.e. 1-(31/99)] of costs and the most technical inefficient could realise an 89% cost saving [i.e., 1-(11/99)] compared with the technical efficient level of the most efficient farmer. The wide range in technical efficiency indicated that most farmers were using their resources inefficiently and there still exists a huge opportunities for improving their current level of technical efficiency.

Table 4. Frequency distribution of technical efficiency of ILV farmers

TE level (%)	Number of farmers (n=60)	Percentage
>90≤100	2	3.3
>80≤90	2	3.3
>70≤80	2	3.3
>60≤70	2	3.3
>50≤60	1	1.7
≤50	51	85
Total	60	100%
Mean 31%	Minimum 11%	Maximum 99%

3.3.4 Processing techniques

In the study area they used two local traditional systems to process (dry) ILVs, the first one was sun-drying cooked products and second one was sun-drying raw leaves. Drying help with post-harvest preservation to maintain supply throughout the year since ILVs are perishable and were only abundant during rainy season but scarce the rest of the year. According to [25] although drying is one solution to the problem of perish-ability, it does not satisfy the needs of a large population of consumers, particularly urban dwellers. Thus there is a need to improve the drying methods that are currently being used taking into account hygienic considerations as well as nutrient degradation and loss. Farmers should incorporate the use of modern methods and equipment.

3.3.5 Production constraints

The major constraint in the production of ILVs was water, the production depends on rain-fed and the province receives small summer rainfall. Farmers also lack financial resource to reinvest in their farming activities, they were unable to acquire all the necessary inputs needed and the one that will help them improve their production. Farmers struggle with infrastructure, they didn’t have proper infrastructure like storage, irrigation system etc. The constraints were rigorous because extension services were apparent concentrated on commercial exotic crops.

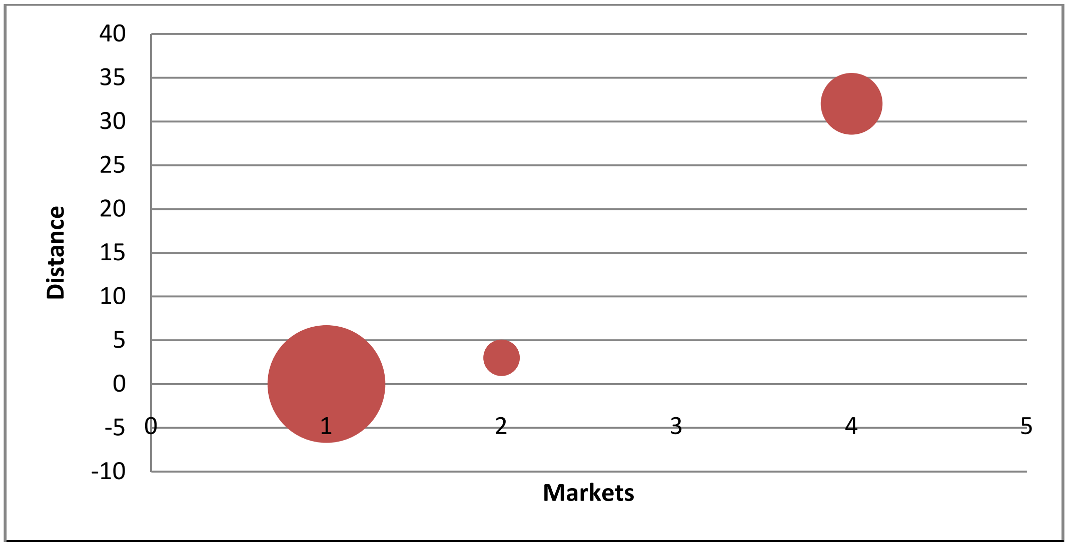

Fig. 1. Bubble Map results (Marketing)

ILVs are recognized as subsistence crops, its marketing is very limited, and most farmers produce for their own consumption with few products reaching the informal market. Several studies [11] have found that ILVs have long been regarded as minor crops and thus have attracted little marketing attention; they were recognised as subsistence crops. Women are major players in the marketing of ILVs. Fig. 1 above outline ILVs output market results from the study area, the x-axis represent markets whereby 1 was the local market, 2 neighbouring villages, 3 supermarkets and 4 town markets. From the Bubble map results, it was evident that local market has a bigger market share of about 73%, followed by town market with 20%, neighbouring village share was 7%. There were no evident of ILVs reaching the supermarkets. Most farmers sold their produce locally because of lack of market information and lack of resource to reach other markets. According to [26] it showed that a number of transaction cost variables had a significant effect on the proportion of meat sold and thus indirectly on the choice of marketing channels.

The distance to the point of sale and the type of transport affect the quantity and the quality of the product sold. The distance to different output markets vary, indicated that most local consumers buy from the farmer's house with few farmers selling door to door or in pension points. Respondents who were not working in town faced high transaction costs in marketing their products in town; these made them not to market in town. These gave middlemen an opportunity to move the produce from the hands of the farmer to town at the same time giving them a share of income but there seem to be uninvestigated allegations that these middlemen benefited more than farmers. ILVs are sold as both fresh and dry products. Farmer's price setting was based on the market, with few setting their price as dictated by buyers.

3.3.6 Potential markets

In the country there is an increasing trend of supermarket chains in the food system and consumer preferences for quality and easy to prepare food. The emergence and growth of the black middle class is the most powerful marketing trend in the country, the advantage of

ILVs to be absorbed by this market is because most of them grow up consuming these crops and it nutritious value. Selling this crop through retailers, restaurants will assure consumers about its safety.

4. CONCLUSION

There is a great potential for the commercialisation of ILVs in South Africa. Results indicated that farmers are faced by several constraints in their production and commercialisation but the most outstanding were; water scarcity that pose a threat to consistent supply, financial resource that allow them to purchase required inputs, lack of proper infrastructure, lack of knowledge on how to introduce a product to the market, lack of government support; absence of policies that support the development of ILVs and their marketing. Coupled with these constraints farmers as well never saw or believe that these crops could fit in the main-stream food system, although they know their benefits. All factors of production for ILV farmers that were considered by the study were found to be significant except manure. All these factors of production showed a positive contribution towards level of ILVs output apart from tractor cost which make an economic sense.

Results from the inefficiency model, indicated that Age, farm size, labour, land ownership to be significant. Other factors that contributed to technical efficiency were gender, farm size, off-farm employment and access to transport. The mean technical efficiency in the study area was 31% with the minimum and maximum being 11 and 99 respectively. There are no known structured marketing channels for indigenous leafy vegetables in Capricorn district, only informal market exists for these crops.

Based on the findings, recommendations can be the integration of science/ modern technology and indigenous knowledge, to improve the productivity of ILVs, to promote entrepreneurial culture among rural farmers and also involvement of multidisciplinary stakeholder like processing companies, retailers, chefs etc. as the crop is being developed. The limitation of the study was the lack of record keeping. To properly introduce the crops into the mainstream, Future research could further investigate consumer needs in relation to ILVs and develop a sustainable value chain for indigenous leafy vegetables.

The results of this study will be helpful to policy makers in drafting and implementing policies that will promote the use of ILVs at the mainstream of the economy. Well structured ILVs policies, will unleash ILVs potential in contributing to the improvement of rural livelihood, food security and alleviating poverty.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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