

CONTRIBUTION OF PRICKLY PEARS (*OPUNTIA FICUS-INDICA*) TO THE TOTAL HOUSEHOLD INCOME OF HOUSEHOLDS IN LEPELLE NKUMPI LOCAL MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

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Abstract. This study investigated the contribution of Prickly Pears (*Opuntia ficus-indica*) to total household income within Lepelle Nkumpi Local Municipality, Limpopo Province, South Africa. Despite their classification as an invasive species, Prickly Pears notably contribute to the income of economically disadvantaged households. Descriptive statistics and multiple linear regression were employed to analyze data collected from 72 households engaged in the sale of Prickly Pears. The results reveal significant correlations between the frequency of sales per season, agricultural knowledge, harvesting frequency per season, and income from prickly pear sales. Transportation expenses were found to positively affect household income, suggesting that a wider market reach and increased sales volumes compensated for higher costs. These findings underscore the importance of wild fruits like Prickly Pears in poverty alleviation, particularly in regions with high unemployment rates. They emphasize the need for balanced policy approaches taking into account both economic benefits and environmental concerns related to invasive species. Thus, the study offers insights into the socioeconomic dynamics of wild fruit trade, emphasizing the interplay between income generation, agricultural practices, and environmental conservation. Future research should further explore these dynamics to inform evidence-based policies promoting sustainable livelihoods and food security in marginalized communities.

Keywords: household income, income generation, prickly pears, wild fruits, invasive species

INTRODUCTION

Wild fruits are integral to the sustenance of livelihoods and income, particularly among economically disadvantaged populations (Nkosi et al., 2020). Extensive research has illuminated their pivotal role in poverty alleviation and food security, acting as both income generators and nutritional sources for families (Bvenura and Sivakumar, 2017). This global evidence underscores the crucial support wild fruits provide to impoverished communities, providing sustenance and serving as a primary economic driver (Shumsky et al., 2014). In the South African context, the Prickly Pear stands out as a notable wild fruit, renowned for its exotic nature and beneficial attributes, including its sweetness, nutritional value, and medicinal applications (Kucich and Wicht, 2016). Despite its value, the Prickly Pear has been classified as an invasive species under the Biodiversity Act Alien and Invasive Act of 2004, adding a layer of complexity

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to its management. Its trade and consumption in South Africa have attracted the attention of commercial and street market traders, leading to inevitable competition (Shackleton et al., 2007).

The culinary and nutritional significance of Prickly Pears extends beyond South Africa, as they feature in Mexican cuisine and are popular in the American South-western region and beyond (Cota-Sánchez, 2016). The fruit's versatility, with various parts being edible, contributes to its utilization in cocktails, juices, jams, and various dishes. Additionally, their impressive nutritional profile positions Prickly Pears as potential agents in health promotion and disease prevention, including the management of blood sugar levels, diabetes complications, high cholesterol, obesity, and hangovers (Shetty, 2024).

Acknowledging the interconnected issues of poverty, malnutrition, and food insecurity, studies highlight the centrality of income generation, particularly in the face of high unemployment rates in South Africa (Cloete, 2015; Dube-Addae, 2019; Chakona, 2022). Many affected households turn to entrepreneurship, establishing small businesses reliant on exotic wild fruits such as wild Plum, Blueberry, Prickly Pear, and Cranberry to sustain their livelihoods (Kucich and Wicht, 2016). In Limpopo Province, specifically in Lepelle Nkumpi Local Municipality, households engage in the sale of Prickly Pears to earn money. However, the specific contribution of this activity to overall household income remains undocumented. This study aims to fill this knowledge gap by analyzing the contribution of Prickly Pears to the household incomes of Lepelle Nkumpi Local Municipality residents.

Previous research has delved into the contribution of Prickly Pears to incomes in South Africa, highlighting their positive impact on communities, particularly in Makana Municipality in Eastern Cape Province (Shackleton et al., 2011). Similarly, surveys conducted in Limpopo Province shed light on the roadside vendors of Prickly Pears, revealing their engagement in trading as a response to unemployment (Sardeshpande and Shackleton, 2020). These findings emphasize the fruit's crucial role in generating revenue and sustaining communities below the poverty line. Despite its economic benefits, the classification of the Prickly Pear as an invasive species raises challenges in implementing regulations. The species, known for its diverse uses, including edible fruit and beer production, has attracted attention

from both commercial and street market traders, resulting in unavoidable competition (Moshobane et al., 2022). Policymakers face the delicate task of balancing economic benefits with environmental consequences, necessitating strategic approaches to maintaining and expanding the usage and trade of wild fruits (Schreckenberg et al., 2006; Powell et al., 2015).

The conflict between biodiversity managers and users in South Africa, particularly in relation to the family Cactaceae, underscores the complexity of managing alien species. The Cactaceae family's tolerance of arid environments and low rainfall, coupled with high returns for minimal effort, has intensified the conflict. In response, a Prickly Pear Traders' Agency has been proposed to promote the trade of *O. ficus-indica* as a means of income generation, poverty reduction, and ensuring food security (Moshobane et al., 2022).

This study focuses on Limpopo Province, specifically Lepelle Nkumpi Local Municipality, where households rely on the sale of Prickly Pears for income. Despite this economic activity, there is a gap in understanding how the money derived from selling Prickly Pears contributes to overall household income. Therefore, this research aims to analyze the specific contribution of Prickly Pears to household income in Lepelle Nkumpi Local Municipality, shedding light on the socio-economic dynamics at play in this unique context.

MATERIALS AND METHODS

Study area

The study area for this research is Lepelle Nkumpi Local Municipality, situated in Limpopo Province of South Africa. The municipality has a population of approximately 233,925 residents, distributed across approximately 61,305 households, as reported in the Integrated Development Plan (IDP) for Lepelle Nkumpi Local Municipality (2022/2023). Prickly Pears are produced in Limpopo Province due to their drought resistance. As a climate-resilient crop, Prickly Pears are one of the best foods for this environment and consumed by people of various ages.

Data analysis

Descriptive statistics were used to describe the demographic information of the respondents. A multiple linear regression model was used to determine the contribution of Prickly Pears to household income in Lepelle

Nkumpi Local Municipality. The aim of multiple linear regression is to establish a model that depicts the linear connection between the explanatory (independent) variables and the response (dependent) variables. Essentially, multiple regression extends ordinary least-square (OLS) regression by incorporating more than one explanatory variable. In this study, the dependent variable was calculated by dividing the income received from the sale of Prickly Pears by the total household income to get the percentage share of income contributed by Prickly Pears.

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + U_i$$

Where: Y – is the dependent variable, $X_1 - X_n$ – represent the parameters, β_0 – is the constant, $\beta_1 - \beta_n$ – represent the coefficients of the parameters and, U_i – is the error term.

RESULTS AND DISCUSSION

Table 1 presents the summary statistics for households in the study area. The descriptive statistics provide insight into the characteristics of the sample population and key variables under consideration. The sample comprises 72 individuals, with ages ranging from 26 to 71 years. The average age of the respondents is approximately 42 years, with a standard deviation of 9.367, indicating a moderate level of variability in ages within the sample. The income generated specifically from Prickly Pear sales illustrate the minimum and maximum values of R130.00 and R1400.00, respectively. The mean income from Prickly Pear sales is 589.792, with a relatively lower standard deviation of 321.6577, indicating less variability in income specifically derived from this source.

Costs associated with transport range from R0.00 to R900.00, with an average cost of approximately R298.97 and a standard deviation of 208.349. This suggests some variability in transport costs. Finally, the distance travelled for sales activities, measured in kilometers (km), showed that some households travel a minimum of 1 km to sell the fruit while others travel a maximum of 25 km. The average distance of approximately 5,165 km and a standard deviation of 4,4545. This indicates considerable variability in the distances covered for sales activities among the respondents. In summary, the descriptive statistics provide a comprehensive overview of the age distribution, household income, income from Prickly Pear sales, sales transaction costs, and travel distances associated with sales activities within the sample population.

The demographic and socioeconomic information presented in Table 2 illustrates the composition of households within Lepelle Nkumpi Local Municipality. The gender distribution reveals a majority of females at 63.9%, whereas males account for 36.1%. Regarding education levels, secondary education emerges as the most common at 41.7%, closely followed by tertiary education at 38.9%. Notably, about 9.7% have either no formal education or primary education. In terms of marital status, 54.2% are single, while married individuals account for 33.3%, with divorced and widowed individuals representing smaller segments at 4.2% and 8.3%, respectively.

A majority of individuals are self-employed, comprising 56.9% of the group, followed by those who are employed at 25%, and the unemployed at 18.1%. In terms of selling Prickly Pears, the data indicates a diverse range of engagement, with 44.4% selling four to five times a season, 23.6% selling more than five times, 19.4% selling once every season, and 12.5% selling two or three times a season. Interestingly, while 55.6% are

Table 1. Descriptive statistics of some of the socio-economic characteristics (N = 72)

Descriptive statistics	Minimum	Maximum	Mean	Std. deviation
Age of the respondent (actual number)	26	71	41,6	9,367
Total household income (rands)	700	36 000	13 761,11	9 306,072
Income from the sales of Prickly Pears (per season)	130	1 400	589,792	321,6577
Transportation expenses (Rands)	0	900	298,97	208,349
Distance to the selling point (km)	1	25	5,165	4,4545

Source: research survey, 2023.

Table 2. Demographic and socioeconomic information (N=72)

Variables	Frequency	Percentage
Gender		
Female	46	63,9
Male	26	36,1
Level of education		
No formal education	7	9,7
Primary education	7	9,7
Secondary education	30	41,7
Tertiary education	28	38,9
Marital status		
Single	39	54,2
Married	24	33,3
Divorced	3	4,2
Widowed	6	8,3
Employment status		
Employed	18	25
Unemployed	13	18,1
Self-employed	41	56,9
Number of times selling the Prickly Pears		
Once every season	14	19,4
Two-three times a season	9	12,5
Four to five times a season	32	44,4
More than five times a season	17	23,6
Off-farm employment		
Yes	13	18,1
No	59	81,9
Harvest Prickly Pears		
Yes	40	55,6
No	32	44,4

Source: research survey, 2023.

involved in harvesting Prickly Pears, a notable 81.9% are not engaged in off-farm employment. Moreover, while 29.2% of participants use hired labor, the majority, at 70.8%, do not.

Multiple linear regression results on the contribution of Prickly Pears to household income

The ANOVA results in Table 3 show that the regression model is statistically significant ($F(15, 56) = 3.503, p < 0.001$), suggesting that the independent variables collectively contribute to explaining the variation in the dependent variable. The regression model accounts for a significant amount of variance in the dependent variable, as indicated by the large F-value and the small p-value. The regression model explains a substantial portion of the total variance, with a sum of squares of 23154.922. This is supported by a mean square value of 1543.661. The residual sum of squares, representing unexplained variance not captured by the model, is 11082.522. Overall, the regression model provides a good fit to the data and significantly predicts the dependent variable. The predictors included in the model collectively contribute to explaining the variability in the dependent variable.

The proportion of the dependent variable's variance that can be accounted for by the independent variables in the model is expressed as the coefficient of determination, or R-squared, as shown in Table 3. The R-squared value in this instance is 0.676, meaning that the independent variables in the model account for 68% of the variance in the dependent variable. The sample size and the number of predictors in the model are taken into consideration in the modified R-squared value. With an adjusted R-squared of 0.590, the independent variables are thought to account for 59% of the variability in the dependent variable. The degree to which the observed data points resemble the regression line is shown by the standard deviation. The average amount of variation between the observed and predicted values of the dependent variable is roughly 14.07 units in this instance, as indicated by the standard error of the estimate of 14.0677. These model fit findings collectively imply that the regression model fits the data rather well, explaining a significant amount of the variance in the dependent variable through the independent variables.

Table 4 contains the multiple linear regression results for the contribution of Prickly Pear to total household income. As indicated, the results show that the variable frequency of sales per person was found to be statistically significant, with a p-value of 0.012. This implies that a one-unit increase in frequency of sales per person will increase the contribution of Prickly Pears to household income by 0.239. These results are in line with the

Table 3. ANOVA results

ANOVA results	Sum of Squares	df	Mean Square	F	Sig.
Regression	16 574,55	15	1 104,97	3,503	<,001
Residual	17 662,9	56	315,409		
Total	34 237,44	71			
Model Fit results					
R	,822				
R Square	0,676				
Adjusted R Square	0,59				
Std. Error of the Estimate	14,067771				

Source: research survey, 2023.

Table 4. Multiple linear regression results (N = 75)

Variables	Beta	Std. Error	t	Sig.	Tolerance	VIF
Constant		22,439	−1,965	0,054		
Age of the respondent	−0,086	0,24	−0,842	0,404	0,551	1,815
Gender of the respondent	0,117	3,829	1,388	0,171	0,813	1,231
Level of education	0,053	2,344	0,528	0,600	0,578	1,73
Marital status	0,051	2,052	0,61	0,545	0,811	1,234
Employment status	0,037	2,304	0,418	0,678	0,722	1,385
Household size	0,034	1,079	0,355	0,724	0,648	1,543
Frequency of sales per season	0,239	1,952	2,592	0,012**	0,679	1,472
Labour	−0,178	5,728	−1,515	0,135	0,418	2,395
Agricultural knowledge	0,36	9,867	3,133	0,003***	0,437	2,289
Extension services	0,091	4,057	0,989	0,327	0,687	1,455
Distance to the selling point	−0,166	0,037	−1,629	0,109	0,559	1,788
Number of years selling	0,073	0,4	0,832	0,409	0,753	1,329
Off-farm employment	0,144	5,218	1,559	0,125	0,682	1,465
Harvesting frequency per season	−0,255	4,635	−2,417	0,019**	0,518	1,93
Transportation expenses	0,592	0,002	5,772	<,001***	0,55	1,82

Source: research survey, 2023.

findings of Cherume (2018), who reported that Prickly Pears provide a major income boost for unemployed people who forage and sell the fruit.

The variable of agricultural knowledge was statistically significant, with a p-value of 0.003, while the sign of the coefficient was found to be positive. This indicates a positive relationship between agricultural

knowledge and the contribution of Prickly Pears to household income and corroborates the findings of Mahfouz and Abd-Elnoor (2020). Additionally, the results imply that an increase in knowledge will increase the contribution of Prickly Pears to household income by 0.36 units.

Unexpectedly, the coefficient for harvesting frequency per season was -0.255, with a significant p-value of 0.019. This negative coefficient suggests that increasing the frequency of harvesting Prickly Pears per season decreases their contribution to household income. This could be due to various factors, such as resource depletion and changes in consumer preferences (Suwardi et al., 2020). Furthermore, if more households increase the frequency of their harvests, this may result in a greater supply of the Prickly Pears to the market, leading to lower prices for the sellers.

The transportation expenses for Prickly Pears were found to be highly significant ($p < 0.001$) in relation to the contribution of Prickly Pears to household income and had a positive influence. These results suggest that a one-unit increase in the cost of transporting Prickly Pears will increase their contribution to household income by R0.592. Normally, economic theory suggests that an increase in costs reduces the income generated by the seller (Leny and Sausan, 2020). However, in this case, it is possible that the further the sellers of Prickly Pears travel in search of customers, the more customers they are able to supply, thereby increasing their share of the market.

CONCLUSION

The findings of this study underscore the significant contribution of Prickly Pears (*Opuntia ficus-indica*) to household income in Lepelle Nkumpi Local Municipality, situated in Limpopo Province, South Africa. Through the multiple linear regression analysis, several key factors were identified that influence the income generated from the sale of Prickly Pears. Notably, the frequency of sales per season, agricultural knowledge, harvesting frequency per season, and transportation expenses emerged as significant factors.

The positive relationship between the frequency of sales per season and the income generated highlights the importance of consistent engagement in selling Prickly Pears for households to benefit economically. Moreover, Prickly Pears made a greater contribution to household

income for individuals with more agricultural knowledge, indicating the importance of education and skill development in optimizing economic gains from wild fruit sales. Unexpectedly, the harvesting frequency per season exhibited a negative relationship with income contribution, contrary to prior expectations. This suggests the need for further exploration of the underlying dynamics influencing this relationship, possibly related to market dynamics or resource availability. Furthermore, transportation expenses were found to positively influence income contribution, suggesting that increased investment in transportation may lead to higher profits despite the associated costs. This finding reveals the potential benefits of expanding market reach through strategic transportation investments. Overall, Prickly Pears play a crucial role in supplementing household incomes in Lepelle Nkumpi Local Municipality, particularly for economically disadvantaged communities. Understanding the factors influencing income generation from wild fruit sales can inform targeted interventions to enhance livelihoods and promote sustainable economic development.

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