# Rural Households' Perceptions of Rosehip and the Role It Plays in Rural Livelihoods in Lesotho

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**Research Article**

**Keywords:** Invasive alien species, Rosehip, Perceptions, Lesotho, Principal Component Analysis, Probit model

**Posted Date:** July 13th, 2022

**DOI:** https://doi.org/10.21203/rs.3.rs-1811407/v1

# Abstract

Despite the amount of research on the perceived negative impacts of invasive alien species, they remain integral to the rural communities due to their numerous livelihoods uses. More research is required, focusing on the impacts of invasive alien species on the livelihoods of rural communities. This paper investigates the community perceptions of rosehip (*Rosa rubiginosa*) in Lesotho and its contribution to rural communities. A sample of 160 participants was chosen using simple random sampling. Descriptive, Principal component analysis and the probit model were used to analyse the results. The study found that rosehip's livelihood benefits, and its abundance highly influence the social, economic and environmental perception of rural communities. However, the income from rosehip was found to be the lowest income component. Despite the income from rosehip being low, it acts as a safety net in the face of shocks such as limited job opportunities and food shortages to the poorer households who have few income sources.


# 1. Introduction

Internationally, there has been a lot of research on invasive alien species (IAS). Perrings *et al.* (2000) argued that this results from an increase in recognising the severity of consequences related to invasive alien species globally. According to the Convention on Biological Diversity (2002:2), invasive alien species can be generally defined as “an alien species whose introduction and spread threaten ecosystems, habitats or species with socio-cultural, economic and/or environmental harm, and/or harm to human health”. The introduction of plant species in different countries both accidentally and intentionally is done for various reasons, including forestry, agriculture and ornamental purposes (Mack, 2003; Zengeya *et al*., 2017). The growth in human population and the global trade expansion has led to the widespread distribution of species beyond their native ranges (De Lange & Van Wilgen, 2010; Westphal *et al*., 2008; Carbutt, 2012). IAS are introduced outside their native scope by human action that has severe negative impacts on the recipient environment (Blackburn *et al*., 2011)

Globally, invasive alien species (IAS) have resulted in the economic cost estimated to be around $1.3 trillion over the past 50 years (Zenni *et al*., 2021). In Africa, the total annual cost of IAS to agriculture only is estimated at $65.58 billion (Eschen *et al*., 2021). According to Admasu (2008), the negative effects are more severe in areas where households depend primarily on agriculture for food and income. The invasion by alien plants can have adverse impacts on agricultural land productivity, such as reducing its grazing potential and competing for land space that could be used for crop production (Admasu, 2008). Due to their ability to spread rapidly, invasive alien plants are also known to replace valuable native plant species used locally for commercial and non-market purposes (Eviner *et al*., 2012; Ntsonge & Fraser, 2021).

However, Shackleton *et al.* (2011) discovered that in South Africa, prickly pear plays a significant role in the livelihoods of trading households. The contribution varied since poorer families benefited more because they had no other sources of income. Shackleton *et al*. (2007) attempted to clarify the cultural,

economic and social factors, which may have motivated the use of IAS by local communities. IAS are of significant benefit to rural livelihoods due to the scarcity of livelihood opportunities in rural communities (Kannan *et al*., 2016). For example, Kannan *et al*. (2016) noted that communities in Southern India have been using *Lantana* for over 30 years.

*Rosa rubiginosa*, as an invasive alien plant in Lesotho *is* found throughout the country but mainly in mountainous areas where temperatures are low (Kobisi *et al*., 2019). The economic benefits of *R. rubiginosa* are associated with the use and sale of its fruits, known as rosehips. Rosehips were initially used to make rosehip tea and jam due to their sweet taste and high vitamin C content (Aguirre *et al*., 2016). The negative impacts of *R. rubiginosa* include its ability to form dense shrublands in areas where it invades, which hinders livestock access to pastures and water resources (Carbutt, 2012). In Lesotho, research on IAS to date has only focused on their ethnobotanical uses, distribution and safety, as well as policies aimed at regulating them (Fitchett *et al*., 2016; Kobisi *et al*., 2019), but no work has been done on the IAS's contribution to rural communities' livelihoods. Given the lack of knowledge on the contribution of IAS in livelihoods, this study aims to contribute literature on the economic impacts of *Rosa rubiginosa* (rosehip) on livelihoods. Therefore, the objectives of this paper were to 1) understand the community's social, economic and environmental perceptions and use of rosehip, 2) determine the contribution of the income from rosehip trade to the rural livelihoods, and 3) determine factors influencing the individual's decision to participate in rosehip harvesting as a livelihood strategy. Understanding households' perceptions of rosehip and its role in sustaining rural livelihoods are essential for guiding policy and development strategies that respond to local people's needs.

# 2. Context And Method

# 2.1. Study Area

Lesotho is a small landlocked country bordered by South Africa, with an area of 30 355 km² (On The World Map, 2021). The country is divided into ten administrative districts. Leribe is one of the ten districts located in the country's northern part. The population of Leribe is estimated to be 337 500 people, in an area of 2828 km², resulting in a population density of 119 people per square kilometre (Trillo-Figueroa, 2009; Lesotho Bureau of Statistics, 2016). Arable land accounts for 17% of the district's total land area and is rapidly declining due to significant soil erosion and land degradation (Trillo-Figueroa, 2009; Makhata *et al*., 2021). The district is divided into thirteen constituencies and eighteen community councils (Trillo-Figueroa, 2009).

The Leribe District encompasses three ecological zones: lowlands, foothills, and mountains (Trillo-Figueroa, 2009; Hlalele, 2019). Trillo-Figueroa (2009) noted that temperatures range from − 2°C in winter to 32°C or higher in the summer in the lowlands. The climatic conditions are harsh in the mountains, with colder and longer winters and typically cooler summers. Snow falls between April and October in the mountains. Contrarily, the lowland climate is constantly chilly and dry in the winter and exceptionally hot in summer (Trillo-Figueroa, 2009). The average annual precipitation in Leribe ranges between 500 mm

and 800 mm, with the mountain areas receiving a higher percentage of total rainfall than the lowlands (Trillo-Figueroa, 2009). Therefore, due to its good soils and high rainfall, the Leribe District is regarded as one of the country's major agricultural production zones (Trillo-Figueroa, 2009; Hlalele, 2019). The most common crops across the community councils are maize, sorghum, and beans. A significant proportion of the communities throughout this district rely on subsistence agriculture and livestock for a living (Hlalele, 2019; Makhata et al., 2021).

For this study, four community councils (CCs) were purposely selected to understand social, economic and environmental perceptions of *Rosa rubiginosa* (rosehip) and its role in rural livelihoods. From each community council, one village was chosen for sampling. They were the Pitseng community council (Voka-Zenzela village), Matlameng community council (Ha letele village), Limamarela community council (Ha lejone village) and Mphorosane community council (Tiping village). These areas were chosen because of the abundance of *Rosa rubiginosa* near the villages (Fig. 1).

## 2.2. Sustainable Livelihood Framework

The Sustainable Livelihood framework has been used as the framework of analysis for this study. It is characterised as a better way of thinking about the development's objective, scope and priorities to intensify poverty reduction (DFID, 1999; Majale, 2002; Serrat, 2017). It outlines different factors that shape the households' livelihoods, the elements that control or strengthen them, and the relation between those factors (Babulo *et al*., 2008; Serrat, 2017). As a people-centred approach to sustainability, it weighs the progress that the already available activities have made in sustaining livelihoods and aids in formulating development activities (Serrat, 2017). The sustainable livelihood framework comprises five key components: livelihood assets, vulnerability context, transforming structures, livelihood strategies, and livelihood outcomes (Mdee, 2002; Serrat, 2017; Zhao *et al*., 2019). This framework examines how capital assets as a central feature are affected by the vulnerability context components in which they are derived and the institutions and policy changes to develop livelihoods strategies that lead to numerous livelihood outcomes (Mdee, 2002).

## 2.3. Sampling Procedure

To identify research participants, simple random sampling technique was used. The lists of harvesters and non-harvesters obtained from the village chief was used to select participants randomly. Every household was assigned a specific number, which was then placed in a bowl from which participants were drawn at random. The sample population comprised of people from the four villages in the Leribe district. In each village, 40 households were selected, with 20 harvesters and 20 non-harvesters. Thus, 160 respondents participated in the study and were divided into two groups: harvesters and non-harvesters. Hutcheson and Sofroniou (1999) recommended sample size of at least 150 or more for Principal component analysis. As a result, this sample size was sufficient to generate unbiased results.

## 2.4. Data Collection

The mixed-methods approach was used that included collection and analysis of data using both quantitative and qualitative techniques. Primary data was used to acquire detailed information regarding *Rosa rubiginosa* (rosehips) and its role in rural livelihoods in Lesotho. The study used questionnaire-based interviews which were in a face-to-face format. A semi-structured questionnaire was used to collect both qualitative and quantitative data for the study. The semi-structured questionnaire combined predefined questions with several possible answers and open-ended questions that allowed respondents to provide more thorough responses. The interview questions included demographic and socio-economic characteristics, perceptions towards rosehip, rosehip harvesting and marketing, and estimates of incomes from the different livelihood strategies pursued within the households.

# 2.5. Empirical Analysis

The study employed descriptive statistics, Principal Component Analysis (PCA) and the Probit model for data analysis. A non-parametric Mann-Whitney U test was used to compare whether a statistical difference existed in the dependent variable, household income, for groups of harvesters and non-harvesters. A Chi-square ($\chi 2$) test, mainly used for categorical variables, was used to identify whether the harvesting of rosehip is specific to any demographic characteristic and variables.

The households' perceptions of rosehip were collected using a 5-point Likert scale where 1 means strong disagreement and 5 means strong agreement, implying that the household head perceives rosehip to have positive impacts. The households were asked to their rank economic, social and environment perception on several statements as shown in Table 1.

Table 1
Perception variables

| |
|---|
| **Economic Perceptions** |
| Rosehip harvesting creates job opportunities |
| Rosehip harvesting is a source of household income |
| Rosehip harvesting helps to improve household food security |
| Rosehip harvesting serves as a safety net in terms of a crisis |
| Poor households are more dependent on rosehip harvesting to fulfil basic needs |
| The plant does not reduce the yields of farming land |
| **Social Perceptions** |
| Rosehip harvesting helps people to connect with others in the rosehip sector |
| Harvesting of rosehip helps build trust and solidarity among harvesters |
| Rosehip harvesting enhances the ability of individuals to cooperate through stokvels |
| Rosehip harvesting improves involvement in social groups |
| **Environmental Perceptions** |
| Rosehip harvesting is not harmful to the environment |
| Rosehip does not have an impact on pasture productivity |
| Rosehip helps to recover degraded forests as they act as nurse plants |
| Rosehip does not exacerbate soil erosion processes |
| Rosehip harvesting does not alter the forest structure and regeneration |
| Harvesting of rosehip does not alter the rate of growth, reproduction, and survival of the harvested plant |
| Rosehip harvesting permits population persistence in the long term |
| Harvesting of rosehip does not deplete nutrient levels of the plant |
| The plant does not reduce water quantity |

The Principal components analysis (PCA) was then used to generate the perception indexes, which were then used as explanatory variables in the probit model. Principal component analysis, which is a technique for reducing the dimensionality of large datasets by increasing interpretability while minimizing information loss, has been widely used to generate indexes (Muchara *et al.*, 2014; Jolliffe & Cadima, 2016). Shaukat *et al.* (2016) noted that one advantage of PCA is that it enables the use of variables measured in different units. The study used factor extraction, which determines the smallest number of

factors that can be used best to describe the interrelationships among the set of variables. Only PCs with eigenvalues greater than one were used (Kaiser 1960).

Lastly, the probit regression model was used to evaluate the factors influencing households' participation in rosehip harvesting. The probit model is a popular statistical model for analysing data with binomial distributions (Alabi *et al*., 2012). The probit model was used because the sample size was less than 300. The dependent variable takes the values of zero and one. Therefore, according to Oladejo *et al*. (2011), the probit regression model was then specified as follows,

$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{14} X_{14} + \varepsilon i$

Where Y is a dichotomous dependent variable which can be explained as;

Y = 1, if a household participates in rosehip harvesting, Y = 0, otherwise, βo = the intercept, $\beta_1, \ldots \beta_{14}$ = regression coefficients that explain the probability of a household's participation in rosehip, εi = the error term, Xi = vectors of parameters to be estimated, i.e. independent variables (i = 1, 2, 3…14).

Table 2 presents the explanatory variables included in the probit model to determine factors that influence households' decisions to participate in rosehip as a harvester or not. Socio-economic variables such as household size, household head's age, rosehip-related association memberships been reported to be positively correlated with wild plant harvesting. According to Suleiman *et al*. (2017), large families have limited land holdings and high food dependency ratios, so they rely on natural resource collection due to the availability of family labour. Older household heads are more likely to participate in natural resource collection because it improves their livelihood opportunities (Kazungu *et al*., 2021). Studies also found that membership in forest products-related groups or any social network is critical for exchanging information between members and even the pursuit of a common goal (Suleiman *et al*., 2017; Adongo *et al*., 2019).

Table 2
Variables hypothesized to influence households' decision to participate in Rosehip or not as a harvester

| Variable definition | Variable measurement unit | Expected sign |
|---|---|---|
| **Dependent Variable** | | |
| Participation in the harvesting of rosehip | 1 = household harvested rosehip 0 = otherwise | |
| **Independent Variables** | | |
| Age of household head | Number of years | + / - |
| Education level | Numbers of years spent at school | - |
| Household size | Total members in the households | + |
| Gender | 1 = Male 0 = Female | - |
| Occupation of household head | 1 = Salaried job<br>0 = Otherwise | - |
| Group membership | 1 = Yes 0 = No | + |
| Social grants | 1 = Yes 0 = No | + / - |
| Wage income | Household income in Maloti | - |
| Economic perception index | PCA Indices | + / - |
| Social perception index | PCA Indices | + / - |
| Environmental perception index | PCA Indices | + / - |

In contrast, variables such as gender, education, occupation of the household head and wage income expected to have a negative correlation with participation in rosehip harvesting. Years of formal education of household members influence the nature and decisions of their economic activities (Mulenga *et al*., 2011; Adongo *et al*., 2019). In most cases male-headed households tend to be well-off relative to female-headed households (Kamanga *et al*., 2008). Suleiman *et al*. (2017) observed that households that earn wages are more likely to invest their time in other parts of the economy rather than on natural resource collection. A household head with a permanent job is also expected to have lower chances of participating in rosehip harvesting. Lastly, social, economic and environmental perceptions are expected to have either a positive or negative association with participation in rosehip harvesting. Previous studies (Shackleton *et al*., 2019; Sosa *et al*., 2021) reported that increased knowledge about invasive species issues could change how the community perceives them, thus influencing their participation decision.

# 3. Results And Discussion

# 3.1. Descriptive Statistics

Table 3 presents the households' socio-economic characteristics according to their groups of harvesters and non-harvesters. Rosehip harvesters were different to non-harvesters across various socio-economic characteristics, such as household size, gender and occupation.

Table 3
Socio-economic profile of rosehip harvesters and non-harvesters

| | Means + SD | | T- test |
|---|---|---|---|
| | Harvester (n = 80) | Non-harvester (n = 80) | |
| Age of household head | 49.25 (14.86) | 45.56 (20.18) | 1.316 |
| Education level (years completed) | 6.18 (2.68) | 6.61 (3.96) | -0.678 |
| Household size | 4.41 (1.88) | 3.59 (1.83) | 2.815* |
| Gender of household head | 0.14 (0.35) | 0.40 (0.45) | -3.896* |
| Occupation of household head | - | 0.05 (0.22) | -2.039** |
| Group membership | 0.67 (0.47) | 0.79 (0.41) | -1.608 |
| Significance level * (1%), ** (5%) *** (10%) | | | |

Harvesters had a larger average household size (4.41 ± 1.88, $p < 0.01$) than non-harvesters. According to Meyer and Nishimwe-Niyimbanira (2016), large households, are more likely to be poor because they lack financial resources. Furthermore, non-harvesters had more salaried jobs ($z = -3.15$, $p < 0.05$) compared to harvesters who mostly depended on rosehip. As a result, to alleviate the effects of poverty, harvesters were forced to engage in several income-generating activities, such as rosehip harvesting. Results also show that harvesters are dominated by females and older people. According to Godoy (2004) and Nwosu and Ndinda (2018), gender substantially influences one's vulnerability to poverty, with women being more prone to falling into and becoming trapped in poverty. Women were also more likely to turn to rosehip collecting since they generally had lower levels of education, therefore they were in greater need of income to support their families. Rosehip harvesting provides an opportunity to generate revenue with relatively minimal skill requirements, as illiteracy rates indicate the limits on women's access to various forms of assets (Nwosu & Ndinda, 2018).

# 3.2. Perceptions and Use of Rosehip in Lesotho

# 3.2.1. Social Dimensions

Most of the respondents had a favourable social perception of rosehip (Table 4). They agreed that rosehip harvesting allows them to connect with others in the rosehip sector. They also agreed that rosehip

harvesting enhances the ability of individuals to cooperate through stokvels where they save money earned from selling rosehips and buy larger quantities of fertilizer for the next planting season. This implies that rosehip plays a valuable role in contributing to social capital by supporting community relationships and helping build trust and solidarity among harvesters.

Table 4
Social perceptions of Rosehip

| PERCEPTIONS | Mean | Std. Deviation |
|---|---|---|
| **Social** | 4.11 | 1.179 |
| Rosehip harvesting helps people to connect with others in the rosehip sector | | |
| Harvesting of rosehip helps build trust and solidarity among harvesters | 4.06 | 1.194 |
| Rosehip harvesting enhances the ability of individuals to cooperate through stokvels | 3.75 | 1.410 |
| Rosehip harvesting improves involvement in social groups | 2.07 | 1.059 |

# 3.2.2. Economic Dimensions

As shown in Table 5, community members viewed rosehip as having a beneficial economic impact. Most respondents agreed that rosehip harvesting creates job opportunities and is a source of household income. Although rosehip is only available for three months, from March to June, it provides temporary jobs to vulnerable households when they most need income before harvesting crops in the fields. Even though rosehip is seasonal, it helps relieve cash flow problems for the poor. This is consistent with previous research on the impact of invasive alien species on livelihoods (Shackleton *et al*., 2011; Kull *et al*., 2011; Ntsonge & Fraser, 2021. It also serves as a safety net in times of a crisis because they can generate income from the sales of rosehip. Most respondents also felt that poor households relied more on rosehip harvesting to meet their basic needs.

Table 5
Economic perceptions of Rosehip

| PERCEPTIONS | Mean | Std. Deviation |
|---|---|---|
| **Economic**<br>Rosehip harvesting creates job opportunities | 4.28 | 0.940 |
| Rosehip harvesting is a source of household income | 4.46 | 0.699 |
| Rosehip harvesting helps to improve household food security | 4.42 | 0.609 |
| Rosehip harvesting serves as a safety net in terms of a crisis | 4.21 | 0.952 |
| Poor households are more dependent on rosehip harvesting to fulfil basic needs | 4.21 | 1.118 |
| The plant does not reduce the yields of farming land | 3.65 | 1.347 |

# 3.2.3. Environmental Dimensions

Most respondents were undecided whether rosehip is safe for the environment (Table 6). This is attributed to the fact that people typically have negative perceptions of thorny plants when it comes to the environment (Shackleton *et al.*, 2019). Only those who benefit from the plant believe it is not harmful to the environment. Additionally, respondents were unsure whether rosehip affected pasture productivity. This is because the grass continued to grow in the presence of rosehips. Others demonstrated that the rosehip plant could be used as fodder for goats, particularly during the dry season. Respondents also agreed that rosehip aids in the recovery of degraded forests because they act as nursery plants. Finally, most respondents recognised that rosehip aids in soil erosion control. This is owing to the belief that the primary purpose of introducing rosehip in Lesotho was to control soil erosion. Furthermore, respondents agreed that rosehip does not alter forest structure and regeneration. Rosehip thrives in the forest and poses no threat to the environment.

Table 6
Environmental perceptions of Rosehip

| PERCEPTIONS | Mean | Std. Deviation |
|---|---|---|
| **Environmental**<br>Rosehip harvesting is not harmful to the environment | 3.84 | 1.098 |
| Rosehip does not have an impact on pasture productivity | 3.48 | 1.405 |
| Rosehip helps to recover degraded forests as they act as nurse plants | 3.64 | 0.993 |
| Rosehip does not exacerbate soil erosion processes | 4.19 | 0.818 |
| Rosehip harvesting does not alter the forest structure and regeneration | 3.90 | 1.145 |
| Harvesting of rosehip does not alter the rate of growth, reproduction, and survival of the harvested plant | 3.89 | 1.085 |
| Rosehip harvesting permits population persistence in the long term | 3.90 | 0.998 |
| Harvesting of rosehip does not deplete nutrient levels of the plant | 3.39 | 0.965 |
| The plant does not reduce water quantity | 3.15 | 0.870 |

# 3.3. Contribution of Rosehip to Household Income

## 3.3.1. Household income by sources

Table 7 illustrates the percentage share of household income by sources. Results show that remittances, social grants and wage income are the most crucial household income sources in the study areas. These results are consistent with those of Crush *et al.* (2010), who revealed that most households in Lesotho's rural communities rely on remittances for a livelihood due to high domestic unemployment and declining agricultural production. These sources of income are followed by crops and livestock. The results also revealed that rosehip income represented the smallest income component, accounting for only 2% of total household income on average.

Table 7
Household Annual Income

| Income type | Average household annual income (Maloti) | Minimum | Maximum | Standard Deviation | Share (%) of income per year |
|---|---|---|---|---|---|
| Remittances | 11377 | 500 | 60000 | 12609 | 34 |
| Social grants | 8043 | 1080 | 9600 | 3190 | 24 |
| Wage | 7344 | 200 | 72000 | 11910 | 23 |
| Crop | 3232 | 80 | 24900 | 4298 | 10 |
| Livestock | 3058 | 140 | 14320 | 3574 | 9 |
| Rosehip | 631 | 120 | 3000 | 598 | 2 |
| **Total** | | | | | 100 |

## 3.3.2. The differences in household income sources between harvesters and non-harvesters

Significant differences in reported household income sources were discovered between harvesters and non-harvesters (Table 8). There was a significant difference between the groups with respect to remittances.

Table 8
Differences in income sources between the harvester and non-harvester groups

| | Rosehip Harvesting | | Mann-Whitney U Test |
|---|---|---|---|
| | Harvester (n = 80) | Non-harvester (n = 80) | |
| **Income type** | **Mean** | **Mean** | **Sig** |
| Remittances Income | 16.55 | 29.52 | 0.001* |
| Rosehip Income | 40.50 | 0 | |
| Wage Income | 16.25 | 22.32 | 0.132 |
| Social Grants | 12.00 | 13.79 | 0.389 |
| Livestock Income | 26.11 | 31.79 | 0.196 |
| Crop Income | 44.87 | 58.96 | 0 .016** |
| Significance level * (1%), ** (5%) | | | |

There was no significant difference between harvester and non-harvester groups regarding wages, social grants, and livestock incomes. However, the non-harvester group obtained more income from crops than the harvester group ($z= -2.400$, $p < 0.05$). Obviously, the harvester group received income from rosehip, whereas the non-harvester group relied either on remittances or crops. This implies that the harvesters were compelled to harvest rosehip to supplement their income.

# 3.4. PCA Results

Tables 9, 10 and 11 demonstrates the PCA results obtained prior to generating the social, economic and environmental perception indices. Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests were used to determine whether the data was adequate for principal component analysis. In the KMO test, where values range from 0 to 1, values greater than 0.5 are recommended as being acceptable for applying PCA (Kaiser, 1960). The KMO value for the social, economic and environmental perceptions were 0.525, 0.611 and 0.525, respectively, making it suitable for conducting PCA. The statistically significant Bartlett's sphericity test ($p < 0.05$) indicates sufficient correlation between variables to proceed with the PCA analysis. Two components with eigenvalues greater than one were retained using the Kaiser criterion. A cut-off point of 0.50 was adopted in this study (Hadia *et al.*, 2016).

**Table 9: Generation of the Social Perception Index: PCA Results**

| | Principal Components | |
|---|---|---|
| | Social networks | Social development |
| Rosehip harvesting helps people to connect with others in the rosehip sector | **0.804** | -0.001 |
| Rosehip harvesting improves involvement in social groups | **0.730** | 0.100 |
| Harvesting of rosehip helps build trust and solidarity among harvesters | -0.119 | **0.830** |
| Rosehip harvesting enhances the ability of individuals to cooperate through stokvels | 0.241 | **0.672** |
| Summary statistics | | |
| Eigenvalues | 1.345 | 1.056 |
| % variance | 31.287 | 28.745 |
| Cumulative % of variance | 60.031 | |
| KMO statistics | 0.525 | |
| Bartlett's test of sphericity | 16.332 | |
| p-value | 0.012 | |

*Note: Bold items indicate significant factor loadings*

The first principal component (PC1) has higher explanatory power, accounting for 31 percent of the variation in overall household social perceptions of rosehip (Table 5). The second principal component (PC2) accounted for 28.7 percent of the variation. The two PCs explained sixty percent of the total variation in the data. As a result, both PCs were retained because they account for such a large proportion of the variance in the variables that they may be used to generate the social perception indices without much loss in information (Muchara *et al*., 2014). The first component was named social networks because it is dominated by two variables that emphasise rosehip's importance in bringing people together and improving participation in social groups. PC2 was named social development because it is dominated by rosehip's ability to build solidarity among harvesters and improve cooperation through a stokvel. The generated indices were then used as explanatory variables to represent households' social perceptions of rosehip.

As shown in Table 10, the first principal component has higher explanatory power, accounting for 32 percent of the variation in overall household economic perceptions of rosehip. The second principal

component accounted for 22.7 percent of the variation. The two PCs explained about 54 percent of the total variation in the data.

**Table 10: Generation of the Economic Perception Index: PCA Results**

| | Principal Components | |
|---|---|---|
| | Household welfare improvement | Job creation |
| Rosehip harvesting is a source of household income | **0.649** | 0.157 |
| Rosehip harvesting helps to improve household food security | **0.671** | 0.100 |
| Rosehip harvesting serves as a safety net in terms of a crisis | **0.714** | -0.196 |
| Poor households are more dependent on rosehip harvesting to fulfil basic needs | -0.162 | **0.854** |
| Rosehip harvesting creates job opportunities | 0.398 | **0.615** |
| Summary statistics | | |
| Eigenvalues | 1.608 | 1.136 |
| % variance | 32.165 | 22.728 |
| Cumulative % of variance | 54.892 | |
| KMO statistics | 0.611 | |
| Bartlett's test of sphericity | 40.053 | |
| p-value | 0.000 | |

*Note: Bold items indicate significant factor loadings*

The first principal component was named household welfare improvement. It is dominated by three variables demonstrating that rosehip contributes to household income, acts as a safety net in times of crisis, and improves household food security because people can buy food after receiving income. The second principal component is dominated by two variables that indicate that rosehip creates job opportunities for poor households because they rely on it to meet their basic needs. As a result, PC2 was given the name job creation. In addition, the generated indices were used as explanatory variables to represent households' economic perceptions of rosehip.

As presented in Table 11, the first principal component has higher explanatory power, accounting for about 29 percent of the variation in overall household social perceptions of rosehip. The second principal component accounted for 21 percent of the variation. The two PCs explained almost fifty percent of the total variation in the data.

Table 11
Generation of the Environmental Perception Index: PCA Results

| | Principal Components | |
|---|---|---|
| | **Environment conservation** | **Soil conservation** |
| Rosehip helps in the recovery of degraded forests as they act as nurse plants | **0.731** | − .288 |
| Harvesting of rosehip does not alter the rate of growth, reproduction, and survival of the harvested plant | **0.690** | .332 |
| Rosehip improves the forest structure and regeneration | **0.677** | − .351 |
| Rosehip improves pasture productivity | **0.634** | − .079 |
| Rosehip harvesting is not harmful to the environment | 0.095 | **0.723** |
| Rosehip helps to control soil erosion | − .087 | **0.578** |
| Summary statistics | | |
| Eigenvalues | 1.427 | 1.069 |
| % variance | 28.547 | 21.380 |
| Cumulative % of variance | 49.928 | |
| KMO statistics | 0.525 | |
| Bartlett's test of sphericity | 25.413 | |
| p-value | 0.005 | |
| *Note: Bold items indicate significant factor loadings* | | |

The first principal component is named environment conservation, and dominated by rosehip's importance on pasture productivity, recovery of degraded forest, and forest structure and regeneration improvement. The second PC is dominated by soil erosion control and rosehip's friendly nature on the environment; therefore, PC2 was named soil conservation. The generated indices were then used as explanatory variables to represent the environmental perceptions of rosehip among households.

# 3.5. Factors influencing Individual's decisions to participate in Rosehip Harvesting

Table 12 demonstrates the probit model results of the factors that affect the household decision to participate in rosehip harvesting or not. The chi-square is highly significant, at 1%, signifying that the model fits the data well, and $R^2$ is 0.30, which

is considered good for cross-sectional data. The variance inflation factor (VIF) is 1.61, indicating that multicollinearity is not a significant issue among the independent variables since it is less than 10 as per

the rule of thumb (Gujarati 2009).

Male-headed households have a 40 percent lower probability of participating in rosehip harvesting. Consistent with prior expectations, the negative correlation of gender with the individual's decision to participate in rosehip harvesting suggests that women headed households relied more on rosehip harvesting because they are likely to have larger households, are often poorer and thus greater demands on them. According to Adongo *et al.* (2019), most men do not participate in harvesting because it is assumed that collecting forest products is the responsibility of women. In this study, out of 80 respondents involved in rosehip harvesting, 69 were female. Hutchinson (2020) discovered that men primarily feel the impact of rosehip on grazing lands and local medicinal species because livestock herding is their primary responsibility; as a result, they may not participate in rosehip harvesting because the plant affects them negatively.

The findings also revealed that the education level of the household head is statistically significant at a 5% level and has a negative association with participating in rosehip harvesting as expected. A unit increase in the years of education reduces the probability of participating in rosehip harvesting by sixteen percent. This could be because the years of formal education of household members influence the nature and decisions of their economic activities and hence are less likely to be involved in rosehip harvesting (Mulenga *et al*., 2011). This finding is consistent with the findings of Tassou (2017) who argued that education increases one's chances of finding employment compared to lower-educated households, which are mostly poor and vulnerable. As a result, they are compelled to extract forest resources to earn a living. Human capital was low in all study regions due to a lack of education since most respondents (70 percent) reported having either primary education or no education at all.

Household size is statistically significant at a 5% level and positively influences a household's decision to collect rosehip as expected. For a unit increase in the household size, the probability of collecting rosehip increased by 18 percent. This implies that people with larger household sizes were compelled to participate in rosehip harvesting more than those with fewer members because they have more people to feed. This finding backs up previous research that found a positive and significant relationship between household size and forest resources dependency (Aung *et al*., 2014; Adongo *et al*., 2019). According to Suleiman *et al.* (2017), large families have limited land holdings and high food dependency ratios, so they rely on natural resource collection due to the availability of family labour.

Table 12
Probit regression of factors influencing individual's decisions to participate or not in rosehip harvesting

| **Dependent variable: household participate or not in rosehip as a collector (1 = Yes, 0 = No)** | | | |
|---|---|---|---|
| **Variables description** | **Coefficients** | **Standard Error** | **Marginal effects** |
| Age of household head | -0.018 | 0.003 | 0.013 |
| Gender of household head<br>1 = Male 2 = Female | -1.103* | 0.300 | -0.402 |
| Education of household head | -0.412** | 0.226 | -0.164 |
| Household size | 0.463** | 0.213 | 0.184 |
| Occupation of household head 1 = Salaried job 0 = Otherwise | -0.013 | 0.266 | -0.005 |
| Social grants | -0.000 | 0.000 | -0.00003 |
| Wage income | -0.000* | 0.000 | -0.00003 |
| Group membership<br>1 = Yes 2 = No | -0.397 | 0.300 | -0.157 |
| *Social perception index 1*:<br>Social networks | 0.556* | 0.200 | 0.222 |
| *Social perception index 2*:<br>Social Development | 0.148 | 0.127 | 0.059 |
| *Economic perception index 1*: Household welfare improvement | 0.313** | 0.164 | 0.125 |
| *Economic perception index 2*:<br>Job creation | 0.142*** | 0.080 | 0.056 |
| *Environmental perception index 1*: Environment conservation | 0.212** | 0.123 | 0.084 |
| *Environmental perception index 2*: Soil conservation | 0.075 | 0.091 | 0.030 |
| Constant | 0.705 | 0.806 | |
| Log likelihood = -77.505, LR chi$^2$(14) = 66.80, Prob > chi$^2$ = 0.000, Pseudo $R^2$ = 0.301 Significance level * (1%), ** (5%), *** (10%) | | | |

Consistent with *a priori* expectations, wage income is statistically significant at a 1% level and negatively associated with household participation in rosehip harvesting. For a unit increase in wage income, the probability of participating in rosehip harvesting reduces by a meagre amount. The findings revealed that,

when compared to high-income families, low-income households derived the main share of their household income from rosehip. Suleiman *et al*. (2017) observed that households that earn wages are more likely to invest their time in other parts of the economy rather than relying on natural resource collection. Higher-income households can achieve livelihood outcomes by purchasing food to reduce food insecurity (DFID, 1999). In contrast, low-income households extensively rely on natural resource gathering to supplement their financial capital as a means of navigating their vulnerability to economic and environmental shocks, as well as agricultural variability (Mulenga *et al*., 2011; Gautam & Andersen, 2016). Financial capital was low in all four community councils, as most rosehip harvesters stated that the primary reason they engaged in rosehip harvesting was that they were unemployed.

Social perception (social networks) is statistically significant at a 1% level and positively associated with a household's participation in rosehip harvesting. People aware of rosehip's ability to build social networks in the community have a 20 percent higher probability of participating in rosehip harvesting than those who are not informed. This is aligned with the findings of Marshall *et al*. (2011) and Faham *et al*. (2008), who noted that social networks are an excellent predictor for participation in natural resource activities. This is related to the reason that membership in any social network is crucial in disseminating valuable information on other poverty-reduction measures during meetings and striving for a common goal (Suleiman *et al*., 2017). This was also the case in this study, as participants reported being able to form a Stokvel in which they save money obtained from selling rosehips and buy larger quantities of fertiliser for the following planting season, which they then distribute among themselves. This indicates that rosehip contributes to social capital through strengthening community bonds and bringing people together in the community.

The positive correlation between household welfare improvement (economic perception) and participation in rosehip harvesting suggests that people who believe rosehip positively impacts household welfare are 13 percent more likely to participate in rosehip harvesting, as expected. The finding is consistent with previous research on the impact of invasive alien species on livelihoods (Shackleton *et al*., 2011; Kull *et al*., 2011; Mulenga *et al*., 2011; Ntsonge & Fraser, 2021), which found that most rural households participate in forests products extraction to improve their household welfare. In this study, a higher proportion of poor households were engaged in rosehip harvesting than wealthier households with several sources of income. Some harvesters reported that their lives have improved after harvesting since they could afford what they want due to the rosehip money. Furthermore, job creation has a significant and positive influence on household participation in rosehip harvesting. Those who believe that rosehip creates job opportunities have a six percent higher probability of participating in rosehip harvesting. This implies that, despite the reality that rosehip is only available for three months, it plays a significant role in providing seasonal employment to vulnerable households given Lesotho's high unemployment rate.

Environmental perception (environment conservation) is statistically significant at a 5% level and positively associated with the household's participation in rosehip harvesting. This relationship is consistent with *a priori* expectations as people who do not see any negative impacts on rosehip were expected to engage in rosehip harvesting. People who recognise the environmental benefits of rosehip are

eight percent more likely to participate in rosehip harvesting than those who do not. This suggests that whoever believes rosehip negatively affects the environment, such as reducing grazing and farming lands, may refrain from harvesting rosehip. Kull *et al.* (2011) discovered that despite Australian acacias' invasive nature, local communities worldwide value them for their perceived soil, climatic, and fuelwood benefits. Perceptions of IAS may be favourable when people are positively impacted and negative when they are negatively impacted (Pfeiffer & Voeks, 2008; Shackleton *et al.*, 2019).

# 4. Conclusion

This study's evidence suggests that IAS are neither evenly problematic nor evenly beneficial. The social, economic, and natural environment benefits that a species provides influence rural communities' perceptions. Households' perceptions of rosehip have proven that rosehip is a valuable species used for various livelihood activities. Positive perceptions stem from its benefits, while negative perceptions stem from environmental impacts. However, the results showed most people in rural areas have little knowledge of invasive alien species, with only a small percentage having heard the term. This results from low human capital across all the study areas due to low education levels and old age. Therefore, it is crucial to have knowledge of invasive alien species and their threshold points to discover the efficient point to intervene in their management to avoid more detrimental impacts.

Evidence from this study suggests that rosehip harvesting provides a supplementary income that contributes towards alleviating poverty in Lesotho's rural communities. The contribution rosehip makes to the livelihoods of harvesting households is mostly variable and depends on the necessity for cash in the household. It is mostly the low income, uneducated and female-headed households who are more dependent on rosehip harvesting for income generation due to lack of other sources of income. This suggests that rosehip harvesting is viable for marginalised households with fewer job opportunities and are less prepared to insure against uncertainties than higher-income households. Thus, while rosehip income is extremely low and seasonal, it is essential to relieve cash flow problems for the poor. Most harvesters indicated that they would like to have a high abundance of rosehip; thus, it is recommended that policymakers and decision-makers acknowledge the rosehip sector to widen rural development. The government may establish a plantation of rosehip as a sustainable livelihood that can be harvested in large quantities throughout the year.

# Declarations

Ethical Approval and Consent to Participate: Ethical approval was obtained from the Rhodes University Human Ethics Committee for the survey. All respondents signed a consent form to be interviewed.

Human and Animal Ethics: Ethical approval was obtained from the Rhodes University Human Ethics Committee for the survey. No animal ethical approval was necessary.

Consent for Publication: Not applicable.

Availability of Supporting Data: The data set for the study is available from the corresponding author.

Competing interests: Not applicable.

Funding: Thato Makhorole received funding from the Environmental and Natural Resources Focus Area of the Department of Economics and Economic History, Rhodes University. This was to cover her fees, accommodation and survey expenses.

Authors' contributions: Thato Makhorole was the primary researcher as the research was for her Master's degree. She also wrote the first draft of the paper. Prof Gavin Fraser and Dr Sandile Phakathi were supervisor and co-supervisor for the thesis respectively. They also refined the initial draft of the paper to reach the final stage.

Acknowledgements: Environmental and Natural Resources Focus Area of the Department of Economics and Economic History, Rhodes University for funding for the research.

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# Figures

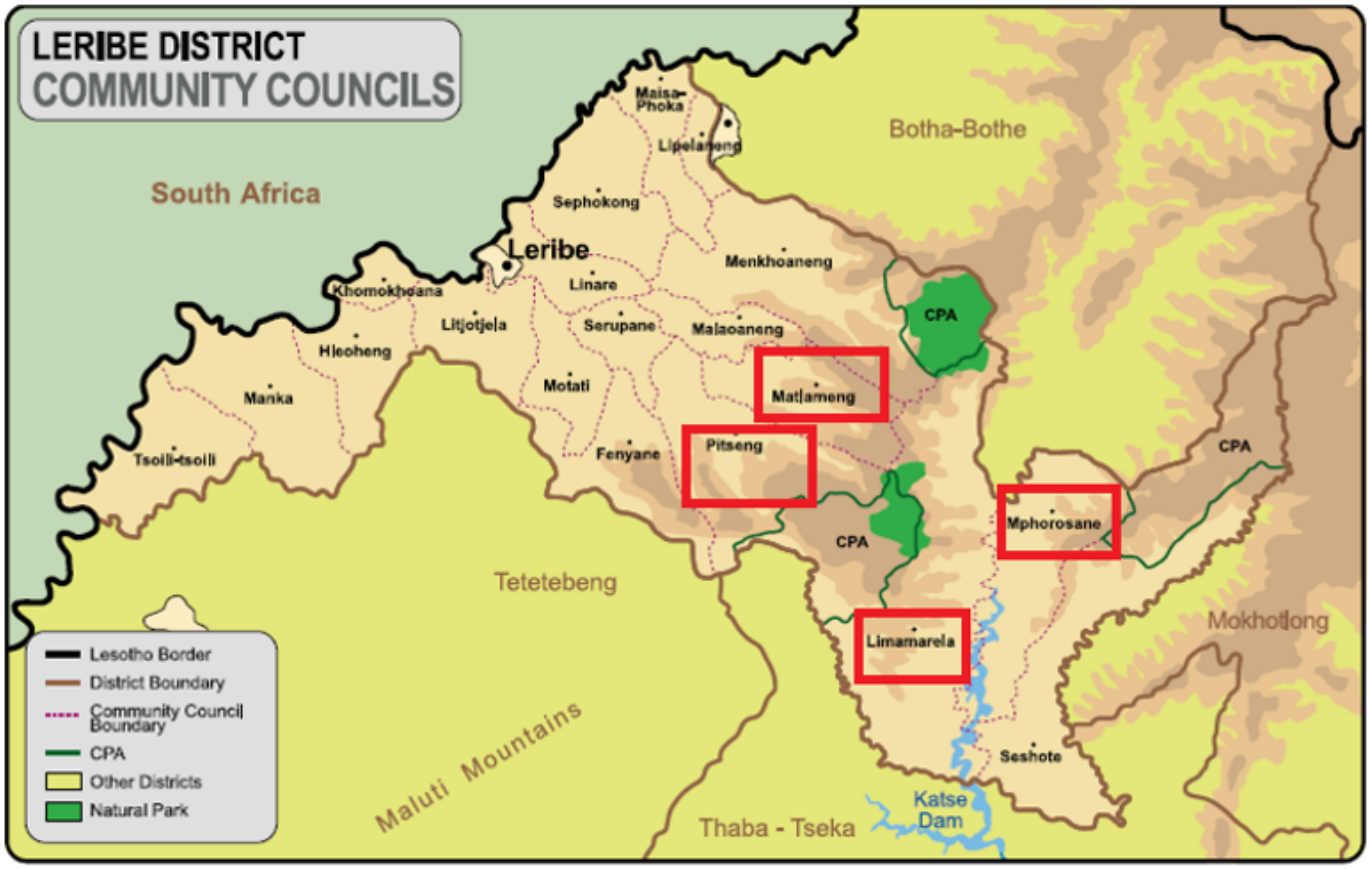


Figure 1

Map of Leribe district Lesotho, rectangles show sampled areas.

*Source:* Adapted from Trillo-Figueroa, 2009