Status of Wild Olive in Murree, Kahuta and Kotli Sattian National Park

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Abstract

This study investigates the ecological and socioeconomic significance of wild olive (Olea ferruginea) within Murree, Kahuta, and Kotli Sattian National Park. A comprehensive field survey was conducted using the fixed area plot method and quadrate sampling. Results showed considerable variability in tree distribution, with the number of trees per site ranging from 1 to 99 and a mean of 50.49 trees. The high standard deviation (29.16) and variance (850.25) indicated moderate clustering in certain areas. Tree ages ranged from 7 to 10 years (average: 9.29), with 47.5% of trees being 10 years old and only 3% being 7 years old, suggesting limited recent regeneration. Height distribution ranged from 6 to 14 feet (average: 9.13 feet), with most trees falling between 8–10 feet. Diameter at breast height ranged from 4 to 58 cm, with over 80% representing medium-sized trees, while larger specimens were scarce. Standard deviations and variance in growth patterns point to potential environmental or genetic influences. The study highlights a moderately healthy population with signs of regeneration; however, the low proportion of younger and larger trees emphasises the need for targeted conservation measures to support sustainable population dynamics and long-term ecological stability of the wild olive in the park.

Keywords: Wild Olive, National Park, Murree, Kahuta, Kotli Sattian.

Introduction

The olive tree, recognised globally as one of the most iconic plants and locally referred to as Zaitoon or Zaytoon in Urdu, is a significant evergreen species from the Oleaceae family. Scientifically known as *Olea europaea*, its name originates from the Latin word "oleum" and the

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Greek word "elaia"(Kaniewski et al., 2022). Classified as a drupe or stone fruit, the olive has an impressive lifespan of 900–1000 years. Historical records indicate that humans have used olives and their oil for over 6,000 years. There are approximately 600 species and 30 genera of olives, with around 800 million olive trees growing worldwide. The International Olive Council (IOC) reports that approximately 139 cultivars or varieties of olives are cultivated across 23 countries, accounting for more than 85% of global olive production (Mohamed, 2017).

Spain is the leading producer of olives globally, yielding around 900,000 tons of olive oil and 380,000 tons of table olives annually from approximately 1.5 million hectares of olive farms (Saqib et al., 2019). Archaeological evidence suggests that olives were among the earliest fruit trees to be domesticated in the region now known as Spain, situated along the eastern edge of the Mediterranean basin. Following Spain, Italy and Greece are among the most prominent olive-producing countries. Overall, European nations account for the majority of olive oil production (78%), although olive cultivation has also expanded to regions such as California, South Africa, and Australia (Dawson, 2020).

There are several health benefits associated with olive fruit. Olive oil offers a range of nutritional benefits, including antioxidant, anti-cancer, antidiabetic, antitoxin, and antimicrobial properties. By controlling blood cholesterol levels, the unsaturated fatty acids found in edible olive oil help prevent cardiovascular diseases. Polyphenols found in olive leaves, such as oleuropein, caffeic acid, and p-coumaric acid, are responsible for their antibacterial and antitoxin properties. Olive leaves may be used to make olive tea, animal feed, and leaf extract (for various uses (Ozturk et al., 2021).

Cold winters, scorching summers with little precipitation, and moderate soil conditions are all ideal for olive development. Brutal winters, which last for two months and have temperatures between 2.0 °C and 19.0 °C, are ideal for the initiation and growth of its reproductive bud. In addition to requiring less water, fertiliser, and pesticides than other oilseed plants, olive orchards also demand less energy and fuel during processing. They can withstand drought as well as mild, wet climates with 900–1000 mm of annual precipitation. Freezing temperatures and waterlogging are detrimental and can potentially cause the plant to die. There are millions of wild olive trees in Pakistan. Olive farming is mostly only feasible in arid, steep regions of the nation. Several problems, including the limited availability of saplings, a shortage of high-quality genetic material, a low success rate for grafted olive trees, and a lack of understanding about the economic significance of the crop, cause reduced cultivation in the nation. Although sunflower, mustard, groundnuts, and maize are ideal for oil extraction, they cannot satisfy the growing demand for edible oil. As a result, importing edible oil incurs a significant annual expenditure of foreign currency. The past several decades have seen a decline in the capacity of agricultural areas to access water, making them more vulnerable to environmental pressures, especially drought. Due to its low water requirements and ability to be grown in arid regions and on poor-quality soils, olive production can help address these issues.

Additionally, it is a significant source of oil that is high in nutrient-dense lipids and preserves the delicate natural resources. The country's tropical environment makes it ideal for growing olives. The Barani Agricultural Research Institute for Pakistan has identified a large number of olive varietals. In addition to expanding the country's agricultural area, growing olives in arid and semi-arid areas like Chakwal, Fateh H. Jang, Zhob, Loralai, Killa Saifullah, Barkhan, North Waziristan, Bajaur Agency, Mohmand Agency, Kurram Agency, Hangu, Khyber Agency, South Waziristan, Mala Kand, Charsadda, and Haripur will enhance the production of edible oil. In the area next to Kallar Kahar, the Izhar Group of Companies has planted 30,000 plants (Jan et al., 2021).

Over the past decade, Pakistan has made significant progress in cultivating and producing olives. Historical records indicate that olive trees have been present in the region for a long time. During the 1950s, grafted olive plants were imported and planted in several areas, including Sargodha, Jhelum, Rawalpindi, the Simla and Kangra Hills, Zhob, Swat, and Azad Jammu and Kashmir (AJK). However, substantial efforts to promote olive cultivation in Pakistan began in 1986 when the Pakistan Agricultural Research Council (PARC) reintroduced them under the "Fruit, Vegetable, and Olive Project," funded by the Italian government. As part of this project, experimental cultivation of *Olea cuspidata* and *Olea ferruginea* was carried out in various suitable regions, such as Potohar in Punjab, the former Federally Administered Tribal Area (FATA) in KPK, and parts of Balochistan (Khaliq et al., 2020).

Although olive cultivation largely depends on favourable soil and climate, Pakistan's overall climate poses challenges. However, specific areas in Khyber Pakhtunkhwa (KPK), Balochistan, and Punjab's Potohar region provide ideal conditions for growing olives. In 1991, the first olive harvest in Chakwal, a semi-arid, rain-fed area of Punjab, revealed that the cultivated olives were larger and contained more oil than wild varieties. Subsequent studies identified millions of wild olive plants across Pakistan. Despite these findings, a federal government initiative that planted over 5 million olive seedlings later reported a survival rate of only 1% (Abdulrahman & Al-Bamarny, 2020).

Recent studies have revealed that olive tree leaves, like olive fruits, are rich in numerous nutritional and therapeutic compounds. Leaf extracts possess properties such as hypoglycemic, astringent, hypotensive, diuretic, and antibacterial effects, and they are also effective in soothing coughs. Due to their high concentration of phenolic compounds, olive leaves have recently been incorporated into pharmaceutical, cosmetic, and medicinal products. Additionally, there is significant potential for utilising olive leaves in animal feed. When used as fodder, they can enhance the nutritional value of fermented milk without compromising the survival of the lactic acid bacteria naturally present in raw milk. Moreover, ground olive leaves have proven to be an eco-friendly and effective alternative to traditional adsorbents for treating wastewater containing heavy metal ions (Ali et al., 2024).

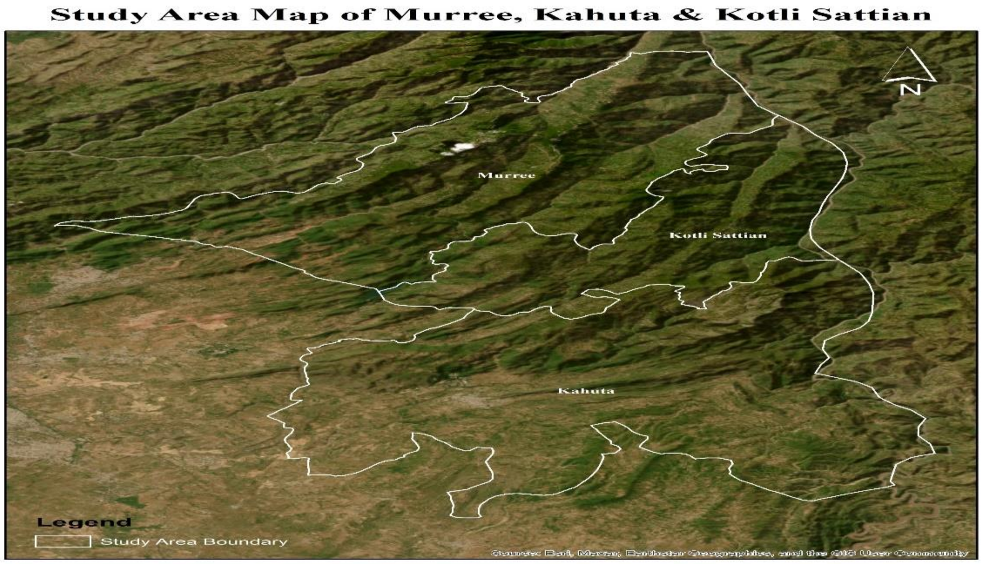
Materials and Methods

Study Area

The present research work was conducted to assess the status of wild olive in Murree, Kahuta, and Kotlisattian National Park (MKSKNP). It is located in Rawalpindi District, Punjab, Pakistan, within the sub-Himalayan mountain range, between latitudes 33°21 ′ to 34°01 ′ N and longitudes 73°11 ′ to 73°38 ′ E. Spanning an area of 934 square kilometres, the park's elevation ranges from 500 to 2,270 meters. The park is bordered by the Jhelum River to the east, Islamabad to the west, Khyber Pakhtunkhwa to the north, and Gujar Khan to the south. While lower elevations feature relatively flat terrain, the majority of the area consists of steep slopes interspersed with narrow valleys. The soil in the region comprises both residual and transported types.

A comprehensive field survey was conducted to collect data on the distribution, density, and health of wild olive populations. The dominant species are *Acacia modesta*, *Olea ferruginea* and *Dodonea viscosa*.

Figure 1: GIS Map of study area



Materials or Equipment's

The following equipment's were used for field inventory.

GPS, measuring tape, diameter tape, tree caliper, Abney's level, Field notebook. The concerned forest department of the study area was visited and compartment history files were obtained. Sampling intensity was (scattered, mountainous 2.5 %). Fixed area sample plot method was used. In this method 1/10th of hectare which is equal to 17.84 meters was taken and inventory was done in selected radius like total number of trees, diameter, age and volume.

To Find Out Current Status of Wild Olive (*Olea ferruginea*) in Murree, Kahuta, Kotli Sattian National Park

Sampling Intensity

The precision of sampling is influenced by intensity of sampling. Usually in forest sampling the intensity is taken as 2.5% because of the forest trees density, market value of growing stock and inherent diversity (Walayat, 2017). Likewise same intensity was taken in this study because of less heterogeneity in the growing stock and rather favorable terrain condition. Plot size, 1/10' of hectare which is equal to 17.84 meters was taken as standard for all the plots.

Size of Sample Plot

The sample size of experimental plot was calculated according to the following formulae:

Area of circular plot = π r2

π1?=1/10 x 10000

Where 1ha= 10000 sq. meters and plot size is equal to 1/10th of hectare.

π2=0.1 x 10000

7=1000/3.1416

(as π = 3.1416)

2=318 30r = 17.84 meter

So each circular plot of radius 17.84 meters will be taken.

Number of Plots in Each Compartment

Numbers of plots sampled in each compartment were calculated on the following basis: Say the area of a particular compartment was 51.01 ha. In order to calculate the sampled plots, sampling intensity of 2.5% was multiplied with compartment area and following procedure was adopted.

Area of a compartment = 51.01 ha

Sampling Intensity =2.5%

= .025 × 51.01

= 1.275 ha

Therefore 1.275 ha area of this compartment was sampled

Area of one plot =1/10th ha

= 1.275/0.1

= 12.75 or 13 plots

Grid Size Calculation

The number of plots calculated for each compartment was given in annex-11

4inches = 1mile (The scale of the map of a Compartment.)

To convert this inch into centimeters multiplied it with 2.54 (as 1 inch =2.54cm),will

2.54 X 4 = 1 mile10.16cm =I mile-. ... - (Equation 1)

We knew that:

1 mile = 1.62 km or

1 mile = 1620 or

1 mile = 162000cm when we added this value in the equation 1, thus we got

10.16cm = 162000cm or

1 cm = 162000/10.16

Thus

1 cm on paper = 15944.9 cm on the ground.

As plot-to-plot distance on ground in meters was 198m

In centimeters it was

= 198 × 100

= 19800cm

On Map (paper) we knewthat

1 cm = 15944 cm

So, the grid size was

= 19800/15944= 1.24 cm

Measurements

Following measurements were taken

• Tree height was measured by using Abney's level by looking at the top and bottom of the tree from reasonable distance where plant top and bottom was easily seen.

• Diameter was measured using diameter tape

• Age of the tree was measured using tree caliper.

To Find Out Current Status of Wild Olive (*olea ferruginea*) in Murree, Kahuta, Kotli Sattian National Park

Quadrate Method

To cover this objective quadrate method was used. A transect of known distance was laid and quadrata along transect were used to find out diversity index. Stratified random sampling was employed to ensure representative coverage of different habitats within the park. Data collection include GPS mapping of wild olive locations, measurement of tree height and diameter, and assessment of health indicators such as leaf condition and presence of pests or diseases. Soil samples were analyzed to understand the edaphic factors influencing wild olive growth. Additionally, interviews with local communities and park officials were conducted to gather information on historical changes in wild olive populations and current conservation practices.

Experimental Layout

The experiment was laid out according stratified random sampling design. Data were evaluated using proper statistical method and important among treatments means were associated using.
The collected data was analyzed using statistical software SPSS to identify patterns and correlations, and the results were used to develop recommendations for the conservation and management of wild olive in the park. The wild olive trees in Kahuta National Park, Murree, can reach a maximum height of approximately 10 to 15 meters. This height can vary depending on environmental conditions and soil quality within the park. While wild olive trees are not native to the Himalayan region, they are occasionally cultivated or introduced in gardens or plantations. It is possible that some wild olive trees may have escaped cultivation and established themselves in the park, especially if they were planted in the past. However, their presence would likely be limited and not a significant part of the park's natural biodiversity.

Results and Discussion

Descriptive Statistics

Table 4.1. showed that the number of plants per sample site ranges from 1 to 99, with a mean of 50.49 plants. This indicates a wide variability in tree distribution across surveyed areas, as evidenced by a high standard deviation (29.16) and variance (850.25). The data shows a moderate clustering of trees in some areas while others have sparse populations. The age of trees ranges between 7 and 10 years, with an average of 9.29 years and low variability (standard deviation: 0.80). This suggests a relatively mature population with minimal age diversity among the surveyed trees. Tree diameters exhibit significant variability, ranging from 4 to 58 cm with a mean of 9.65 cm. The standard deviation (5.51) and variance (30.36) highlight diverse growth patterns, possibly influenced by environmental factors or genetic variations. The radius of trees varies from 1.9 to 7.0 cm, averaging 5.80 cm. The standard deviation (1.28) and variance (1.64) indicate moderate variation, aligning with the observed diameter measurements. Tree height ranges from 6 to 14 feet, with an average height of 9.13 feet. Height variation is relatively small, as reflected by a standard deviation of 1.85 and a variance of 3.42. These results collectively provide insights into the population characteristics and ecological conditions affecting wild olive growth in the park.

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
No of plants	99	1.00	100.00	50.4949	2.93060	29.15909	850.253
Age	99	7.00	10.00	9.2929	.08027	.79863	.638
Diameter	99	4.00	58.00	9.6455	.55378	5.51001	30.360
Radius	99	1.90	7.00	5.7990	.12882	1.28170	1.643
Height in ft	99	6.00	14.00	9.1263	.18591	1.84974	3.422
Valid N (listwise)	99						

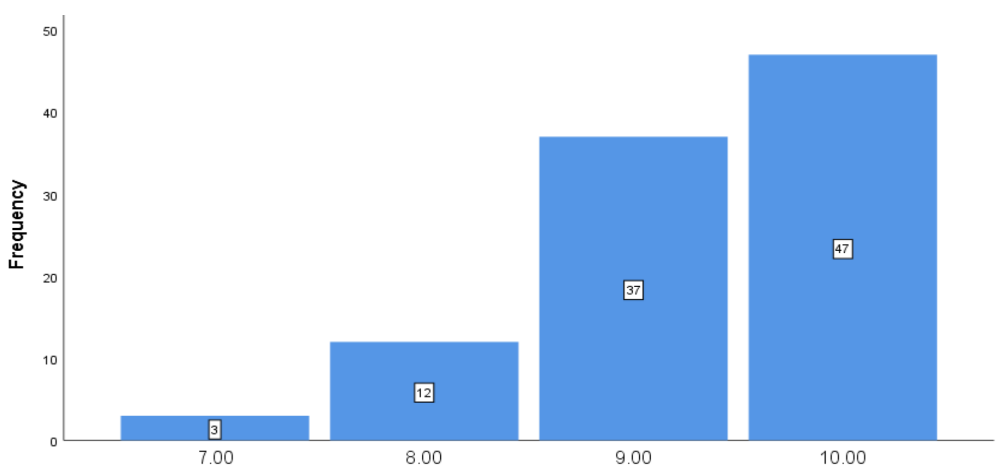
Age of Trees

The frequency distribution table 2 presents the age data of 99 wild olive trees in Kahuta National Park, Murree. The results show that the majority of trees are relatively mature, with 47.5% (47 trees) aged 10 years, making this the most common age group. The next largest age group is 9 years, accounting for 37.4% (37 trees). Younger trees, aged 8 years and 7 years, are less prevalent, with 12.1% (12 trees) and 3% (3 trees), respectively. This distribution suggests a predominance of older trees, indicating potentially limited recent regeneration. Such findings could highlight the need for conservation efforts to ensure the sustainable growth and health of the wild olive population in the park. The results were verified by (Khan et al., 2015; Khan et al., 2023).

Table 2: Frequency Distribution for Age of Trees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	3	3.0	3.0	3.0
	8.00	12	12.1	12.1	15.2
	9.00	37	37.4	37.4	52.5
	10.00	47	47.5	47.5	100.0
	Total	99	100.0	100.0	

Figure 2: Frequency distribution bar chart for age of trees



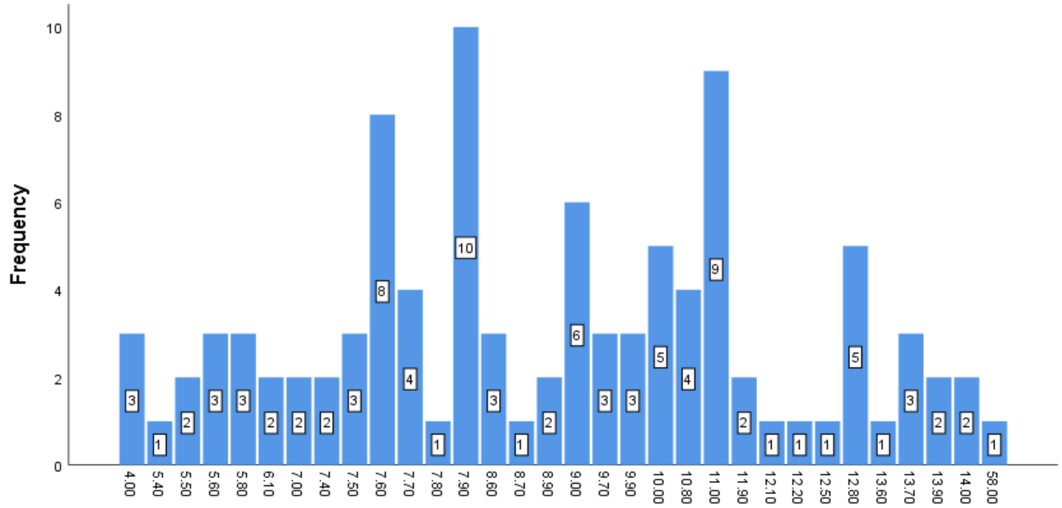
Diameter of Trees

The frequency distribution (Table 3) represented the diameters of 99 wild olive trees surveyed in Kahuta National Park, Murree. The data showed a wide range of diameters, from 4.00 cm to 58.00 cm, with the majority of tree diameters concentrated between 7.60 cm and 11.00 cm. The most frequent diameter was 7.90 cm, accounting for 10.1% of the sample, followed by 11.00 cm at 9.1%. Diameters between 7.60 cm and 11.00 cm collectively made up a significant portion, reflecting the dominance of medium-sized trees in the population. Outliers, such as the largest tree with a diameter of 58.00 cm, represented only 1% of the sample, indicating their rarity. The cumulative percentages illustrated that over 80% of the trees had diameters of 11.00 cm or less. These results highlighted the prevalence of relatively younger and medium-sized trees, suggesting ongoing regeneration but a lack of older, larger specimens in the population.

Table 3: Frequency Distribution for Diameter of trees

		Frequency	Percent	Valid Percent%	Cumulative Percent
Valid	4.00	3	3.0	3.0	3.0
	5.40	1	1.0	1.0	4.0
	5.50	2	2.0	2.0	6.1
	5.60	3	3.0	3.0	9.1
	5.80	3	3.0	3.0	12.1
	6.10	2	2.0	2.0	14.1
	7.00	2	2.0	2.0	16.2
	7.40	2	2.0	2.0	18.2
	7.50	3	3.0	3.0	21.2
	7.60	8	8.1	8.1	29.3
	7.70	4	4.0	4.0	33.3
	7.80	1	1.0	1.0	34.3
	7.90	10	10.1	10.1	44.4
	8.60	3	3.0	3.0	47.5
	8.70	1	1.0	1.0	48.5
	8.90	2	2.0	2.0	50.5
	9.00	6	6.1	6.1	56.6
	9.70	3	3.0	3.0	59.6
	9.90	3	3.0	3.0	62.6
	10.00	5	5.1	5.1	67.7
	10.80	4	4.0	4.0	71.7
	11.00	9	9.1	9.1	80.8
	11.90	2	2.0	2.0	82.8
	12.10	1	1.0	1.0	83.8
	12.20	1	1.0	1.0	84.8
	12.50	1	1.0	1.0	85.9
	12.80	5	5.1	5.1	90.9
	13.60	1	1.0	1.0	91.9
	13.70	3	3.0	3.0	94.9
	13.90	2	2.0	2.0	97.0
	14.00	2	2.0	2.0	99.0
	58.00	1	1.0	1.0	100.0
	Total	99	100.0	100.0	

Figure 3: Frequency distribution bar chart for diameter of trees



Radius of Trees

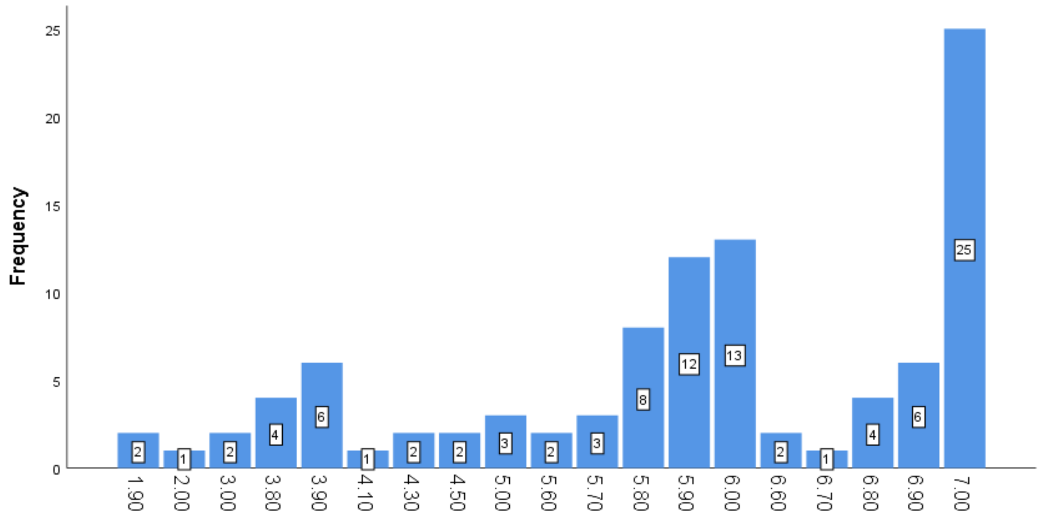
The data revealed a wide variation in tree diameters (Table 4), ranging from 1.9 to 7.0 units. The highest frequency was recorded for trees with a diameter of 7.0, accounting for 25.3% of the sample. Trees with diameters of 6.0 and 5.9 were also relatively common, representing 13.1% and 12.1% of the population, respectively. Conversely, smaller diameters, such as 2.0 and 4.1, were less frequent, each occurring only once (1%). The cumulative percentage showed that over 60% of the trees had diameters between 5.9 and 7.0, indicating a concentration of mature trees in the sample. According to the results of the present study, it was revealed that most of the wild olive trees in the park were well-developed trees, however some small diameter trees seeing the signs of regeneration. This distribution was useful in gaining understanding on the structure and health status of the wild olive trees in the study area. The same results were obtained by (Abdulrahman and Al-Bamarny, 2020).

Table 4: Frequency Distribution for radius of trees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.90	2	2.0	2.0	2.0
	2.00	1	1.0	1.0	3.0
	3.00	2	2.0	2.0	5.1
	3.80	4	4.0	4.0	9.1
	3.90	6	6.1	6.1	15.2
	4.10	1	1.0	1.0	16.2
	4.30	2	2.0	2.0	18.2
	4.50	2	2.0	2.0	20.2
	5.00	3	3.0	3.0	23.2
	5.60	2	2.0	2.0	25.3
	5.70	3	3.0	3.0	28.3
	5.80	8	8.1	8.1	36.4
	5.90	12	12.1	12.1	48.5
	6.00	13	13.1	13.1	61.6

6.60	2	2.0	2.0	63.6
6.70	1	1.0	1.0	64.6
6.80	4	4.0	4.0	68.7
6.90	6	6.1	6.1	74.7
7.00	25	25.3	25.3	100.0
Total	99	100.0	100.0	

Figure 4: Frequency distribution bar chart for radius of trees



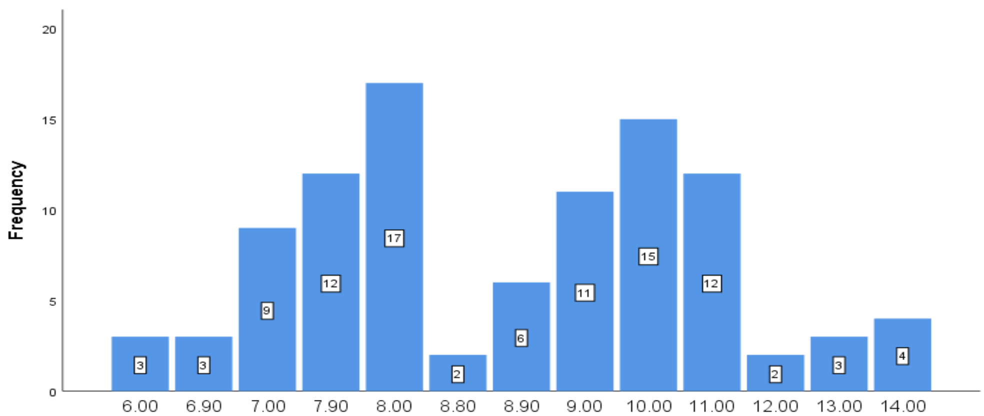
Height of Trees

The data revealed a wide variation in tree height (Table 5), ranging from 1.9 to 7.0 ft. The highest frequency of sampled trees was found to be at a height of 7.0 ft, this constituted 25.3% of the sample trees. Trees with DBH of 6.0 and 5.9 ft also had relatively high frequency; their frequency was equal to 13.1% and 12,1% of trees in the sample, correspondingly. On the other hand, lower heights; 2.0 and 4.1 were rare with their occurrences being only once (1%). The combined relative frequency revealed that majority of the trees in the sample were of mature age since more than 60% of the trees sample fell under the 5.9-7 ft length parameter. The results indicated that majority of the WOT in the park has well growth but regular appearance of relatively small stature tree proved that regeneration process was continuous. This distribution contributed significantly in establishing the population distribution and condition of wild olive trees in the area. The results verified by (Ahmed et al., 2009; Ahmed et al., 2019).

Table 5: Frequency distribution for height of trees

		Frequency	Percent	Cumulative Percent
Valid	6.00	3	3.0	3.0
	6.90	3	3.0	6.1
	7.00	9	9.1	15.2
	7.90	12	12.1	27.3
	8.00	17	17.2	44.4
	8.80	2	2.0	46.5
	8.90	6	6.1	52.5
	9.00	11	11.1	63.6
	10.00	15	15.2	78.8
	11.00	12	12.1	90.9
	12.00	2	2.0	92.9
	13.00	3	3.0	96.0
	14.00	4	4.0	100.0
	Total	99	100.0	

Figure 5: Frequency distribution bar chart for height (ft) of trees



Socioeconomic Impact of Olive Tree

Demographic Characteristics

The data was collected from three US's, with 15 participants from each. Respondents' ages ranged from 1 to 4 (mean = 2.56, SD = 1.24), indicating a skew towards younger age groups. Gender responses ranged from 1 to 2 (mean = 1.40, SD = 0.50), reflecting a higher proportion of males. These results verified by (Gregoriou et al., 2007)

Table 6: Descriptive statistics of demographic characteristics of survey respondents

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
					Std. Error		
Q1: Age	45	1.00	4.00	2.5556	.18410	1.23501	1.525
Q2: Gender	45	1.00	2.00	1.4000	.07385	.49543	.245
Valid N (listwise)	45						

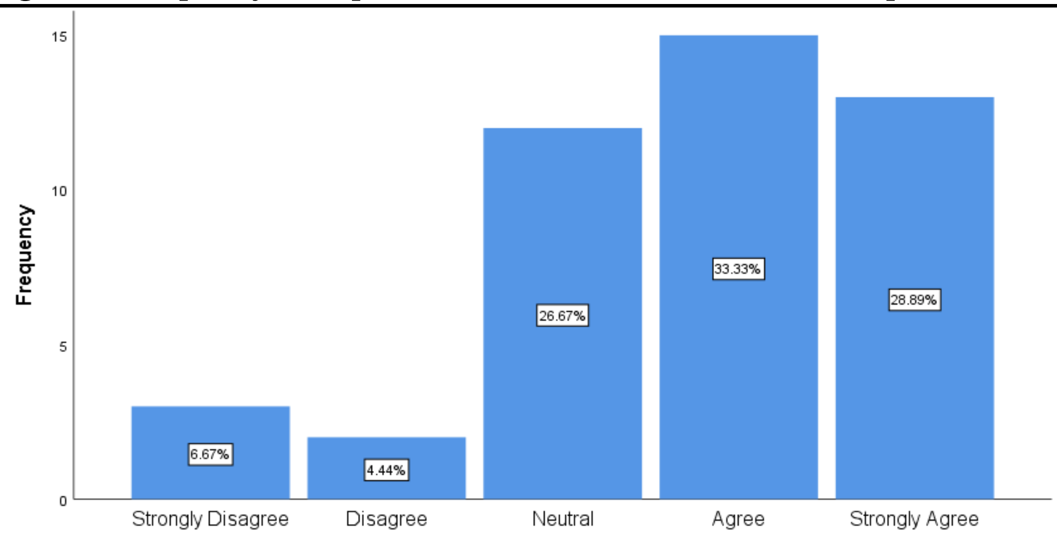
Positive Socioeconomic Impact

The frequency distribution table 7 revealed that most respondents agreed (33.3%) or strongly agreed (28.9%) with the positive socioeconomic impact, comprising 62.2% collectively. A smaller proportion remained neutral (26.7%), while few disagreed (4.4%) or strongly disagreed (6.7%).

Table 7: Frequency distribution Table showing frequency of respondents for Positive socioeconomic impact

		Frequency	Percent
	Strongly Disagree	3	6.7
	Disagree	2	4.4
	Neutral	12	26.7
	Agree	15	33.3
	Strongly Agree	13	28.9
	Total	45	100.0

Figure 6: Frequency of respondents for Positive socioeconomic impact



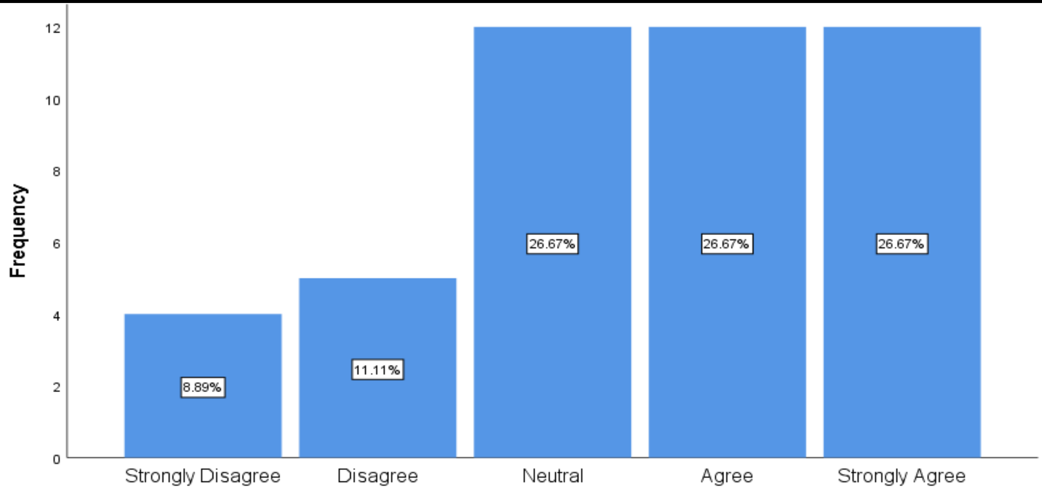
Increased Income from Conservation

The frequency distribution table 8 revealed that 53.4% of respondents agreed or strongly agreed that conservation efforts increased income, while 20% disagreed or strongly disagreed. A significant portion (26.7%) remained neutral, indicating varied perspectives.

Table 8: Frequency distribution Table showing the frequency of respondents for increased income from conservation

		Frequency	Percent
Valid	Strongly Disagree	4	8.9
	Disagree	5	11.1
	Neutral	12	26.7
	Agree	12	26.7
	Strongly Agree	12	26.7
	Total	45	100.0

Figure 7: Frequency of respondents for increased income from conservation



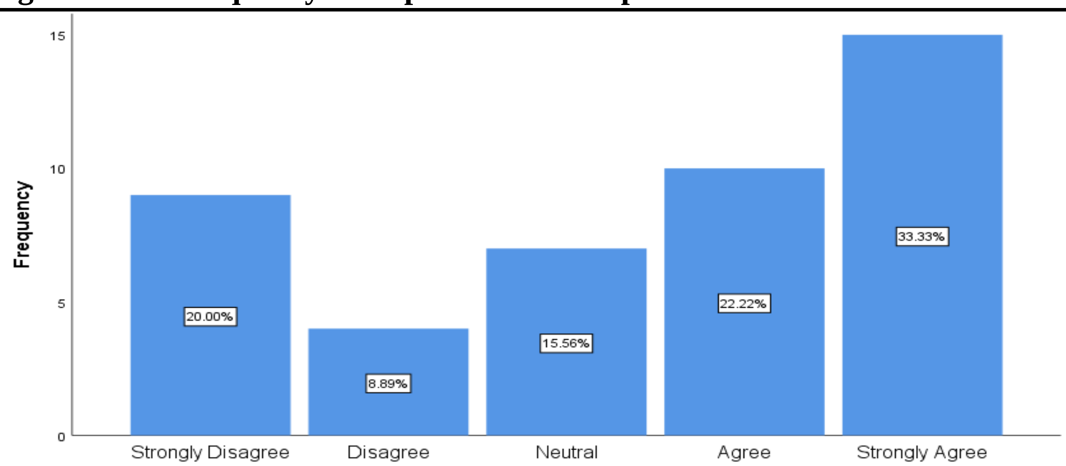
Improved Resource Access

The frequency distribution table 9 revealed that most respondents (33.3%) strongly agreed that resource access had improved, followed by 22.2% who agreed. A minority disagreed (8.9%) or strongly disagreed (20.0%). Neutral responses accounted for 15.6%. Overall, 55.5% expressed positive views, indicating broad satisfaction with improved resource access.

Table 9: Frequency distribution Table showing the frequency of respondents for improved resource access

		Frequency	Percent
Valid	Strongly Disagree	9	20.0
	Disagree	4	8.9
	Neutral	7	15.6
	Agree	10	22.2
	Strongly Agree	15	33.3
	Total	45	100.0

Figure 8: The frequency of respondents for improved resource access



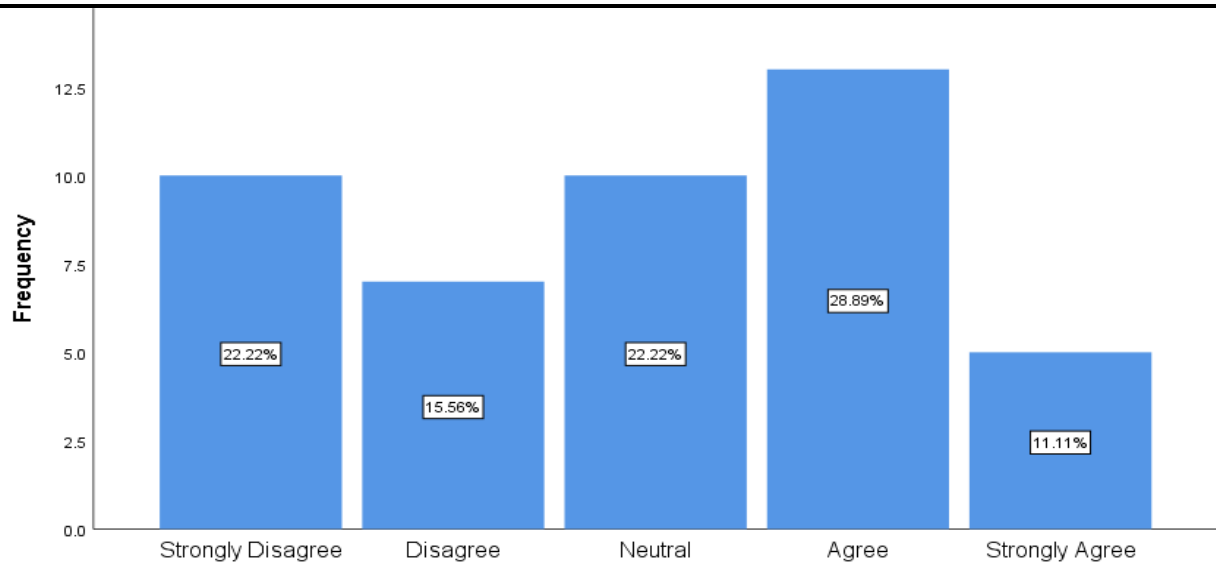
Increased Tourism as a Result of the Preservation of Trees

The frequency distribution (table 10) revealed that most respondents (28.9%) agreed that preserving trees increased tourism, while 22.2% remained neutral. A smaller percentage (11.1%) strongly agreed. However, 37.8% collectively disagreed or strongly disagreed, indicating mixed perceptions.

Table 10: Frequency distribution Table showing the frequency of respondents' replies for increased tourism as a result of the preservation of trees

		Frequency	Percent
Valid	Strongly Disagree	10	22.2
	Disagree	7	15.6
	Neutral	10	22.2
	Agree	13	28.9
	Strongly Agree	5	11.1
	Total	45	100.0

Figure 9: The frequency of respondents' replies for increased tourism as a result of the preservation of trees



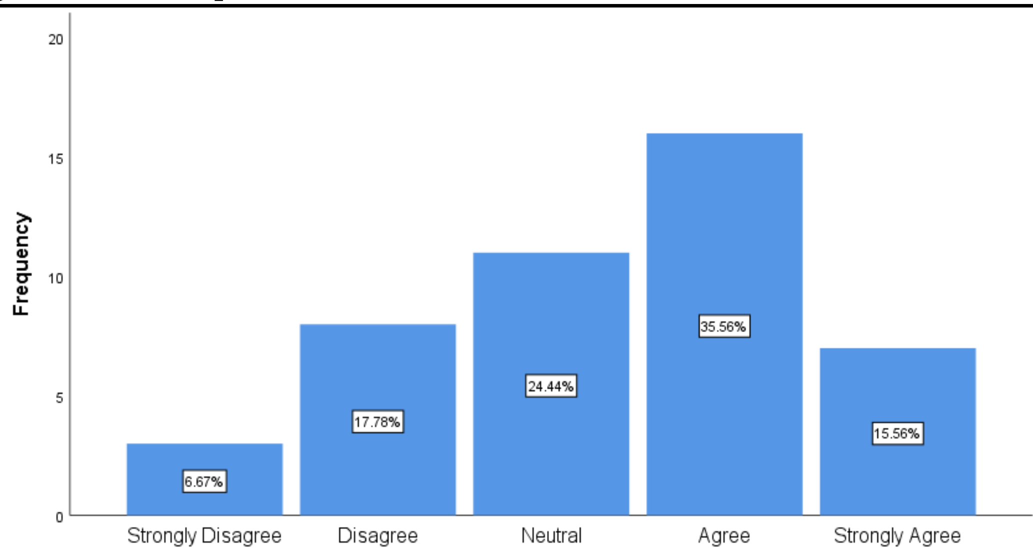
Wild olive trees have shown increased growth over the past decade

The frequency distribution (table 11) indicated that most respondents agreed or strongly agreed with the statement about the increased growth of wild olive trees over the past decade. Specifically, 35.6% agreed, and 15.6% strongly agreed, while 24.4% were neutral, and 24.5% disagreed or strongly disagreed (Quiroga & Iglesias, 2009; Qureshi & Shaheen, 2013).

Table 11: Frequency distribution Table showing the frequency of respondents' replies for Wild olive trees has shown increased growth over the past decade

		Frequency	Percent
Valid	Strongly Disagree	3	6.7
	Disagree	8	17.8
	Neutral	11	24.4
	Agree	16	35.6
	Strongly Agree	7	15.6
	Total	45	100.0

Figure 10: The frequency of respondents' replies for Wild olive trees has shown increased growth over the past decade



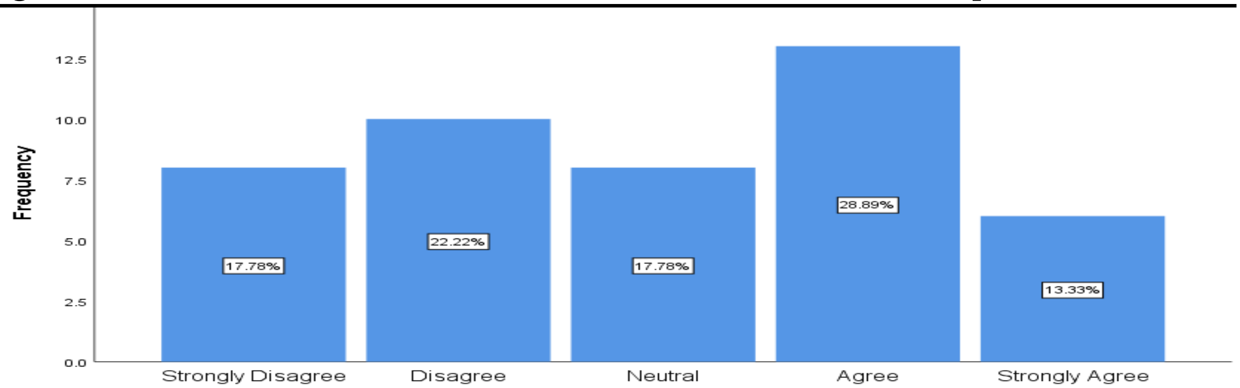
Pest infestations have affected over 50% of wild olive trees in the park

The frequency distribution (Table 12) showed that 28.9% of respondents agreed, and 13.3% strongly agreed that pest infestations had affected over 50% of wild olive trees in the park. 22.2% disagreed, while 17.8% strongly disagreed. 17.8% were neutral, indicating varied opinions on the issue among the 45 respondents.

Table 12: Frequency distribution Table showing the frequency of respondents' replies for question: Pest infestations have affected over 50% of wild olive trees in the park

		Frequency	Percent
Valid	Strongly Disagree	8	17.8
	Disagree	10	22.2
	Neutral	8	17.8
	Agree	13	28.9
	Strongly Agree	6	13.3
	Total	45	100.0

Figure 11: Pest infestations have affected over 50% of wild olive trees in the par



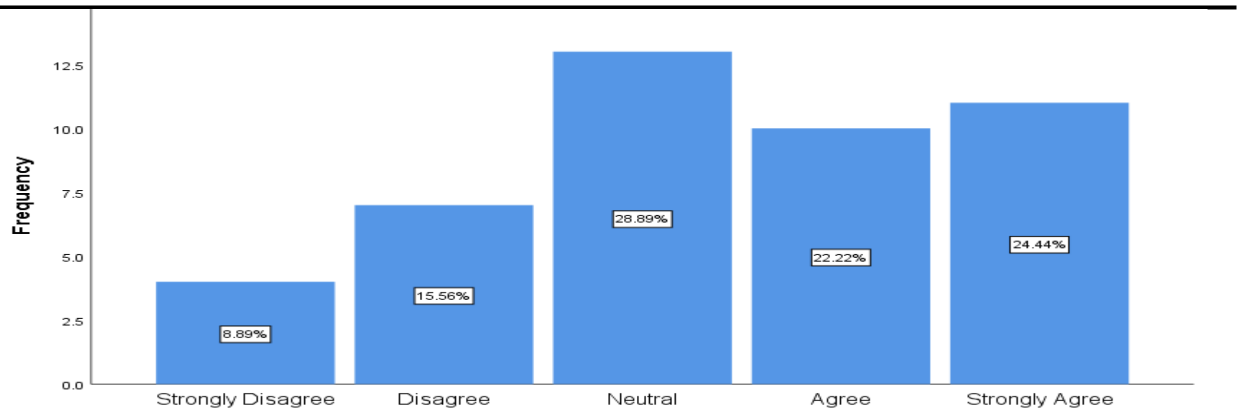
The health of wild olive trees differs significantly across various habitats in the park

The frequency distribution table 13 showed that 8.9% of respondents strongly disagreed, while 15.6% disagreed with the statement about the health of wild olive trees varying across habitats. 28.9% remained neutral, 22.2% agreed, and 24.4% strongly agreed. Overall, most respondents supported the statement, with 46.6% agreeing or strongly agreeing (Nelson, 2020).

Table 13: Frequency distribution Table showing the frequency of respondents' replies for question: The health of wild olive trees differs significantly across various habitats in the park

		Frequency	Percent
Valid	Strongly Disagree	4	8.9
	Disagree	7	15.6
	Neutral	13	28.9
	Agree	10	22.2
	Strongly Agree	11	24.4
	Total	45	100.0

Figure 12: The health of wild olive trees differs significantly across various habitats in the park



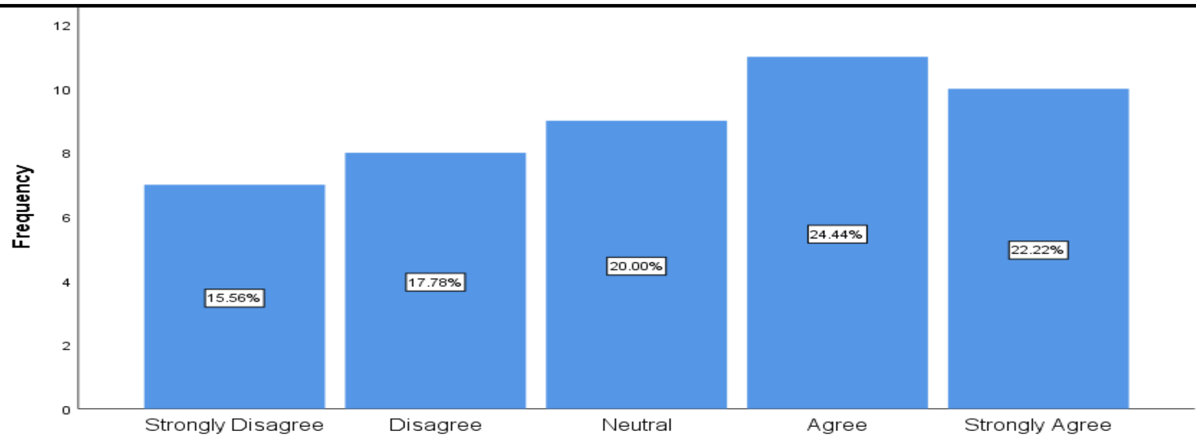
The wild olive population in the park has decreased over the past 20 years

The frequency distribution table 14 showed that 15.6% of respondents strongly disagreed, 17.8% disagreed, and 20.0% were neutral. A larger portion, 24.4%, agreed, while 22.2% strongly agreed that the wild olive population in the park had decreased over the past 20 years. The majority expressed agreement with the statement.

Table 14: Frequency distribution Table showing the frequency of respondents' replies for question: The wild olive population in the park has decreased over the past 20 years

		Frequency	Percent
Valid	Strongly Disagree	7	15.6
	Disagree	8	17.8
	Neutral	9	20.0
	Agree	11	24.4
	Strongly Agree	10	22.2
	Total	45	100.0

Figure 13: The health of wild olive trees differs significantly across various habitats in the park



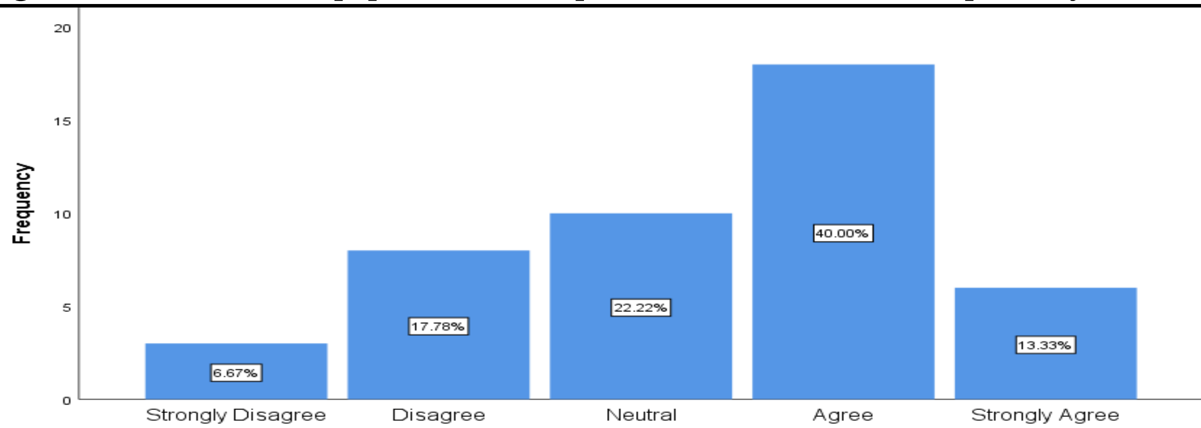
Park officials actively implement conservation measures for wild olive trees

The results (table 15) showed that 40% of respondents agreed, and 13.3% strongly agreed that park officials actively implement conservation measures for wild olive trees. 22.2% were neutral, while 17.8% disagreed, and 6.7% strongly disagreed. The majority of respondents (53.3%) expressed agreement or strong agreement with the statement.

Table 15: Frequency distribution Table showing the frequency of respondents' replies for question: Park officials actively implement conservation measures for wild olive trees

Park officials actively implement		**Frequency**	**Percent**
	Strongly Disagree	3	6.7
	Disagree	8	17.8
	Neutral	10	22.2
	Agree	18	40.0
	Strongly Agree	6	13.3
	Total	45	100.0

Figure 14: The wild olive population in the park has decreased over the past 20 years

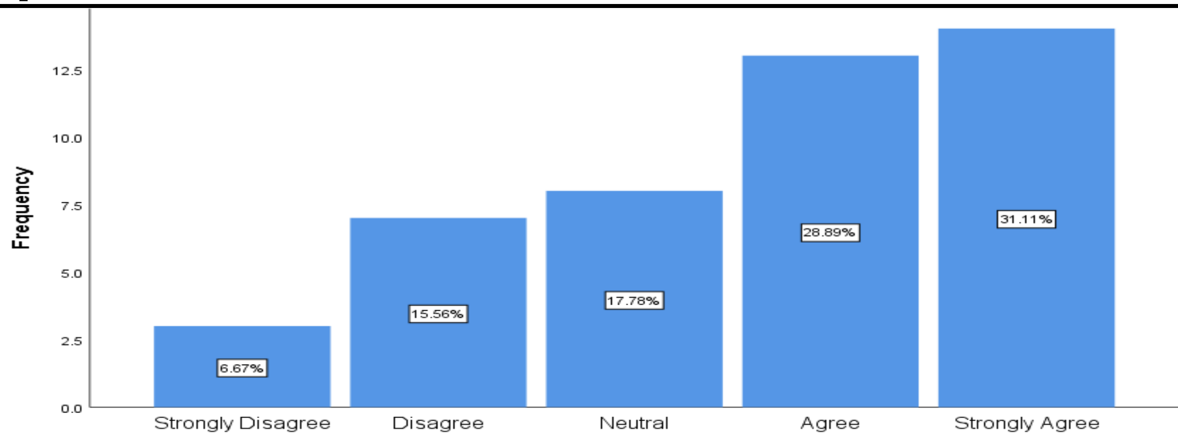


Current conservation practices are adequate to ensure the future of wild olive populations. The frequency distribution (table 16) showed that the majority of respondents (31.1%) strongly agreed that current conservation practices were adequate to ensure the future of wild olive populations, followed by 28.9% who agreed. Fewer respondents disagreed (15.6%) or strongly disagreed (6.7%). A smaller proportion (17.8%) remained neutral.

Table 16: Frequency distribution Table showing the frequency of respondents' replies for question: Current conservation practices are adequate to ensure the future of wild olive populations

		Frequency	Percent
Valid	Strongly Disagree	3	6.7
	Disagree	7	15.6
	Neutral	8	17.8
	Agree	13	28.9
	Strongly Agree	14	31.1
	Total	45	100.0

Figure 15: Current conservation practices are adequate to ensure the future of wild olive populations



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