



Ethnobotany and local conservation of *Durio graveolens* Becc. (Malvaceae): A threatened wild edible fruit plant in Sumatra, Indonesia

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Research

Abstract

Background: *Durio graveolens* is essential for the livelihoods of local communities and has been used for multiple purposes. However, the existence of this species is under threat, particularly by human activities. As a result, there is a critical need to conduct ethnobotanical investigations and document indigenous botanical knowledge of local communities in a given area. The aim of the study is to investigate the different ethnobotanical uses of *Durio graveolens*, as well as the associated indigenous botanical knowledge of the local community, threats, and local conservation practices in Sumatra, Indonesia.

Methods: A total of 389 respondents were involved in this study, with gender, age, and educational status considered. Semi-structured interviews and field observations were used to collect data. The data was analyzed using descriptive statistical methods. Pearson's chi-square test, direct matrix ranking, and pair-wise ranking were used to compute respondents' ethnobotanical knowledge.

Results: *Durio graveolens* provides multiple uses to local people's livelihoods as food, building materials, fuelwood, furniture, agricultural tools, fences, and fodder. Local people's indigenous knowledge of the usage of *Durio graveolens* has significant correlations with age groups and educational status. Respondents' consumption habits are significantly related to their age and educational status. Due to agricultural expansion and timber harvest for building materials, the status of *Durio graveolens* has declined. The attitudes and interests of respondents toward the maintaining and conserving of this species have been found to be significantly related to age groups and educational status.

Conclusions: The present study provides information on multiple uses of *Durio graveolens*. Given the importance of *Durio graveolens* for people and the environment in improving family food security, as well as the threats to it, it is critical to protect it in natural forests. Concerned studying of this species will eventually allow local people to receive the promised advantages in areas where this plant species is becoming rare, particularly in the Sumatra region.

Keywords: *Durio graveolens*, indigenous knowledge, tropical fruit, West Sumatra

Abstrak

Latar Belakang: *Durio graveolens* berperan penting bagi penghidupan masyarakat lokal dan telah digunakan untuk berbagai keperluan. Meskipun demikian, keberadaan spesies ini dalam kondisi terancam, terutama akibat berbagai aktivitas manusia. Oleh karena itu, diperlukan upaya untuk melakukan investigasi etnobotani dan mendokumentasikan pengetahuan botani asli masyarakat lokal di suatu wilayah. Tujuan dari penelitian ini adalah untuk menyelidiki keragaman pemanfaatan *Durio graveolens* secara etnobotani, serta pengetahuan botani indigenus yang terkait dengan masyarakat lokal, ancaman, dan praktik konservasi lokal di Sumatera, Indonesia.

Metode: Sebanyak 389 responden dilibatkan dalam penelitian ini, dengan mempertimbangkan jenis kelamin, usia, dan status pendidikan. Wawancara semi terstruktur dan observasi lapangan digunakan dalam pengumpulan data. Data dianalisis dengan menggunakan metode statistik deskriptif. Uji chi-kuadrat Pearson, pemeringkatan matriks langsung, dan pemeringkatan berpasangan digunakan untuk menghitung pengetahuan etnobotani dari responden.

Hasil: *Durio graveolens* memberikan berbagai manfaat bagi kehidupan masyarakat lokal sebagai bahan pangan, bahan bangunan, kayu bakar, furnitur, alat pertanian, pagar, dan pakan ternak. Pengetahuan masyarakat lokal mengenai pemanfaatan *Durio graveolens* berkorelasi secara signifikan dengan kelompok umur dan status pendidikan. Kebiasaan konsumsi responden secara signifikan berkaitan dengan umur dan status pendidikan. Akibat perluasan lahan pertanian dan pemanenan kayu untuk bahan bangunan, status *Durio graveolens* mengalami penurunan. Sikap dan minat responden terhadap pemeliharaan dan konservasi spesies ini berkaitan dengan kelompok umur dan status pendidikan.

Kesimpulan: Penelitian ini memberikan informasi tentang berbagai kegunaan *Durio graveolens*. Mengingat pentingnya *Durio graveolens* bagi masyarakat dan lingkungan dalam meningkatkan ketahanan pangan keluarga, serta ancaman terhadapnya, maka sangat penting untuk melindungi habitatnya. Kajian yang mendalam terhadap spesies ini pada akhirnya akan memungkinkan masyarakat lokal untuk menerima manfaat pada daerah dimana spesies ini menjadi langka, khususnya di wilayah Sumatera.

Kata Kunci: *Durio graveolens*, pengetahuan asli, buah tropis, Sumatera Barat

Background

Indonesia, the largest tropical rainforest in Southeast Asia, is considered a mega biodiversity country (Von Rintelen et al. 2017). This forest is critical for regulating nutrient cycling and soil formation, flood mitigation, water and air purification, and providing food and medicinal plants (Navia et al. 2021; Navia et al. 2022; Song et al. 2016; Suwardi et al. 2022). Indonesian tropical forests are home to various wild plants, including wild edible fruits (Suwardi & Navia 2022). Indonesia is known as a distribution center of tropical fruit, including durian. At present, it is recorded that of around 27 species of *Durio* worldwide, 18 of them are grown in Kalimantan, 11 are in Malaya, and seven are in Sumatra (Milow et al. 2014).

Durio graveolens Becc. (Malvaceae), one of the wild durians is native to the tropics and is commonly grown in Southeast Asia, particularly Peninsular Malaysia, Sumatra, and Borneo (Sarawak, Brunei, Sabah, West-, Central- and East-Kalimantan) and has been listed as vulnerable under criteria A2c (IUCN 2022). The species is characterized by a large tree growing up to 50 m (160 ft) tall, flowers occur in short cymes on branches, white in color, fruit is globose to an ovoid capsule, seeds are ellipsoid glossy brown, completely enclosed by a fleshy aril with a diversity of color ranging from pale yellow, deep yellow, orange to crimson red (Lim 2011). *Durio graveolens* is a tropical plant species that requires high heat and humidity. It is usually found in moist lowland dipterocarp forests on clayey soils, often along riverbanks and marshes. It is also found on hillsides and shale ridges up to 1,000 m (3,300 ft) elevation. *Durio graveolens* fruit is edible and is commonly consumed by local communities (Lim 2011). The pulp of the fruit is usually eaten raw and has an aroma of roasted almonds and burnt

caramel. The taste has been described as sweet and cheesy, like eating avocado or pimento cheese. Apart from being a food source, they are also a source of supplementary income.

Despite the fact that *Durio graveolens* has been used by the community as a food source, its existence in the wild is threatened. The wood from this plant, such as other durian trees, was widely exploited as a building material (Suwardi et al. 2023), leading the population in nature to decrease. On the other hand, deforestation of tropical forests, particularly in Sumatra, has contributed to the destruction of the habitat of the *Durio graveolens*. Land use changes in terms of forest conversion to other uses, particularly agricultural land, resulting in a loss of a lot of wild plants in the wild, including *Durio graveolens*. On the other side, the rise of superior genetically engineered fruits has resulted in changes in the lifestyle of local people who prefer eating these fruits over wild fruits such as *Durio graveolens*. Given such a situation, traditional knowledge about wild plants has eroded (Sujarwo et al. 2014; Navia et al. 2020). As a result, a study on the local utilization and conservation practices of *Durio graveolens* is required. Socio-cultural and demographic factors such as gender, age, and literacy/formal educational level are all related to an individual's level of plant knowledge (Albuquerque et al. 2011; Hanazaki et al. 2013). The local knowledge and conservation practices of indigenous communities around the habitat of *Durio graveolens* in Sumatra contribute to sustaining the population of *Durio graveolens* species. The aim of the study is to investigate the different ethnobotanical uses of *Durio graveolens*, as well as the associated indigenous botanical knowledge of the local community, threats, and local conservation practices in Sumatra, Indonesia.

Materials and Methods

Study area

The current investigation was carried out in two provinces, namely West Sumatra and Jambi. Given our prior studies, *Durio graveolens* was only found in two districts: Pesisir Selatan, West Sumatra, and Tebo, Jambi (Figure 1). The Pesisir Selatan district is located in the West Sumatra province, Indonesia (0057'31.21"- 2028'42.32" S and 100017'48.64"-101017'34.3" E, at an elevation of 0-1000 m above sea level). This region has a tropical climate with two seasons: the dry season (January to July) and the rainy season (August to December). Annual rainfall ranges from 77.25 to 519.55 mm. This district covers a total area of 6,049.33 km² and is divided administratively into 15 sub-districts and 182 villages (BPS Kabupaten Pesisir Selatan 2022). Pesisir Selatan district has a total population of 429,246 people, the majority of whom are Minangkabau tribe. The Minangkabau tribe is believed to have evolved from a mix of West Sumatran Proto-Malay and Proto-Minangkabau tribes. The Minangkabau ethnic group has a long history of forest preservation and conservation in their region. Nature is used as a way of life and a source of analogy by the Minangkabau tribe in constructing rules that govern existence and guide thinking and conduct (Navis 1984). The Tebo district is located in the Jambi province, Indonesia (0°52'32"-1°54'50" S and 101°48'57" to 102°49'17" E, at an elevation of 0-1000 m asl). This region has a tropical climate with two seasons: the dry season (January to July) and the rainy season (August to December). Annual rainfall ranges from 7.97 to 32.21 mm. This district covers a total area of 6,461 km² and is divided administratively into 12 sub-districts and 107 villages (BPS Kabupaten Tebo 2022). Tebo district has a total population of 340,868 people, the majority of whom are Melayu tribe. The Talang Mamak tribe, an isolated tribe, was also discovered in this area.

Respondents Selection

The sample size was determined following the standard procedure of Cochran's sample size formula indicated in Kotrlík & Higgins (2001). Consequently, the sample sizes for the five villages were determined separately based on the total number of populations in each village (Table 1). The study involved 389 respondents consisting of 379 general respondents who were selected at random, and 10 key respondents were chosen on purpose based on recommendations from local authorities and elders, who confirmed their knowledge of *Durio graveolens* and agreed to participate in the study.

Data collection

The ethnobotanical survey was carried out from May to June 2023. Prior informed consent was obtained from the head of the villages under study. In addition, the local people verbally agreed to the dissemination of their traditional knowledge. The ethnobotanical data were collected using semi-structured interviews (Martin 1995; Cotton & Wilkie 1996) to gather information on the traditional knowledge of *Durio graveolens*, such as their local names, utilization, collection and consume patterns, perceptions, and attitudes about maintaining and conserving and transfer knowledge. The semi-structured interview was conducted using a checklist of questions written in Indonesian and translated into the local languages by an expert local translator.

Data analysis

To evaluate ethnobotanical knowledge, the Statistical Package for Social Sciences (SPSS) ver. 26.0 was employed. A Pearson's chi-square test was performed to determine ($P < 0.05$) the relationship between respondents' ethnobotanical knowledge of

different genders, age groups, educational levels, and villages, in terms of use categories, consumption practices, and respondents' attitudes toward species conservation. Ethnobotanical ranking methodologies were used to assess the highest-risk threats of *Durio graveolens*. On a scale of 0 to 5, with 0 being the least destructive and 5 being the most destructive, a pair-wise ranking was used to determine the degree to which activities posed dangers to *Durio graveolens*. Finally, the given numbers for all key respondents were then summed up, giving an overall rank as demonstrated by Martin (1995). The greatest scores in the threat ranking were considered the most serious threats to *Durio graveolens*.

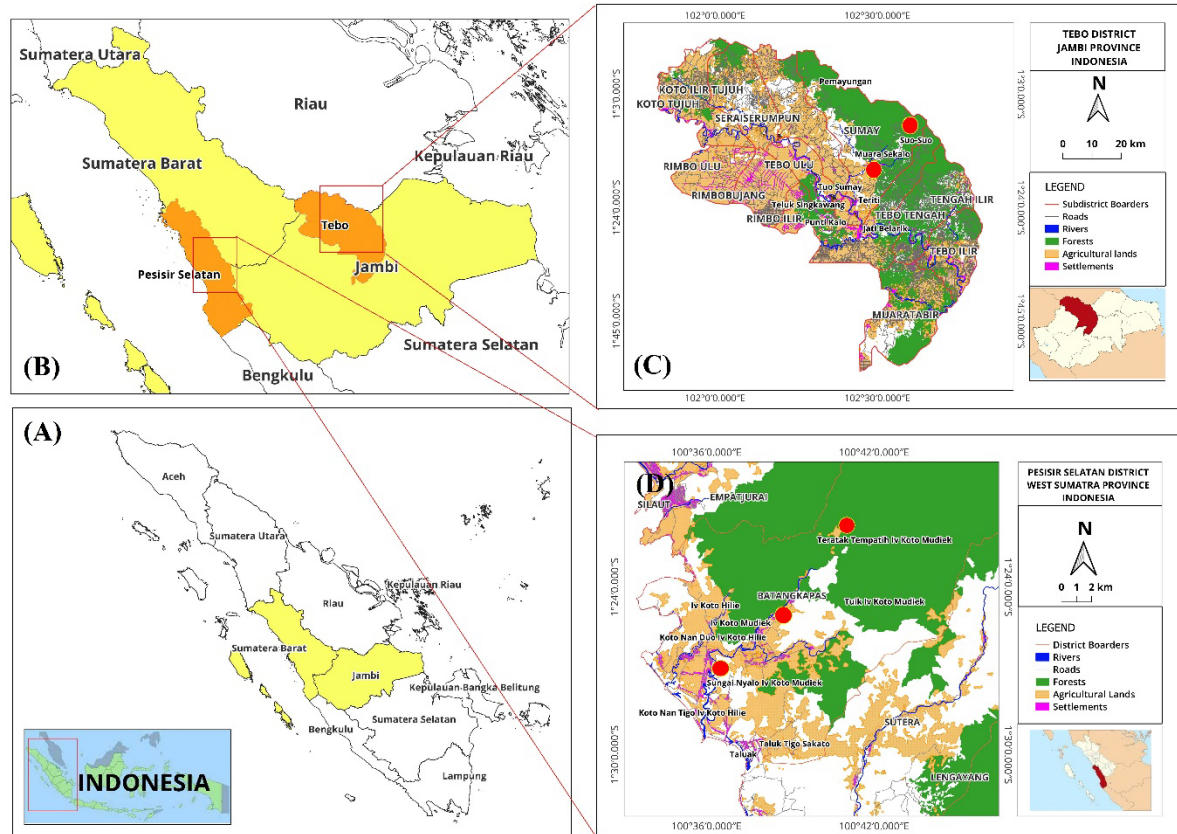


Figure 1. The site of the studied area. (A) The map shows the location of Sumatra; (B) The map highlights the West Sumatra and Jambi provinces; (C) [●] shows the study site of the Sumay subdistrict, and (D) [●] shows the study site of the Batang Kapas subdistrict

Table 1. The sample size of respondents from the selected villages

Province	District	Subdistrict	Name of village	Area (km ²)	Population	No. of respondents involved in the study
West Sumatra	Pesisir Selatan	Batang Kapas	IV Koto Mudiek (KM)	5.84	3,032	86
			Sungai Nyalo (SN)	8.18	3,082	88
			Taratak Tempatih (TK)	88.09	2,802	80
Jambi	Tebo	Sumay	Muara Sekalo (MS)	121.13	1,368	39
			Suo-Suo (SS)	119.8	3,343	95
Total				240.93	13,627	389

Results

Demographic characteristics of respondents

A total of 389 (379 general and 10 key) respondents were involved in the ethnobotanical study of *Durio graveolens*. Of the 389 respondents, 221 (56.81%) are women and 167 (42.93%) are men. All interviewed respondents were between the ages of 16 and 65, and were divided into five age groups: 16-25 years (16.71%), 26-35 years (23.65%), 36-45 years (24.68%), 46-

55 years (25.19%), and 56-65 years (9.51%). Informants represented various educational backgrounds and were categorized according to the Indonesian educational system. Twenty-eight percent of respondents were in Junior High School, 27% in Senior High School, 22% in Elementary School, 15% in no education, and 7% had Higher Education (Table 2).

Diversity of use

The fruit of *Durio graveolens* is frequently consumed raw by local people in the study area. This fruit is harvested from a forest near their village between August and October, depending on the availability of rainfall. Approximately 21.8% of the respondents reported that children were involved in the collection of fruit. *Durio graveolens* fruit is usually eaten raw; however, 8(2%) of respondents reported that the fruit is frequently further processed into fermented processed food. There is no difference in the collection and consumption pattern of the fruit between genders ($\chi^2 = 1.703$, $df = 6$, $P = 0.625$), but there is a significant association between age ($\chi^2 = 118.7$, $df = 24$, $P < 0.0001$) and educational status ($\chi^2 = 134.2$, $df = 24$, $P < 0.0001$). Along with food, various plant parts are frequently utilized for various purposes, such as stems for furniture, construction materials, agricultural tools, fences, and firewood, while leaves are used as fodder (Figure 2).

Table 2. Demographic characteristics of the respondent

Variable		Village				
		IV Koto Mudiek	Sungai Nyalo	Taratak Tempatih	Muara Sekalo	Suo-Suo
Gender	Men	34	37	39	18	39
	Women	52	51	41	21	56
Age	15-25	16	17	9	6	17
	26-35	19	23	16	8	26
	36-45	26	19	22	8	21
	46-55	20	21	23	11	23
	56-65	5	8	10	6	8
Education	No Education	11	12	7	3	26
	Elementary School	18	19	12	14	23
	Junior High School	21	26	22	11	29
	Senior High School	28	26	27	9	15
	Higher Education	8	5	12	2	2

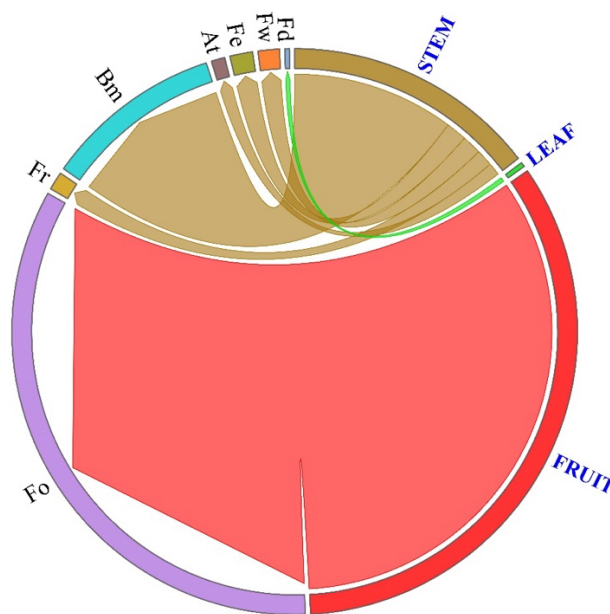


Figure 2. Distribution of 558 use reports across three plant parts and 7 different use categories in the study area. Use categories include food (Fo), furniture (Fr), building materials (Bm), agricultural tools (At), fence (Fe), fuelwood (Fw), and fodder (Fd)

Cross-cultural analysis

Principal component analysis (PCA) showed two top principal components (eigenvalue > 1), accounting for 95.02% of the total variation of the parameters studied. The results of the PCA comprehend three different criteria by grouping communities and use categories. First, local communities in the Taratak Tempatih used *Durio graveolens* as fodder, agricultural tools, and fodder. Second, local communities used *Durio graveolens* as building materials, fences, and furniture. Third, local communities in the IV Koto Mudiek and Sungai Nyalo mainly used *Durio graveolens* as food (Figure 3).

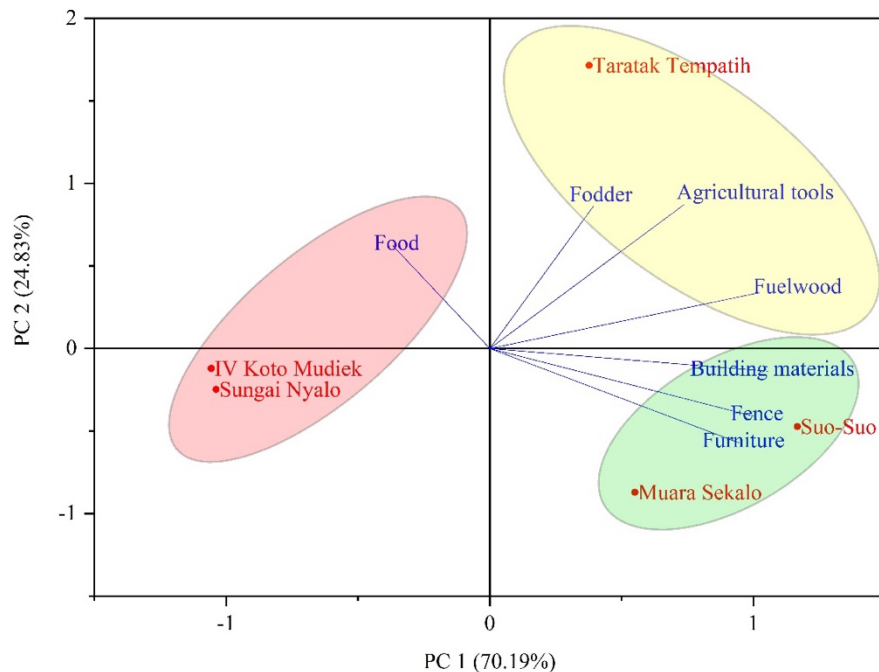


Figure 3. PCA showing the distribution of use reports from the five communities in the study area

The findings demonstrate that there is a significant relationship between the age ($\chi^2 = 217.9$, $df = 24$, $P < 0.0001$) and educational level ($\chi^2 = 106.9$, $df = 24$, $P < 0.0001$) of the respondents regarding their knowledge on the uses of *Durio graveolens*. Older age respondents had more knowledge about the uses of *Durio graveolens* than younger age respondents. However, there is no significant relationship between the gender ($\chi^2 = 1.946$, $df = 6$, $P = 0.925$) of the respondents regarding their knowledge of the uses of *Durio graveolens*. The different use categories in each village were analyzed using Pearson's chi-square test and the result shows that there is a significant association between villages in the ethnobotanical knowledge of use categories ($\chi^2 = 201.3$, $df = 24$, $P < 0.0001$).

The status of *Durio graveolens* in the study area

The findings revealed that 80.6% of respondents believed the *Durio graveolens* population at the study site had decreased in recent years (Figure 4). A field study discovered only a few seedlings of *Durio graveolens* (29 individuals) growing under the mother tree.

During the discussion, respondents claimed that the seedling survival rate of *Durio graveolens* was quite lacking, demonstrated by the small number of tree individuals. However, 10% of respondents indicated that the *Durio graveolens* population has increased in recent years as a result of regulations prohibiting the extraction of fruit-producing trees, including *Durio graveolens*. For example, the Taratak Tempatih village government established local regulations restricting the extraction of wild plants from the forest surrounding the village.

Threats to the sustainability of *Durio graveolens*

The findings revealed that a variety of factors, particularly human activities, threaten the existence of *Durio graveolens* in the study area. Given the analysis of the pair-wise ranking on the degree of destructive effects of *Durio graveolens*, agricultural expansion and timber extraction for household materials ranked first and second, respectively, indicating that they are the most proximate threatening factors (Table 3).

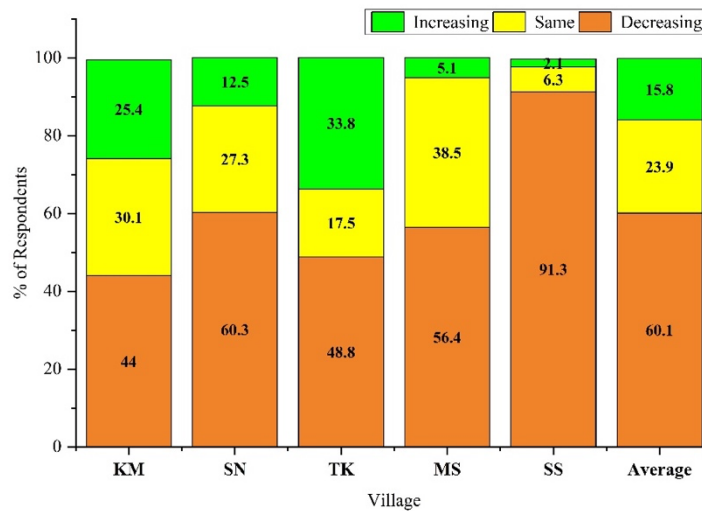


Figure 4. Respondent's response on the status of *Durio graveolens* in the study area

Table 3. Results of a pair-wise ranking of factors considered threats to *Durio graveolens*

Threatening factors	Key respondents										Total	Rank
	KM1	KM2	SN1	SN2	TK1	TK2	MS1	MS2	SS1	SS2		
Agricultural expansion	5	5	5	5	5	5	5	5	5	4	49	1
Household materials	5	5	5	5	5	5	4	4	4	4	46	2
Logging	4	4	4	5	5	5	4	5	4	4	44	3
Fuelwood	4	3	3	3	3	3	2	3	3	2	29	4
Fire	3	4	3	2	2	3	3	1	3	2	26	5
Fruit harvesting	1	1	2	1	2	1	1	1	1	1	12	6

Note: KM = IV Koto Mudiek; SN = Sungai Nyalo; TK = Taratak Tempatih; MS = Muara Sekalo; SS = Suo-Suo

Threats to the sustainability of *Durio graveolens*

Respondent attitudes toward *Durio graveolens* management and conservation techniques revealed that 57% of men and 56% of women were very interested in managing and conserving *Durio graveolens*. The educational level influences perceptions and interest in managing and conserving *Durio graveolens*. The majority of respondents across all educational levels are interested in managing and conserving *Durio graveolens*. Moreover, the study's findings also revealed an increase in interest in *Durio graveolens* management and conservation, as well as an increase in the age group of respondents (Figure 5). The Pearson's chi-square test results on respondents' perceptions and attitudes about maintaining and conserving *Durio graveolens* demonstrate a strong relationship between age group ($\chi^2 = 116.8$, $df = 24$, $P < 0.0001$) and educational level ($\chi^2 = 198.6$, $df = 24$, $P < 0.0001$) of respondents. However, there is no statistically significant difference between the genders in terms of their perception and attitude toward the maintenance and conservation of *Durio graveolens*.

Discussion

Durio graveolens is essential to the livelihoods of local people, particularly those who live near forests. This fruit plant has been utilized for a variety of uses, most notably as a food ingredient, and has been ingrained in local culture. This study supports the findings of Syamsuardi et al. (2022), who found that most wild edible fruit species are used as food by indigenous communities. The use of plants for various purposes indicates that humans and their environment are inextricably linked, as well as between plant knowledge and its uses (Martin 1995; Kacholi 2014; Amjad & Arshad 2014). In general, respondents' ethnobotanical knowledge of *Durio graveolens* in the local people is similar. This demonstrated that indigenous knowledge of the usage of *Durio graveolens* was being transferred successfully across community members. However, the ethnobotanical knowledge of the local people in the study area was influenced by age and educational level attributes. This finding is consistent with the findings of Suwardi et al. (2023), who discovered that age and educational level influence local people's ethnobotanical knowledge. The association between the respondents' knowledge of the uses of *Durio graveolens* and their age groups showed that the elders were more knowledgeable about the uses of *Durio graveolens* than the younger generation.

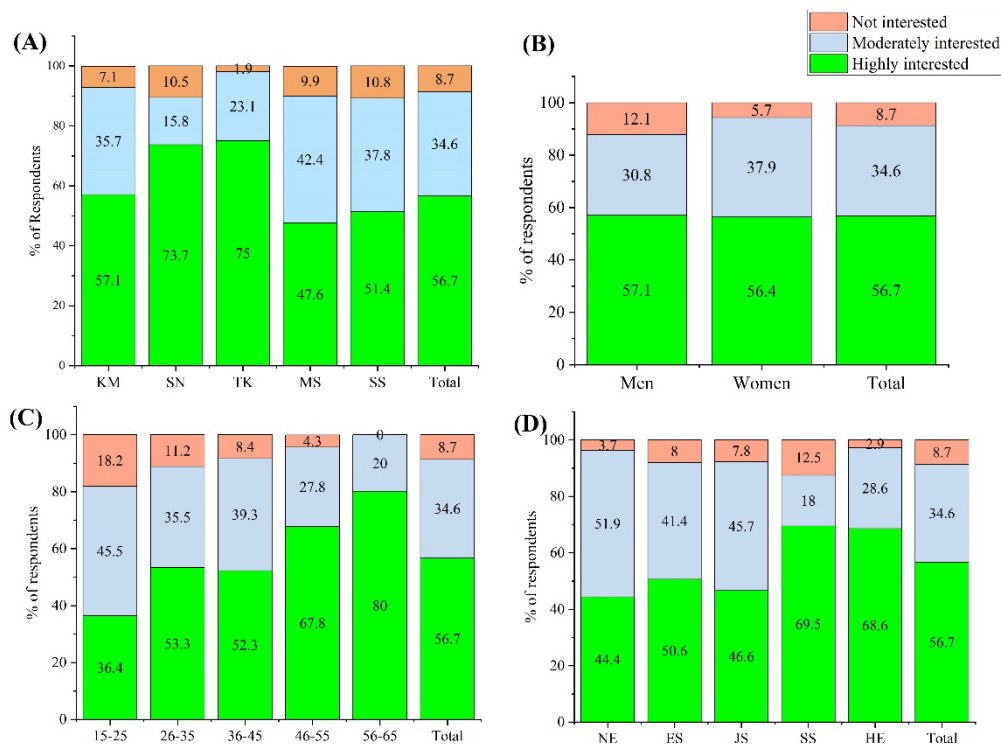


Figure 5. The attitude of respondents to maintain and conserve *Durio graveolens* based on village (A); gender (B); age (C); and educational level (D).

The local community in the study area is actively collecting wild plants, including *Durio graveolens*. Despite the fact that its population is declining in nature, the fruit of *Durio graveolens* is popular with people of all ages. When compared to *Durio zibethinus*, *Durio graveolens* fruit has a distinct flesh color, flavor, and aroma. The red color of aril becomes the most distinctive feature of *Durio graveolens* and one of the most intriguing aspects of this durian. *Durio graveolens* is noted for its high calorie, protein, carbohydrate, fat, and mineral content (Hoe et al. 1999). According to Ho & Bhat (2015), the nutrition content of *Durio graveolens* is higher than the nutrition content of *Durio zibethinus* in terms of caloric, protein, and zinc content. According to Adhikari et al. (2016), and Suwardi et al. (2022), wild edible plants are highly nutritious and provide vitamins and minerals. As a result, wild edible fruit, including *Durio graveolens*, is important for household food security since it may supplement staple foods in normal times, substitute seasonal food shortages, and combat low micronutrient intake. *Durio graveolens*, therefore, has a great economic potential to be developed as superior commodities in Indonesia (Kurniadinata et al. 2020), including in West Sumatra. Human activities, however, provide a variety of threats to the survival of *Durio graveolens*. The primary threatening factors were discovered to be agricultural expansion and timber extraction for domestic materials. The continuing conversion of forest to agricultural land threatens the availability of suitable habitats for many wild plants, including *Durio graveolens*. The conversion of forested areas into agricultural land and other land-use systems was the primary source of deforestation in many countries in the world, including Indonesia (FAO 2017).

The local communities in the study area have performed to preserve the *Durio graveolens* available by incorporating their traditional knowledge into wild fruit plant management. The village government of Taratak Timpatih, for example, implemented a community law governing the use of wild plants in the forest surrounding the village. Several studies have demonstrated that attempts to conserve and maintain wild plants are more effective when combined with local community knowledge (Reyes-Garca et al. 2011; Ca'mara-Leret et al. 2014). On the other hand, our findings suggest that more than half of respondents are very interested in protecting and maintaining *Durio graveolens*. Personal observation also confirmed that several respondents in the study area manage and conserve *Durio graveolens* that grow on their farmland by avoiding cutting and protecting it, but there is no direct planting and maintaining of this species located on communal land. Cao et al. (2020) and Kebebew and Leta (2016) illustrate the importance of bringing preferred wild plants into agricultural land and home gardens for biodiversity conservation. The knowledge and attitude to manage and conserve increase alongside education level, showing that educated communities have greater knowledge and willingness to maintain and conserve wild edible fruit plants. The most prominent biodiversity conservation practice involves the use of traditional knowledge to protect

forests (Gandile et al. 2017). To sustain and conserve the species, it has become essential to incorporate cultural importance into biodiversity investigations and conservation actions, involving local users and other stakeholders from all sectors. Several studies reveal that local people have an in-depth knowledge of traditional plant use they have received from their forefathers; however, given modernity and the oral transmission of traditional knowledge between generations, this knowledge could be lost in the future (Jan et al. 2021a; Jan et al. 2021b; Mir et al. 2021). Indigenous ecological knowledge, therefore, must be noticed and properly included in management and conservation plans. Increasing attention among policymakers and across the community regarding the significance of wild plants for human beings entails local leaders issuing proactive, protective guidelines to promote and protect important wild edible fruit plants, including *Durio graveolens*.

Conclusion and Recommendations

This study intended to provide information on the various uses of *Durio graveolens* while also documenting local community knowledge. There is an effective transfer of local traditional knowledge regarding the uses of *Durio graveolens* among communities. However, it was discovered that there is a knowledge gap among generations, showing that young people are less knowledgeable about the usage of *Durio graveolens*. As a result, documenting traditional knowledge on the usage of *Durio graveolens* in the current study area and other parts of the country is extremely useful and should be expanded. *Durio graveolens* contributes to the nutritional intake of local communities and promotes food security. As a result, while developing strategies to combat food insecurity and promote rural livelihood systems, *Durio graveolens* should be given consideration. Local communities use it for multiple purposes, including food, building materials, fuelwood, furniture, agricultural tools, fences, and fodder. The findings also revealed that the status of *Durio graveolens* has decreased as a result of anthropogenic pressures. The primary threats are agricultural expansion and timber harvesting for building materials. As a result, there is a need to raise public awareness and implement community-based management. It is, therefore, essential to promote *Durio graveolens* as a useful tree that will improve household food security and, in the long term, provide an income source for local communities.

Declarations

Ethics approval and consent to participate: Permission was taken from the head of each village before data collection. Oral agreements were obtained from local respondents and all field data were collected through their oral approval.

Consent for publication: Not applicable

Availability of data and materials: Data will be available from the corresponding author in a special request.

Competing interests: The authors declare no competing interests.

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Author contributions: S, ABS, and RK carried out fieldwork and data analysis. S, IAF, V, and EM configured the research project. ABS drafted the manuscript. All authors read, reviewed, and approved the final version of the manuscript.

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