

Phyto-Taxonomic Insights into the Flora of Wadi Ganona: A Case Study from Southwestern of Saudi Arabia

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Abstract

This study affords a protaxonomic and phytosyllabic review of the plant species established at Wadi Ganona, southwestern Saudi Arabia. A total of 106 plant species were identified as follows: through an extensive collection, preparation, and identification of plant samples in the study area: 44 families and 83 genera. There is a higher specific richness in medicinal plant species, of which 39 species (36.8 percent of the total) illustrate pharmacological uses. Checklist of fodder, famine food, and threatened plant species is prepared to be used as aids to conservation. This study adheres to recent taxonomic corrections, incorporating updates to the classification of the *Acacia* genus, which is now divided into two distinct genera: *Vachellia* and *Senegalia*. The results suggest that Wadi Ganona plant species need to be protected and preserved to reduce desertification effects, to support the variability of species, and to prevent the loss of species that have economic and medicinal values. Measures to protect this peculiar vegetation, focusing on the further rational use of the described territory due to the violation of the balance of the biotic and abiotic components, are outlined. The present study adds to the knowledge of the force flora of the Western Kingdom of Saudi Arabia, as there is a lack of such data in the published botanical literature for this area of the region and emphasizes the need to protect these invaluable resources.

Keywords

Identification, Classification, Plant Species, Medicinal Values, Famine Plants, Threatened Plants

1. Introduction

Saudi Arabia divides its vegetation cover into five broad categories. 1) Vegetation of coastal plains and Sabkhas; 2) Deserts and scarcely vegetated areas; 3) Dwarf shrublands; 4) Woodlands and xeromorphic shrublands in high-altitude areas; 5) Wadi Communities [1]. The Kingdom of Saudi Arabia is situated in the Arabian Peninsula, occupying an area of about two million square kilometers and including highland structures—mountains and valleys, dunes and stony deserts, salt marshes, and volcanic fields—Harrats [2]. Thornthwaite's global climate classification categorizes the overall climate of the country, except for Asir Province, as arid [3]. The flora of Saudi Arabia is considered the richest biodiversity in the Arabian Peninsula, containing important genetic resources of crop and medicinal plants, with xerophytic vegetation making up the prominent features of the kingdom's plant life [4]. According to Collenette [5], the greatest species diversity in Saudi Arabia has occurred in Asir and Hijaz, the western mountainous area of the Kingdom, which borders the Red Sea. This is because of rainfall and a variety of altitudes, from sea level to 9300 m. Many previous studies showed that the topography of the study area and climatic conditions are the main factors affecting the degree of speciation. The flora and vegetation cover of Saudi Arabia were extensively studied and represented in several works, which may be regarded as the standard reference flora of the area [6]-[9]. The western part of Saudi Arabia is characterized by a diverse and dense vegetation structure with significant ecological and floristic diversity. This region is divided into distinct ecological zones, including coastal Tihama, foothills, and escarpments, each supporting unique plant communities as populations of *Acacia tortilis*, *Maerua crassifolia*, *Ficus palmata*, *Moringa peregrina*, and *Ocharadenus baccatus* visible. Recent studies have highlighted the presence of approximately 2253 plant species in Saudi Arabia, with about 20% classified as rare, distributed across 132 families and 837 genera [10] [11]-[13]. This diversity is reflected in the specific plant communities found in the western region, which include both native and alien species. A single species represents 37 families. The southwestern region, from Taif to the Yamen border, contains about 70% of floristic elements of Saudi Arabia. The main objectives of this study are to document the flora of Wadi Ganona, thereby contributing to the updating of the flora of Saudi Arabia, and to identify plant species of economic importance.

The flora of Saudi Arabia is somewhat complex, having affinities with the flora of East Africa, North Africa, the Mediterranean countries, and the Irano-Turkish countries. The distribution of species is unequal in Saudi Arabia. Most of the species are in meadows, mountains, and wadis (valleys). The average number of species occurring in a km² area is only a few, especially in the central, eastern, and northern areas, with the largest species load in the densely forested southwest mountainous region. These regions report having an area of flora that is about 70%. Nonetheless, the percentage of endemism in such a vast country remains comparably small. Currently, there are 2215 species documented, of which only

56 are strictly endemic to the Kingdom, contributing to only 2.54% of the total recorded species. [14]-[16]. The study area was selected for investigation in the present for several reasons. Firstly, there is no large number of specimens from the study area. Secondly, the last years witnessed the prevalence of good rainy seasons, which would support the actual flora of the area.

The study of native Flora is important for many reasons. In the article under analysis, ecological value, economic value and social and cultural value can be distinguished. Flora should be managed in efforts to increase the general health of some ecosystems. Known threats that have the potential to affect the flora are clearance, declining ecosystem health, pollution and diseases, overgrazing by livestock, competition with introduced plants, salinity, impacts of mining, urbanization, and climate change. The environment in semi-arid areas has the following key issues: drought, heat stress, low soil fertility, as well as reduced rainfall incidences.

2. Material and Methods

2.1. Study Area

The study area is the Wadi Ganona area, which is in the southwest region of Saudi Arabia. This area extends approximately 108 kilometers and passes through Al-Ardiyat and Al-Qunfudhah provinces in the Makkah District (**Figure 1**). The research region holds variant terrains in proportion to the numerous plant species in the area.

The region under investigation has a dry subtropical climate, with hot summers and mild winters. According to data from 1994 to 2024 gathered from the website: <https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/al-qunfudhah-saudi-arabia-108896>, the average annual temperature is 30.7°C, with January and February being the coldest months and June and July being the hottest. There is little and irregular precipitation. The climate chart showing the average annual temperatures and precipitation in Al-Qunfudhah provinces (1994-2024) is presented in **Figure 2**.

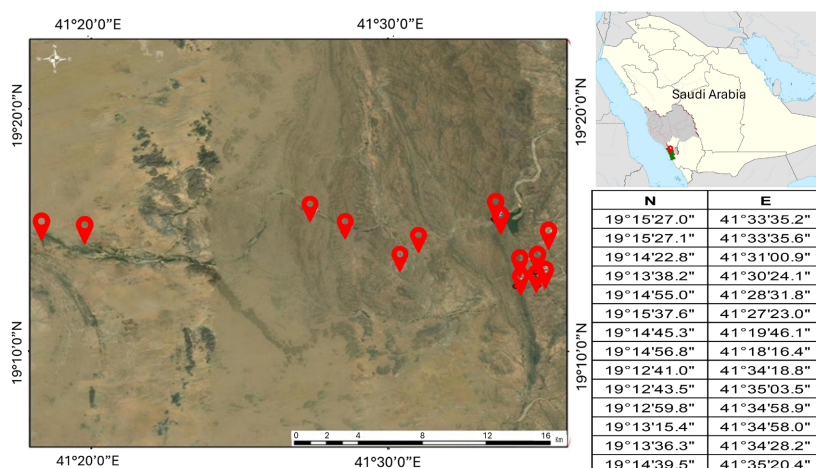


Figure 1. The position of the study area.

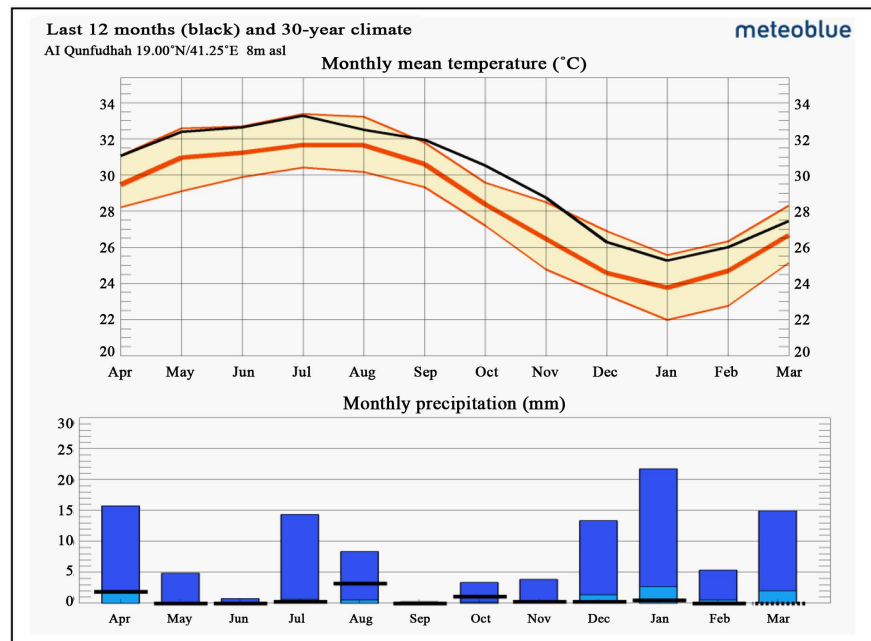


Figure 2. Climate chart showing the average annual range of temperatures and precipitation in Al-Qunfudhah provinces (1994-2024).

2.2. Materials Collection and Specimen Preparation

The field trips were carried out to the study area for collecting the specimens randomly using a circular quadrat with a diameter of 50 m. Plant specimens were collected fresh from different sites of the study area at different times of the years 2023 and 2024. The whole plant was collected in the case of herbs and twigs with leaves and flowers and/or fruits in the case of shrubs and trees. Newspapers were regularly replaced during the drying process to prevent material degradation; field observations were documented, encompassing habit, habitat, distribution, and coloration of flowers and liquids during the collection excursions. In the herbarium, further analysis and identification were conducted by examining the various parts of the collected specimens with a hand lens. Delicate floral characteristics were analyzed using the Mbc-10 dissection microscope.

The common names of species were documented by residents in the study area [17]. The medicinal folkloric applications of the collected species and additional uses have been presented. The uses have been derived from existing literature or flora of adjacent countries [18], and additional information was gathered from the local inhabitants of the study area.

3. Results

The survey of the plant species in the study area portrayed 106 species of plants belonging to 44 families, which show a variety of vegetation types (Table 1). The identified flora included 42 dicotyledons and two monocotyledons, which indicates a relatively high level of angiosperm representation. Species richness proved to be variable depending on the families, some families comprised more than one

species; on the other hand, while others consisted of only one species.

Of the 106 plant species, 39 were found to have therapeutic applications: making up 36.8% of the total number of plants (Table 2). Some medicinal plants found in the study area, including *Adenium obesum*, *Senna alexandrina*, and *Commiphora myrrha*, are illustrated in Figure 3. The finding indicates that a substantial portion of therapeutic plants can be found in the study area. Further illustrating the area's potential as a grazing resource, the vegetation sampling study also indicated fodder values for 22 species, or roughly 21.2% of the total documented flora species in the area (Table 3). Some fodder plants found in the study area, including *Vachellia flava*, *Cleome pallida*, and *Maerua crassifolia* are shown in Figure 4. Furthermore, 8 nutritious species—which accounted for 7.6% of plant species—were also investigated (Table 4). Some famine food plants found in the study area, including *Delonix elata*, *Odontanthera radians*, and *Senna italica*, are depicted in Figure 5. As a result, some woody species were designated as threatened, as Table 5 below illustrates.

The Flora

A total of 106 different species of plants in the region were recognized according to the 44 families, which include 42 families of dicotyledons and 2 families of monocotyledons. The nomenclature of the species, genera, and families of the flora of the studied area has been updated. The following results are enumerated.

Table 1. Flora of Wadi Ganona, Western Saudi Arabia (Families are listed alphabetical order).

	Family		Species	Ver. Name
1	Acanthaceae	1	<i>Blepharis ciliaris</i> (L.) B.L. Burt	Suha
		2	<i>Anisotes trisulcus</i> (Forssk.) Nees.	Mud
2	Aizoaceae	3	<i>Trianthema portulacastrum</i> L.	Ragum Lany
3	Amaranthaceae	4	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Tirf
		5	<i>Amaranthus graecizans</i> L.	Shadkh
		6	<i>Caroxylon spinescens</i> (Moq.) Akhani & Roalson	Jurm
4	Amaryllidaceae	7	<i>Pancreatium tortuosum</i> Herbert	Basal
				Althaelab
5	Apocynaceae	8	<i>Adenium obesum</i> (Forssk) Roem. & Schult.	Aden
		9	<i>Clatropis procera</i> (Ait.) Ait. f.	Eushar
6	Arecaceae	10	<i>Hyphaene thebaica</i> (L.) mart.	Dum
		11	<i>Phoenix caespitosa</i> Chiov.	Shatab
		7	Asclepiadaceae	12
13	<i>Leptadenia arborea</i> (Forssk.) Schweinf.			Ghashy, Liwyth
14	<i>Leptadenia pyrotechnica</i> (Forssk.)			Marakh
15	<i>Odontanthera radians</i> (Forssk.) D.V. Field			Shutb
16		16	<i>Sarcostemma forskaolanum</i> (Schult.) Meve & Liede	Ryd
8	Asparagaceae	17	<i>Dipcadi erythraeum</i> Webb. & Berthel.	Basal Alsayd

Continued

9	Asteraceae	18	<i>Pulicaria inuloides</i> (Poir.) DC.	Sukab		
		19	<i>Pulicaria undulata</i> (L.) C.A.Mey	Jithjath		
10	Boraginaceae	20	<i>Heliotropium arbainense</i> Fresen.	Ramram		
		21	<i>Heliotropium curassavicum</i> L.	Akrir Aghbur Raqib		
		22	<i>Heliotropium aegyptiacum</i> Lehm.	Alshams Misri		
		23	<i>Heliotropium longiflorum</i> (A. DC.) Jaub. & Spach	Raqib alshams		
		24	<i>Heliotropium pterocarpum</i> Hockst. & Steud. ex Bunge	Akrir		
11	Burseraceae	25	<i>Commiphora gileadensis</i> (L.) C.Chr	Basham		
		26	<i>Commiphora Kataf</i> (Forssk.) Engl.	Gafal		
		27	<i>Commiphora quadricincta</i> Schweinf.	Qataf		
		28	<i>Commiphora myrrha</i> (Nees) Engl.	Mur		
12	Capparaceae	29	<i>Cadaba longifolia</i> DC.	Ghassa'		
		30	<i>Cadaba rotundifolia</i> Forssk.	Qadab		
		31	<i>Cadaba glandulosa</i> Forssk.	Taneim		
		32	<i>Capparis decidua</i> Edgew (Forssk.)	Tundub		
		33	<i>Maerua crassifolia</i> Forssk.	Ssarh		
		34	<i>Maerua oblongifolia</i> (Forssk.) A.Rich.	Sommar		
		35	<i>Suaeda monoica</i> Forssk. ex J.F.Gmel.	Hamd		
14	Cleomaceae	36	<i>Cleome gynandra</i> L.	Ayfqan Earfaj		
		37	<i>Cleome pallida</i> Kotschy	Tihama		
		38	<i>Cleome paradoxa</i> R.Br. ex DC.	Gharira, Hindib		
		39	<i>Cleome viscosa</i> L.	Sumah elaeir		
		40	<i>Convolvulus prostratus</i> Forssk.	Oleik, Rukhami		
16	Cucurbitaceae	41	<i>Ipomea carenea</i> Jacq.	Ipomoea		
		42	<i>Citrullus colocynthis</i> (L.) Schrad.	Handhal		
		43	<i>Cucumis melo</i> L.	Shmmam		
17	Cyperaceae	44	<i>Cyperus macrorrhizus</i> Nees.	Eashm		
18	Euphorbiaceae	45	<i>Chrozophora oblongifolia</i> (Delile) A.Juss. ex Spreng.	Tanwm		
		46	<i>Euphorbia cuneata</i> Vahl.	Bakaa		
		47	<i>Jatropha pelargoniiifolia</i> Courbon	Eaga		
		48	<i>Ricinus communis</i> L.	Khrwe		
		19	Fabaceae	49	<i>Delonix elata</i> (L.) Gamble	Rnf
				50	<i>Indigofera oblongifolia</i> Forssk.	Hasar
51	<i>Indigofera hochstetteri</i> Baker			Saql		
52	<i>Indigofera spinosa</i> Forssk.			Shibrq		
53	<i>Lotus arabicus</i> Sol. ex L.			Al Hathra		
54	<i>Prosopis julliflora</i> (Sw.) Dc.			Misqeat		
55	<i>Rhynchosia pulverulenta</i> Stocks			Argos		
		56	<i>Senna alexandrina</i> Mill.	Senna		
		57	<i>Senna italica</i> Mill.	Makkah Ashraq		

Continued

		58	<i>Senegalia asak</i> (Forssk.) Kyal. & Boatwr.	Easaq, Dahyan
		59	<i>Senegalia hamulosa</i> (Benth.) Boatwr.	Qtad
		60	<i>Tamarindus indica</i> L.	Homar
		61	<i>Tephrosia purpurea</i> (L.) Pers.	Huayra
		62	<i>Tephrosia nubica</i> (Boiss.) Baker	Eadhb
		63	<i>Vachellia flava</i> (Forssk.) Kyal. & Boatwr.	Sslam
		64	<i>Vachilia oerfota</i> (Forssk.) Kyal. & Boatwr.	Orfot
		65	<i>Vachellia johnwoodii</i> (Bouls) Ragup., Seigler, Ebinger & Maslin	Sial
		66	<i>Vachellia tortilis</i> (Forssk.) Galasso & Banfi	Samur
20	Gisekiaceae	67	<i>Gisekia pharnaceoides</i> L.	Eidman
21	Labiatae	68	<i>Ocimum forsskaolii</i> Benth.	dymran
22	Lamiaceae	69	<i>Lavandula pubescens</i> Decne.	Shaye
		70	<i>Premna resinosa</i> (Hochst.) Schauer	Shuqab
23	Loranthaceae	71	<i>Plicosepalus curviflorus</i> (Benth. ex Oliv.) Tiegh.	Anum
24	Lythraceae	72	<i>Lawsonia inermis</i> L.	Henna
25	Malvaceae	73	<i>Corchorus depressus</i> (L.) Peterm.	Wykah
		74	<i>Grewia tenax</i> (Forssk.) Fiori.	Nabaa
26	Menispermaceae	75	<i>Cocculus pendulus</i> (J.R.Forst. & G.Forst.) Diels	Gashwa
27	Moraceae	76	<i>Ficus salicifolia</i> Vahl	Athab
		77	<i>Ficus sycomorus</i> L.	Gomez, Ebra
28	Moringaceae	78	<i>Moringa peregrina</i> (Forssk.) Fiori	Ussr, Ban
29	Molluginaceae	79	<i>Mollugo cerviana</i> (L.) Ser.	Gaishageshan
30	Nyctaginaceae	80	<i>Boerhavia diffusa</i> L.	Ragam
31	Papaveraceae	81	<i>Argemone ochroleuca</i> Sweet	Hashrah
32	Plantaginaceae	82	<i>Bacopa monnieri</i> (L.) Pennell	Ladaid
		83	<i>Scorparia dulcis</i> L.	Dafra
33	Poaceae	84	<i>Cenchrus ciliaris</i> L.	Eibad
		85	<i>Chloris gayana</i> Kunth	Rodass Bari
		86	<i>Dactyloctenium scindicum</i> Boiss.	Andab
		87	<i>Aeluropus lagopoides</i> (L.) Thwaites	Ekrsh
		88	<i>Imperata cylindrica</i> (L.) P.Beauv.	Halfa
		89	<i>Panicum turgidum</i> Forssk.	Thumam, Dharam
		90	<i>Pennisetum divisum</i> (Forssk.ex J.F.Gmel.) Henrard	Sabga
34	Resedaceae	91	<i>Ochradenus baccatus</i> Delile	Garady
35	Rhamnaceae	92	<i>Ziziphus spina-christi</i> (L.) Desf.	Sidr
36	Salvadoraceae	93	<i>Dobera glabra</i> (Forssk.) Juss. ex Poir.	Dabr
		94	<i>Salvadora persica</i> L.	Arak
37	Orobanchaceae	95	<i>Lindenbergia indica</i> (L.) Vatke	Hwaimdah
38	Solanaceae	96	<i>Solanum coagulans</i> Forssk.	Hadaq
		97	<i>Withania somnifera</i> (L.) Dunal	Obaab
39	Tamaricaceae	98	<i>Tamarix nilotica</i> (Ehrenb.) Bunge	Athl, Thalthal
		99	<i>Tamarix aphylla</i> (L.) H.Karst.	Athel
40	Typhaceae	100	<i>Typha domingensis</i> Pers.	Bardi

Continued

41	Urticaceae	101	<i>Forsskaolea tenacissima</i> L.	Lasyq
42	Verbenaceae	102	<i>Phyla nodiflora</i> (L.) Greene	Mashaba
43	Vitaceae	103	<i>Cissus quadrangularis</i> L.	Salae
		104	<i>Cissus rotundifolia</i> Lam.	Halas, Galef
44	Zygophyllaceae	105	<i>Fagonia indica</i> Burm.fil.	Shkae
		106	<i>Zygophyllum simplex</i> L.	Garmal

Table 2. Medicinal plant species at the study area (Families are listed alphabetical order).

	Family		Species	Used Parts	Disease treated	Ref.
1	Acanthaceae	1	<i>Blepharis ciliaris</i> (L.) B.L. Burt	Whole Herb	Toothache and skin wounds	[19]
		2	<i>Anisotes trisulcus</i> (Forssk.) Nees.	Leaves	Diabetes Foot inflammation	[19]
2	Aizoaceae	3	<i>Trianthema portulacastrum</i> L.	Leaves	skin conditions and gastrointestinal issues.	[20]
3	Amaranthaceae	4	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Whole Plant	Toothache	[18]
4	Apocynaceae	5	<i>Adenium obesum</i> (Forssk) Roem. & Schult.	Aerial Parts	Joint pain, paralysis, skin infections, wounds, and bone dislocations	[19]
5	Asclepiadaceae	6	<i>Leptadenia arborea</i> (Forssk.) Schweinf.	stems, roots	respiratory issues and digestive disorders	[21]
		7	<i>Sarcostemma forskaolium</i> (Schult.) Meve & Liede	Stem, Root, Latex, Seeds	diabetic foot ulcers	[22]
6	Boraginaceae	8	<i>Heliotropium arbainense</i> Fresen.	Whole Plant	gout, rheumatism, skin disorders, and inflammatory conditions	[23]
7	Burseraceae	9	<i>Commiphora gileadensis</i> (L.) C. Chr	Stem	burns and skin infections	[24]
		10	<i>Commiphora Kataf</i> (Forssk.) Engl.	Resin	wounds and ulcers	[22]
		11	<i>Commiphora quadricincta</i> Schweinf.	Stem	wounds and skin infections	[25]
		12	<i>Commiphora myrrha</i> (Nees) Engl.	Resin	wounds, mouth ulcers, arthritis, and hyperlipidemia	[26]
8	Capparaceae	13	<i>Cadaba rotundifolia</i> Forssk.	Leaves	Arthritis, tonsillitis, tumors and abscesses	[27]
		14	<i>Cadaba glandulosa</i> Forssk.	Leaves	liver-related issues and viral infections	[27]
9	Cucurbitaceae	15	<i>Citrullus colocynthis</i> (L.) Schrad.	Fruits	alleviate indigestion and stomach pain	[18]
10	Cyperaceae	16	<i>Cyperus macrorrhizus</i> Nees.	Powder	gastrointestinal and respiratory issues, blood disorders, and inflammatory diseases	[28]
11	Euphorbiaceae	17	<i>Jatropha pelargoniifolia</i> Courbon	Aerial Parts	Pain and fever	[27]
		18	<i>Ricinus communis</i> L.	Leaves	constipation and promoting digestive health	[29]

Continued

12	Fabaceae	19	<i>Delonix elata</i> (L.) Gamble	Fresh leaves	alleviate pain and joint stiffness	[30]
		20	<i>Senna alexandrina</i> Mill.	Leaves	constipation and digestive disorders	[26]
		21	<i>Senna italica</i> Mill.	Fruits	constipation and digestive disorders	[31]
		22	<i>Senegalia asak</i> (Forssk.) Kyal. & Boatwr.	Leaves, Bark, Roots	respiratory issues	[32]
		23	<i>Senegalia hamulosa</i> (Benth.) Boatwr.	Leaves, Bark	dental pain	[32]
		24	<i>Tamarindus indica</i> L.	Fruits	diabetes, fever, ulcers, and respiratory issues	[18]
		25	<i>Vachilia oerfota</i> (Forssk.) Kyal. & Boatwr.	Bark	diabetes, respiratory issues, and skin conditions.	[25]
13	Lamiaceae	26	<i>Lavandula pubescens</i> Decne.	Aerial Parts	alleviate mild mood disorders, such as anxiety and depression	[33]
14	Loranthaceae	27	<i>Plicosepalus curviflorus</i> (Benth. ex Oliv.) Tiegh.	Stem	diabetes and cancer	[23]
15	Lythraceae	28	<i>Lawsonia inermis</i> L.	Leaves	skin and hair health	[26]
16	Malvaceae	29	<i>Grewia tenax</i> (Forssk.) Fiori.	Aerial Parts	Iron Deficiency Anemia and Gastrointestinal Disorders	[19]
17	Moraceae	30	<i>Ficus salicifolia</i> Vahl	Whole Plant	diabetes, gastrointestinal disorders, and respiratory issues	[34]
		31	<i>Ficus sycomorus</i> L.	Stem	dysentery and as a wound dressing agent	[25]
18	Moringaceae	32	<i>Moringa peregrina</i> (Forssk.) Fiori	Leaves, Seeds	fever, muscle pain, asthma, and digestive issues	[26]
19	Poaceae	33	<i>Panicum turgidum</i> Forssk.	Whole Herb	Antifungal	[18]
20	Resedaceae	34	<i>Ochradenus baccatus</i> Delile	Whole herb	Reproductive health, headaches, fevers, and as antibiotic and deodorant	[18]
21	Rhamnaceae	35	<i>Ziziphus spina-christi</i> (L.) Desf.	Leaves	Swellings, inflammatory disorders and wounds	[18]
22	Salvadoraceae	36	<i>Salvadora persica</i> L.	Aerial parts	Gastrointestinal disorders, increase milk production	[29]
23	Solanaceae	37	<i>Withania somnifera</i> (L.) Dunal	Leaves	resilience to stress and restore balance	[18]
24	Tamaricaceae	38	<i>Tamarix aphylla</i> (L.) H.Karst.	Leaves, Roots	oxidative stress	[22]
25	Verbenaceae	39	<i>Phyla nodiflora</i> (L.) Greene	Leaves	Detoxification, diuretic, stomachic, and astringent	[29]

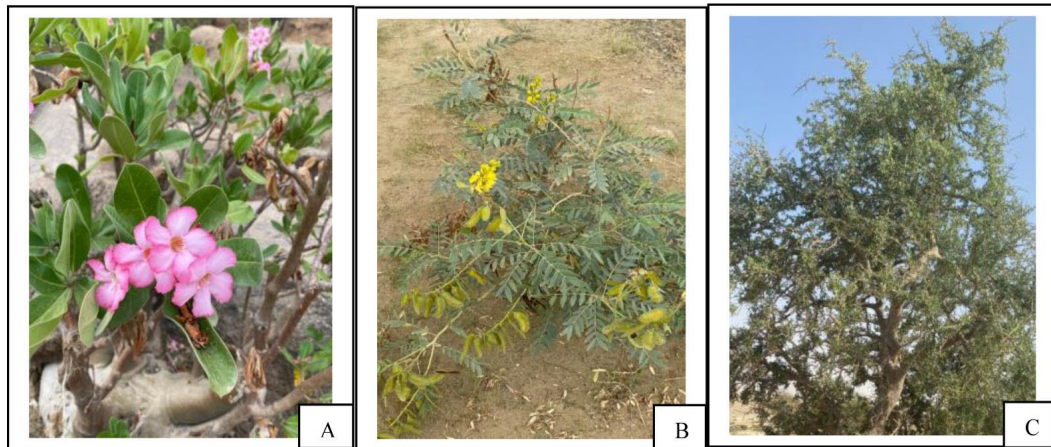


Figure 3. Some medicinal plants found in the study area. (A) *Adenium obesum*; (B) *Senna alexandrina*; (C) *Commiphora myrrha*.

Table 3. Fodder plant species at the study area (Families are listed alphabetical order).

	Family		Species	Nutritional value	Ref.
1	Asclepiadaceae	1	<i>Leptadenia pyrotechnica</i> (Forssk.)	High protein and mineral content, for ruminants	[35]
2	Boraginaceae	2	<i>Heliotropium pterocarpum</i> Hockst. & Steud. ex Bunge	Fibrous structure and nutrient content, for cattle and goats	[36]
3	Capparaceae	3	<i>Capparis decidua</i> Edgew (Forssk.)	Rich in protein, vitamins, minerals, flavonoids and other phytochemicals, for goats, sheep and camels	[37]
		4	<i>Maerua crassifolia</i> Forssk.	Crude protein, organic matter and minerals, for ruminants	[38]
4	Cleomaceae	5	<i>Cleome pallida</i> Kotschy	High levels of crude protein, mineral composition for ruminants	[39]
5	Convolvulaceae	6	<i>Convolvulus prostratus</i> Forssk.	Crude protein and mineral content for Goats and camels	[40]
6	Cucurbitaceae	7	<i>Cucumis melo</i> L.	Rich in carbohydrates, protein, lipids, minerals and fiber content, for ruminants and livestock	[41]
7	Cyperaceae	8	<i>Cyperus macrorrhizus</i> Nees.	Carbohydrates, proteins, rich in fats, vitamins and minerals for ruminants and livestock	[42]
8	Euphorbiaceae	9	<i>Chrozophora oblongifolia</i> (Delile) A.Juss. ex Spreng.	Crude protein and mineral content, for camels and cattle	[43]
9	Fabaceae	10	<i>Indigofera oblongifolia</i> Forssk.	High crude protein, mineral content, for small ruminants and cattle	[44]
		11	<i>Indigofera hochstetteri</i> Baker	Rich in crude protein, crude fiber, minerals and vitamins, for ruminants and non-ruminants	[44]
		12	<i>Indigofera spinosa</i> Forssk.	High crude protein, for goats	[44]
		13	<i>Rhynchosia pulverulenta</i> Stocks	Crude protein, fat, fiber, High carbohydrate, minerals and vitamins for livestock	[45]

Continued

		14	<i>Vachellia flava</i> (Forssk.) Kyal. & Boatwr.	High crude protein, minerals, for goats, cattle and sheep	[46]
		15	<i>Vachilia oerfota</i> (Forssk.) Kyal. & Boatwr.	Crude protein, minerals for ruminants	[46]
10	Loranthaceae	16	<i>Plicosepalus curviflorus</i> (Benth. ex Oliv.) Tiegh.	Essential nutrients that support animal health, for ruminants	[42]
11	Gisekiaceae	17	<i>Gisekia pharnaceoides</i> L.	Rich in carbohydrates and essential fatty acids, for ruminants	[47]
12	Nyctaginaceae	18	<i>Boerhavia diffusa</i> L.	Crude protein, rich in alkaloids, flavonoids, and glycosides, for ruminants	[48]
13	Poaceae	19	<i>Cenchrus ciliaris</i> L.	Protein, mineral, fiber and energy for cattle, goats, sheep and wildlife	[49]
		20	<i>Panicum turgidum</i> Forssk.	Crude protein, mineral content for cattle, goats, and sheep	[50]
14	Salvadoraceae	21	<i>Salvadora persica</i> L.	Vitamin C, fluoride, chloride, for camels, goats and sheep	[51]
15	Zygophyllaceae	22	<i>Zygophyllum simplex</i> L.	Flavonoids, phenolic acids, amino acids and fatty acids for camels	[52]

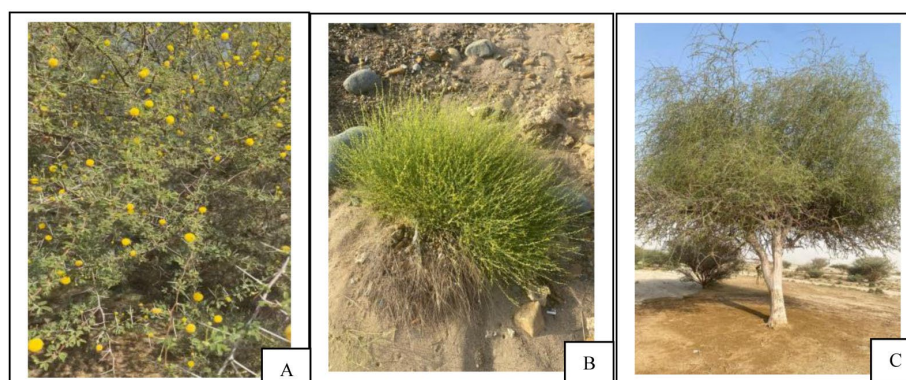


Figure 4. Some fodder plants found in the study area. (A) *Vachellia flava*; (B) *Cleome pallida*; (C) *Maerua crassifolia*.

Table 4. Famine food plant species at the study area, which are used particularly in regions facing nutritional crises.

Family	Species	Ref.
Amaranthaceae	<i>Amaranthus graecizans</i> L.	[53]
Asclepiadaceae	<i>Sarcostemma forskolianum</i> (Schult.) Meve & Liede	[54]
	<i>Odontanthera radians</i> (Forssk.) D.V. Field	[55]
Cleomaceae	<i>Cleome gynandra</i> L.	[56]
Euphorbiaceae	<i>Euphorbia cuneata</i> Vahl.	[57]
	<i>Delonix elata</i> (L.) Gamble	[55]
Fabaceae	<i>Tamarindus indica</i> L.	[58]
	<i>Senna italica</i> Mill.	[59]

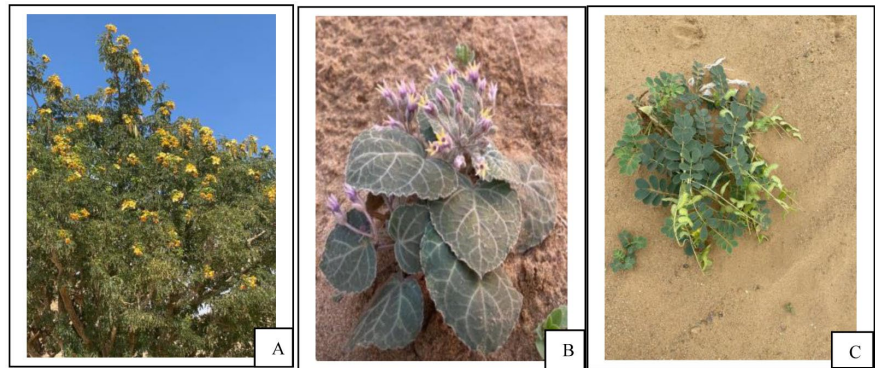


Figure 5. Some famine food plants found in the study area. (A) *Delonix elata*; (B) *Odontanthera radians*; (C) *Senna italica*.

Table 5. Threatened plant species at the study area, which host endemic and endangered species.

Family	Species	Reasons
Apocynaceae	<i>Leptadenia pyrotechnica</i> (Forssk.)	Browsing by camels
Burseraceae	<i>Commiphora gileadensis</i> (L.) C.Chr	Medicinal uses
Fabaceae	<i>Vachellia tortilis</i> (Forssk.) Galasso & Banfi	Fuel wood and fodder.
Salvadoraceae	<i>Dobera glabra</i> (Forssk.) Juss. ex Poir.	Browsing (palatable) by camels.
	<i>Salvadora persica</i> L.	Browsing (palatable) and use as teeth brushes.

4. Discussion

The present study found similar findings in [6] [17]. The study reported findings like those of flora studies in Western K.S.A. [14]-[16]. that *Salvadora persica* and *Dobera glabra* had become rare species. This may be alongside browsing, demand, and consideration of the fact that these trees form a good source of income.

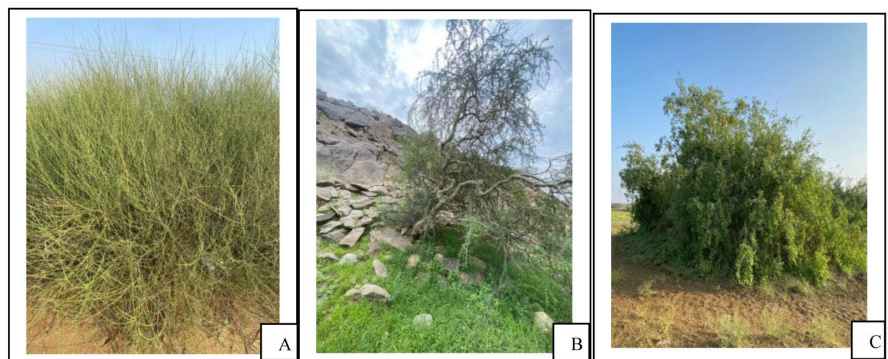


Figure 6. Some threatened plants found in the study area. (A) *Leptadenia pyrotechnica*; (B) *Commiphora gileadensis*; (C) *Salvadora persica*.

Some of the families contained only a few species, some containing just one species because of a lack of suitable habitat. The study area is generally sparsely

vegetated and has low species diversity. This is especially because of differences in rainfall, overgrazing, excessive use of the resources, and the sand slip drop-off effect. Some wood species are threatened and endangered in the study area. This is probably due to climate change, excessive use, and overgrazing. Some threatened plants found in the study area, including *Leptadenia pyrotechnica*, *Commiphora gileadensis*, and *Salvadora persica*, are presented in **Figure 6**.

5. Conclusion

The most common families in the study area were Fabaceae and Capparaceae, whereas the most important monocotyledon was Poaceae. The study updated some families, genera, and plant species in the study area. A recently published correction led to these changes. The changed families of the plants were Palmae to Arecaceae, Compositae to Asteraceae, Leguminosae to Fabaceae, Labiateae to Lamiaceae, and Gramineae to Poaceae. The *Acacia* genus underwent a transformation into two genres: *Vachellia* and *Senegalia*. The species that underwent changes included *Gynandropis gynandra*, which became *Cleome gynandra*, *Dipterygium glaucum*, which became *Cleome pallida*, *Acacia ehrenbergiana*, which became *Vachellia flava*, and *Acacia nubica*, which became *Vachellia oerfota*.

6. Recommendation

The conservation of plant species in the study area is a priority for conserving and improving a variety of biodiversity. Additionally, efforts at preservation should be targeted toward plant species of economic and medicinal importance. For their long-term survival, this species must be reseeded and replanted. Moreover, educational programs must be implemented for the given population to convey the significance of the subjects in the study as a principal national resource. The current situation demands the combined efforts of researchers, policymakers, and local communities to adopt a socio-ecological approach for achieving sustainability in arid land.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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