

## REVIEW OF THE GENUS ACACIA MILL. AND ITS ALLIED GENERA IN KINGDOM OF SAUDI ARABIA AND THEIR CONSERVATION STATUS

ABDALLA A. ELFEEL<sup>1\*</sup>, KHALID A. ASIRY<sup>1</sup>, REFAAT A. ABOHASSAN<sup>1</sup>, NAIMAH A. ALANAZI<sup>2</sup>  
AND ALI K. ELSAFORI<sup>1</sup>

<sup>1</sup>Department of Agriculture, Faculty of Environmental Sciences, King Abdulaziz University, Jeddah 21589, Saudi Arabia

<sup>2</sup>Department of Biology, Faculty of Science, University of Ha'il, P.O. Box 659, Ha'il 81421, Saudi Arabia

\*Corresponding author's email: aidris@kau.edu.sa

### Abstract

The genus *Acacia* Mill. (s. lat.), a member of the *Fabaceae*, subfamily *Mimosoideae* contains over 1500 known species. Recent molecular phylogenetic analysis has reclassified African *Acacia* into two genera: *Vachellia* and *Senegalia*. Within the Kingdom of Saudi Arabia (KSA) *Acacia* communities, represent one of the largest forest communities. This paper provides a comprehensive analytical review of the classification, relocation to the new genera, distribution, multifaceted uses, and current conservation status of *Acacia* species in KSA.

The genus naturally spans diverse biogeographical distribution across KSA, from flat dry forests to high mountainous regions like the Soudah mountains of Asir. Currently, approximately 14 known *Acacia* species, with about 10 species allocated to *Vachellia* (with globular inflorescences and true spines) and 4 to *Senegalia* (with spicate flowers and prickles). However, there is still a lack of precise information about the exact number of species, subspecies and varieties, taxonomic relations and their biogeographical distribution. The species of two genera offer substantial ecosystem services, including environmental protection, medicinal applications, desertification control, climate change mitigation, water catchment protection, and the provision of various wood and non-wood products. Significantly, *Acacia* (s. lat.) trees are positioned to play a pivotal role in achieving the ambitious Greening Saudi Initiative objectives, such as planting 10 billion trees. However, the conservation status of many species is unfortunately declining, primarily due to a complex array of forest disturbances. These include insect pests, such as bark beetles, seed borers, and desert locust (e.g., bark beetles alone caused over 21% damage to *Acacia* populations in Hail). Furthermore, invasive species like *Prosopis juliflora*, coupled with forest fires, human-induced disturbances, and the overarching impacts of climate change, exert heavy pressure on these vital forest ecosystems. To address these challenges and resolve the existing taxonomic ambiguities, this review strongly recommends further studies in phylogenetic analysis and conservation status.

**Key words:** *Acacia*; *Vachellia*; *Senegalia*; Conservation status; Greening Saudi Initiative globular inflorescences and true spines versus *Senegalia*'s spicate flowers and prickles

### Introduction

In general, due to the arid and hyper-arid climate of Kingdom of Saudi Arabia and a large desert area including the empty quarter (Rub' al Khali) desert the forest cover is low compared to the total land area (Anon., 2020). Nevertheless, the plant diversity is very high due to its unique geographical location, the very large area and great ecological diversity (plant diversity of Saudi Arabia, 2024). More than 2000 plant species belonging to more than 140 families were reported in KSA with more than 250 medicinal and aromatic plants (Plant Diversity of Saudi Arabia, 2024). There are three main forest ecological zones; the high altitudinal mountainous forest communities on the southwestern and central part of the country, the dry land terrestrial forests that cover the major area of the country and the coastal mangrove forests on the coasts of the Red Sea and Arabian Gulf (Chaudhary & Al-Jawaid, 2013).

The genus *Acacia* was first described by Philip Miller as early as 1754 (Doran *et al.*, 1983). The first recorded *Acacia* species was *A. nilotica*. There are nearly 1500 known species of *Acacia* (Dyer, 2014). The natural range of the genus covers all continents, except Europe and Antarctica (Maslin *et al.*, 2003). However, in 2011 the

African *Acacias* were re-named into two genera *Vachellia* and *Senegalia* (Kyalangalilwa *et al.*, 2013). In the Kingdom of Saudi Arabia, *Acacias* (s. lat.) represent the main part of arid zone forest vegetation community, the largest forest community (Chaudhary *et al.*, 2013). Fourteen species of *Acacias* (s. lat.) were reported in the KSA (Sheila, 1985; Chaudhary, 1983).

In the year 2012 the *Green Saudi Initiative* was announced. This is very ambitious initiative covering the period between 2021–2030 and following the vision 2030. The initiative highlights an overall sustainable goal for the current and future generation with three main target objectives: Greening Saudi, by planting about 10 billion trees, reducing carbon emissions to 278 million tons per annum and protecting about 30% of terrestrial and marine ecosystems.

In this regard, *Acacia* trees will have a very great role in contributing to the achievement of the initiative objectives. Due to their wide natural range, multiple uses and values and perfect resilience to the changing climatic conditions. This paper presents analytical review about the new placement of Saudi *Acacia* and its allied genera *Vachellia* and *Senegalia*, their distribution, uses, values and conservation status.

## Discussion

**Botanical history of the genus *Acacia*:** The *Acacia* genus, commonly known as *Acacia* or *Wattles* belongs to the pea family *Fabaceae*, subfamily *Mimosoideae*. First described by Phillip Miller in 1754 (Doran *et al.*, 1983). The first recorded *Acacia* was Egyptian thorn *Acacia* (*A. nilotica*). There are about 1500 known species of *Acacia* (Dyer, 2014). In Australia alone, there were over 1000 species of *Acacia* (s. lat.) (Richardson *et al.*, 2023). In addition to over 130 species are native to African; about 100 species found in Madagascar; 270 species in America and 55 species in Asia-pacific region (International Dendrology Society, 2024). The natural range of the genus covers all continents, except Europe and Antarctica (Maslin *et al.*, 2003). Recently the analysis of fossilized pods of *Acacia* revealed the occurrence of *Acacia* in the Southern lower altitude of China during the middle Miocene, suggesting a wide biogeographical distribution and diversification of *Acacia* (Wang *et al.*, 2023). However, due to a very large number of species and a wide diversified natural range of the genus, there is a lot of debate and controversy on *Acacia* among the scientific community throughout history (Thiele, 2011). Until recently, a finding of molecular phylogenetic analysis of *Acacia* resulted in the placement of the African *Acacia* into two genera, namely *Vachellia* and *Senegalia* (Kyalangalilwa *et al.*, 2013). This new classification of the genus was approved in the year 2011 during the 17th International Botanical Congress, held in Melbourne, Australia (Dyer, 2014). However, there is still some sort of disagreement about the way this was done (retaining the name *Acacia* for the Australian species) (Tropical Plants Database, 2024). The main differences between *Vachellia* and *Senegalia* are that *Vachellia* have globular head (capitate) inflorescence and spinescent stipules, while in *Senegalia* the inflorescence with spicate flowers and non-spinescent stipules (prickles) (Dyer, 2014). In the Kingdom of Saudi Arabia, *Acacias* represent the main part of dry zone forest vegetation community, the largest forest community (Chaudhary *et al.*, 2022). There are about 14 native species of *Acacia* recorded in Saudi Arabia, in addition to *Faidherbia albida* (Chaudhary & Al-Jawaid, 2013; Abdul Wali *et al.*, 2016; Chaudhary, 1983; Sheila, 1985). The occurrence of the species extending from low-level flat areas to high altitudinal areas. Fayed and Zayed (1989), identified about 6 *Acacias* in Makkah region (*A. raddiana*, *A. tortilis*, *A. ehrenbergiana*, *A. hamulosa*, *A. asak*, *A. gerradii*). While, Waly and Emad (2012) added two species to these 6 species in the same area (*A. etbaica* and *A. nubica*). In Al-Baha there are about 8 registered species, 6 of which are among the 17% widely distributed tree species in the area (*A. gerradii*, *A. asak*, *A. flava*, *A. origena*, *A. ebaica* and *A. tortilis*) (Abdul Wali *et al.*, 2016). In Asir Region at the lower slope (400 – 1000 m) there are about 7 species of *Acacias*, in the area between 1000–1600 m there are 3 species, in 1600–2200 m there are 3 species while on the mountains between 2200 and 3100 m there is only one species (*Vachellia origena*) (Plant Diversity of Saudi Arabia, 2024).

**Communities and biogeographical distribution of the genus *Acacia* in KSA:** In the Kingdom of Saudi Arabia, *Acacias* (s. lat.) represent the main part of arid zone forest vegetation community as well as part of mountainous forest community (Chaudhary & Al-Jawaid, 2013). It is the most widespread forest communities, stretching from low flat

areas to high altitudinal areas (Waly & Emad, 2012). Some species like *V. tortilis*, *V. flava* and others are found in flat plains and along wadis and sand dunes while others found in very high altitudinal areas associated with *Juniperus procera* (*Vachellia origena*) (Table 1 & 2). The distribution of the different species in KSA were presented in (Fig. 1). *V. tortilis* is the species with widest natural range covering most regions of KSA. While others like *V. origena* are restricted to high altitudes and others Like *V. etbaica* and *S. hamulosa* are characteristics of lower slopes and rocky hills.

However, there is a lot of controversy in the literature about the different species, subspecies and varieties. According to the Anon., (2014), *V. Gerradii* have two varieties; *iraquensis* and *najddensis*, while in Chaudhary (1983) and Chaudhary and Al-Jawaid (2013), there is one subspecies (subsp. *Negevensis* and two varieties *negevensis* and *najdensis*) where according to Kew (Plants of the World Online, 2024) there is only one subspecies in KSA (Subspecies *najdensis*). For *V. johnwoodii*, Chaudhary *et al.*, (2022), described *abyssinica* as syn. for *johnwoodii*, while Abdul Wali (2016) revealed that *abyssinica* var. *macroloba* was syn. for *johnwoodii*. The same way Chaudhary *et al.*, (2022) describes *origena* as a new name for *negrii*, while Chaudhary and Al-Jawaid (2013), mentioned that *origena* was previously mistakenly identified as *negrii*. Therefore, in this review we did not include *abyssinica* and *negrii*. Thus, we reviewed a total of 14 species with *V. tortilis* having two subsp. (*raddiana* and *spirocarpa*).

**How to differentiate between the *Acacia* species in the two genera in KSA:** Fig. 2 summarizes the main features of identification and differentiation between the *Acacias* in KSA. In general, according to the new separation of African *Acacia* into the genus *Vachellia* and genus *Senegalia*, there are about 14 *Acacias* (s. lat.), plus *F. albida*. They were relocated as follows: 10 species were placed into the *Vachellia* of which in 7 species the inflorescence was arranged in white or creamy or creamy-white globose heads, while 3 species with yellow capitate inflorescences. The other 4 species were placed into the genus *Senegalia* and all with white spicate inflorescence. In most of the KSA *Acacias* the leaves are bipinnate, but the species differed in some characters such as the number of the pinnae and the leaf blade size. The thorns are either spinescence stipules (with spines) arising from the near leaf base or curved with two or three prickles arising from epidermis and are usually found in the nodes or may found in the stem (Timberlake *et al.*, 1999). It was observed that in the species with straight spines or stipules usually have spherical cluster of flowers with some exceptions like *F. albida* with straight spines, but with spicate flowers. While the species with prickles usually their flowers are in cylindrical cluster, also with some exceptions like *V. tortilis* which have both straight and curve thorns but its flowers in head (Timberlake *et al.*, 1999). Concerning the fruits, most of the *Acacia* species are with dehiscent pods, while few other species are with indehiscent pods. The fruits are widely differing in shape and size. In the same way, the seeds are widely variable in shape, size and color. In addition, the seeds of most *Acacia* have a seed coat dormancy. However, according to Ross (1973) the species with spicate inflorescence have small centrally located areoles, while those with capitate inflorescence have large areoles in the seed.

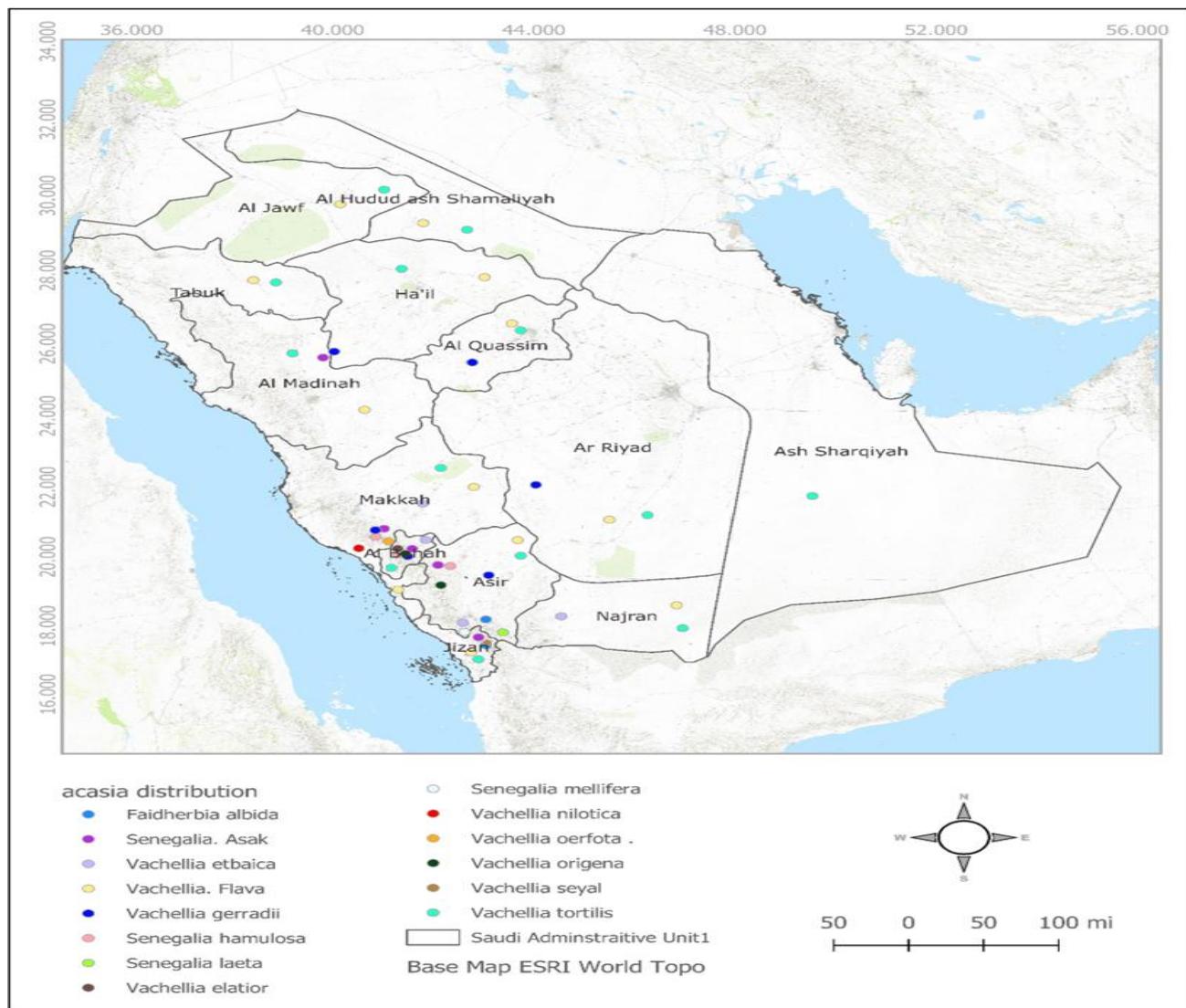


Fig. 1. Map of two genera (*Vachellia* and *Senegalia*) of *Acacia* Species distribution in Kingdom of Saudi Arabia based on varying elevations using the SRTM Digital Elevation Model (DEM) from Google Earth Engine (GEE) and analyzed with advanced QGIS Software.

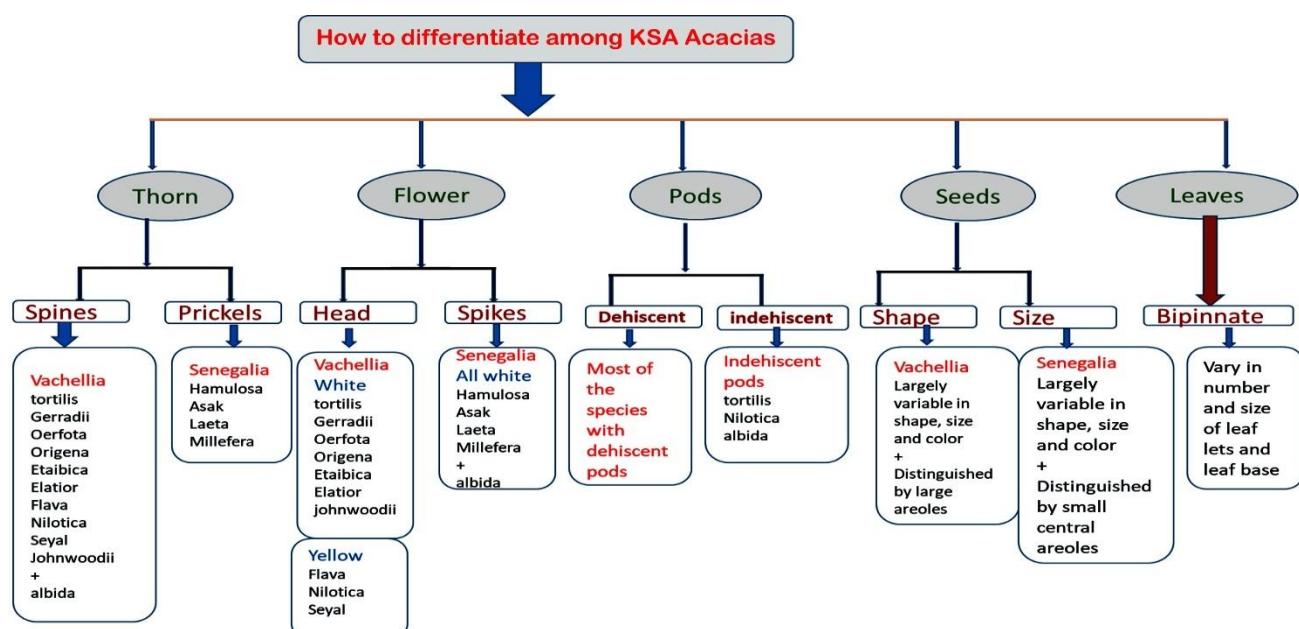


Fig. 2. Differentiation between the different species of the two genera (*Vachellia* and *Senegalia*) in the Kingdom of Saudi Arabia according to their morphological features (Thorns, Flowers, pods, Seeds and Leaves).

Table 1. Description and habitat of species, subspecies and varieties of the genus *Vachellia* found in Kingdom of Saudi Arabia.

No.	Scientific name	Common name	Local name	Description	Habitat
1.	<i>Vachellia tortilis</i> (forssk.) Galasso & Banfi.	Umbrella Thorn	Samur, Sayal	A tree 7-21 m high. Stipules spinescent, hooked or straight. Leaves compound. Flowers: Capitate, white. Fruit: pods spirally twisted or coiled and constricted.	Found from the east coast to the west coast except for the deep sands and very high mountains. In the southwest, the western plains and the southern wadis it forms wood kind of vegetation.
	subsp. <i>raddiana</i> (Savi) Kyal. & Boatwr.			Shrub 4-7 m high. Spines all straight. Leaves: compound. Flowers: Capitate, white. Fruit: Pod spiral and compressed.	
2.	<i>Vachellia flava</i> (Forssk.) Kyal. & Boatwr.		Salam	Many-stemmed shrubs 1-5 m high. Barks with flakes. Stipules spinescent straight, with shorter spines. Leaves: compound. Flowers: Capitate, yellow. Fruit: Pods with thin sheet.	Widely distributed in central, western, southern, northern parts at top of sand dunes, wadis and lower slopes of mountains
3.	<i>Vachellia gerrardii</i> (Benth.) P.J.H. Hurter subsp. <i>najdensis</i> [?]	Red Thorn; Grey-haired <i>Acacia</i>	Talh Nagdy, Sunt waraqi, Shabaan	A tree 7 -15m tall. Spines are stout straight and short. Leaves compound bipinnate. Flowers: white balls and sweet -scented. Fruit: Pods narrow falcate.	Widely distributed in KSA along wadis and water flow, shallow channels as well as high areas. In Al-Baha area as high as 2000 m; also in high areas of Asir and Al-Taif
4.	<i>Vachellia oerfota</i> var. <i>oerfota</i> (Forssk.) Kyal. & Boatwr.	Orfort	Urfut	A shrub or tree 1-5m tall. Thorns short, conical and thick. Leaves: Compound. Flowers: White -cream -green heads, capitate several together. Fruit: Pods usually straight. Broken branches emit a nasty nitrogenous smell characteristics of this species	Found in areas as high as 2700 amsl in southwest, west and far north
5.	<i>Vachellia origena</i> (Hundle) Kyal. & Boatwr.		Talh Kanhabl, Asiri	A tree up to 6m tall. Thorns: Long Leaves: highest altitude areas (up to 2700 m) Compound. Flowers: white Spherical heads. Fruit: Flat pods.	In Asir region; it is <i>Acacia</i> found in the highest altitude areas (up to 2700 m) sometimes associated with <i>Juniperus procera</i> in Jabal Soudah of Abha region; found in Al-Baha
6.	<i>Vachellia etbaica</i> (Schweinf.) Kyal. & Boatwr.		Qardh or Algard	Shrubs or small trees 2.4 m high. Thorns: Straight and short. Leaves: Compound. Flowers: Capitate, white. Fruit: Pods shiny.	Found in western slopes between 900 - 1500 amsl in Taif, Asir and Al-baha
7.	<i>Vachellia elatior</i> (Brenan) Kyal. & Boatwr.	River <i>Acacia</i>	Sunt Nahri	A tree 7 m high. Thorns: White, straight and long. Leaves: Compound. Flowers: In spherical heads. White to pale yellow. Fruit: Pods straight or slightly falcate	NW of Abha, at the edge of a small sandy wadi among the foothills 1500ft.
8.	<i>Vachellia seyal</i> (Delile) P.J. Hurter var. <i>seyal</i> (Delile) P.J. Hurter var. <i>fistula</i> (schweinf.) Kyal & Boatwr.	Red <i>Acacia</i> , Shittim wood, Shittah tree	Seyal or Talh	Trees 3-17m high Spines long, white. Leaves: Compound. Flowers: Capitate, yellow. Fruit: pods falcate.	Reported in Jazan area and Fayfa mountains
9.	<i>Vachellia nilotica</i> var. <i>tomentosa</i> (L.) P. J.H. Hurter & Mabb.	Babul <i>Acacia</i> , Egyptian <i>Acacia</i> , Sunt Al Arabi	Sunt Arabi, Garad	Without inflated spines and green white or red bark.	Southwest Saudi Arabia
10.	<i>Vachellia johnwoodii</i> (Boulos) Ragup, Seigler, Ebinger & Maslin		Talh Sayal	Trees 5-15 m high. Stipules spinescent, straight. Leaves: Compound. Flowers: Capitate, yellow. Fruit: Variable pods	Southwest Saudi Arabia; Abha region; Al-baha area, Jazan, Tohama and Asir, Al-Madinah.

Sources: (Chaudhary *et al.*, 2022; Chaudhary & Al-Jawaid1, 2013; Abdul Wali *et al.*, 2016; Sheila, 1985; Chaudhary, 1983)

**Benefits and value of the species of *Acacia*:** In the Kingdom of Saudi Arabia, both genera (*Vachellia* and *Senegalia*) represent the main part of arid zone forest ecosystems, the largest forest community in addition the mountainous areas of south-west of the country (Chaudhary *et al.*, 2022). Tables 3 & 4 highlight some of the uses and values of the two genera.

**Drivers and trends in disturbance of *Acacia* communities:** This review showed that many disturbances were recorded in the *Acacia* forest ecosystems. Among the most disturbing agents are insects' pests such as bark beetles (Alanazi *et al.*, 2022), seed borers (Elfeel & Abohassan, 2016), desert locust (Anon., 2022). In Hail region northern of Saudi Arabia, a beetle's infestation on *Acacia* forest's population composed of three main species *A. gerradii* (dominant), *A. ehrenbergiana* and *A. raddiana* caused more than 21% damage on individuals of this population (Alanazi *et al.*, 2022; Van Lierop *et al.*, 2015). In Europe and North America, insect pests seem to be one of the most frequent forest disturbing agents (Bastit *et al.*, 2023). Moreover, the impacts of insect pests are increasing with the increase of climate change (Alanazi *et al.*, 2024; Guégan *et al.*, 2023). Among major disturbances in Saudi

Arabia terrestrial ecosystems are invasive species (Thomas *et al.*, 2016), such as *Prosopis juliflora* and *Rhaza stricta* (AlZubaidi *et al.*, 2022). In addition, to forest fires (Aref *et al.*, 2011), humans induced disturbances, climate change and others. All these factors exerted heavy impacts on *Acacia* forests. Deforesting and forest degradation by various interacting agencies has a very high impact on forest ecosystems especially in arid lands which necessitate the need for ecological forest restoration actions (Chen *et al.*, 2023). In areas where conditions are favorable, the *Acacia* restoration can be done through assisted natural regeneration. Assisted natural regeneration enhances biodiversity recovery, community structure (Rajapakshe *et al.*, 2024), as well as biomass and carbon stock (Joshi *et al.*, 2024). Evaluation of many *Acacia* species suggested that *Acacias* are potential for restoration in KSA (Al-Ghamdi *et al.*, 2020). For a successful action for restoration a thorough ecosystem assessment is needed, including population structure, phylogenetic analysis, pattern of regeneration, soil seed bank as well as forest disturbance factors. Following by a high-quality seedlings production, suitable regeneration methods and proper arid land planting techniques such as water micro-catchments (Oweis, 2022; Owino *et al.*, 2021).

**Table 2. Description and habitat of species, subspecies and varieties of the genus *Senegalia* in addition to *Faidherbia albida* found in Kingdom of Saudi Arabia.**

No.	Scientific name	Common name	Local name	Description	Habitat
1.	<i>Senegalia asak</i> (Forssk.) Kyal. & Boatwr.		Asak, Dhahian, Dhahia,Dhabian	A tree or shrub up to 10m.Thorns: Variable short, straight or re-curved. Leaves: Compound. Flowers: White –pale yellow on spikes. Fruit straight flat pods.	Found in altitudes from 300 up to 1700 around Asir and Sarwat Mountains; Al-Baha; Al-Taif; Jazan
2.	<i>Senegalia hamulosa</i> (Benth.) Boatwr		Gatad, Katad	Shrub 3m high. Prickles: In threes. Leaves: compound. Flowers: Pedunculate spikes, white and Asir in rocky and lower up to 6 cm long including the peduncle. Fruit: Pods wide and slightly twisted	Widely distributed in Hijaz and Asir in rocky and lower slope
3.	<i>Senegalia laeta</i> (R. Br. ex Benth.) Seigler & Ebinger	Black-hooked <i>Acacia</i>	Sunt Saeed	Shrubs 2-6m high Prickles: In pairs Leaves: Compound Flowers: Spicate, white. Fruit: Pods flat and straight.	Southern Asir In narrow channel of wide sandy wadi. 4400ft.
4.	<i>Senegalia mellifera</i> (M. Vahl.) Seigler & Ebinger	Black Thorn	Sunt Masal,	Shrubs 1-9 m high. Prickles: in pairs and hooked Leaves: Compound. Flowers: creamy-white - spicate, or cylindrical heads like. Fruit: Pods straight	Southern Asir In hard sand. 600ft.
5.	<i>Faidherbia albida</i> (Delile) A. Chev.	Apple-ring <i>Acacia</i>	Haraz, Sunt Abyad	Large trees up to 30 m high. Stipules spinescent, straight. Leaves: Compound Flowers: Cylindrical spikes, white to creamy white. Fruit: Pods falcate curled or spiral.	In southwest KSA. rocky ground at edge of juniper forest.6500ft.

Sources: (Chaudhary *et al.*, 2022; Chaudhary & Al-Jowaid1, 2013; Abdul Wali *et al.*, 2016; Sheila, 1985; Chaudhary, 1983).

**Table 3. Multiple uses and values of genus *Vachellia* in the Kingdom of Saudi Arabia.**

No.	Species	Uses	Part used	Reference
1.	<i>Vachellia tortilis</i>	Traditional medicinal uses Rehabilitation, sand dunes fixation, water catchment Antioxidant activity Honey production Anticancer and antimicrobial	Many parts Leaves Pollen, Aerial parts	Hnini <i>et al.</i> , 2023 ElShamy <i>et al.</i> , 2024 AlGhamdi & Ansari, 2020 Alajmi <i>et al.</i> , 2017
2.	<i>Vachellia flava</i>	Anti-inflammatory; diuretic Live fence Antioxidant Coughs Asthma	Plant Plant Leaves Bark Bark	Arbonnier, 2004
3.	<i>Vachellia gerradii</i>	Antiseptic; emetic Bilharzia, pains	Plant Root	Aldhahrani & Althobaiti, 2019 Arbonnier, 2004
4.	<i>Vachellia oerfota</i> var. <i>oerfota</i>	Poultice Scorpion bite, Rheumatism, Back pains, Anthrax and Emetic Traditional medicinal uses Rheumatism	Leaves, Roots, Stems, Ash and bark Bark Bark	Elsafori, 2006 Tropical Plants Database, 2024
5.	<i>Vachellia origena</i>	High quality honey Medicinal uses Browsing tree Fuel	Pollen Bark Bark exudate Wood	Abdul wali <i>et al.</i> , 2016
6.	<i>Vachellia etbaica</i>	Antimicrobial & cytotoxic activity Silver nano particles antimicrobial property	Leaves Leaves	Kayed <i>et al.</i> , 2021 Kalam <i>et al.</i> , 2021 Elghaly, 2021
7.	<i>Vachellia elatior</i>	Diarrhoea, coughs	Bark	Tropical Plants Database, 2024
8.	<i>Vachellia seyal</i>	Emulsifier, stabilizer, dietary fibre, prebiotic Smoke, Shelterbelts, Charcoal Colic, Agroforestry	Gum Wood Plant, Wood, Bark Plant	Antoine-Michard <i>et al.</i> , 2023 Elgorashi <i>et al.</i> , 2022 Arbonnier, 2004
9.	<i>Vachellia nilotica</i>	Tannin Resin biocure Railway sleepers Furniture Traditional medicine Furniture Riverbank erosion control Anti-inflammatory Anti- hepatitis Astringent Tooth decay	Pods Pods Pods Wood Fruit, bark Plant Bark, root, fruit Root	Shakil <i>et al.</i> , 2023; Ndiwe <i>et al.</i> , 2019 Mewoli <i>et al.</i> , 2023 Rather <i>et al.</i> , 2015 Arbonnier, 2004 Ahovegbe <i>et al.</i> , 2021 Arbonnier, 2004
10.	<i>Vachellia johnwoodii</i>	Phytochemicals content	Leaves	Khan <i>et al.</i> , 2022

**Table 4. Multiple uses and values of genus *Senegalia* in addition to, *Faidherbia albida* in the Kingdom of Saudi Arabia.**

No.	Species	Uses	Part used	Reference
1.	<i>Senegalia asak</i>	Browsing Feul Medicine	Leaves Wood Bark, gum	Abdul Wali <i>et al.</i> , 2016
2.	<i>Senegalia haumlosa</i>	Anticancer and antimicrobial	Aerial parts	Alajmi <i>et al.</i> , 2017
3.	<i>Senegalia laeta</i>	Antioxidant activity Anticancer and antimicrobial Asthma	Aerial parts Bark	Elshamy <i>et al.</i> , 2024 Alajmi <i>et al.</i> , 2017 Arbonnier, 2004
4.	<i>Senegalia mellifera</i>	Live Fence Syphilis	Plant Bark	Arbonnier, 2004
5.	<i>Faidherbia albida</i>	Antioxidant activity Agroforestry Honey production	Leaves Pollens	Elshamy <i>et al.</i> , 2024

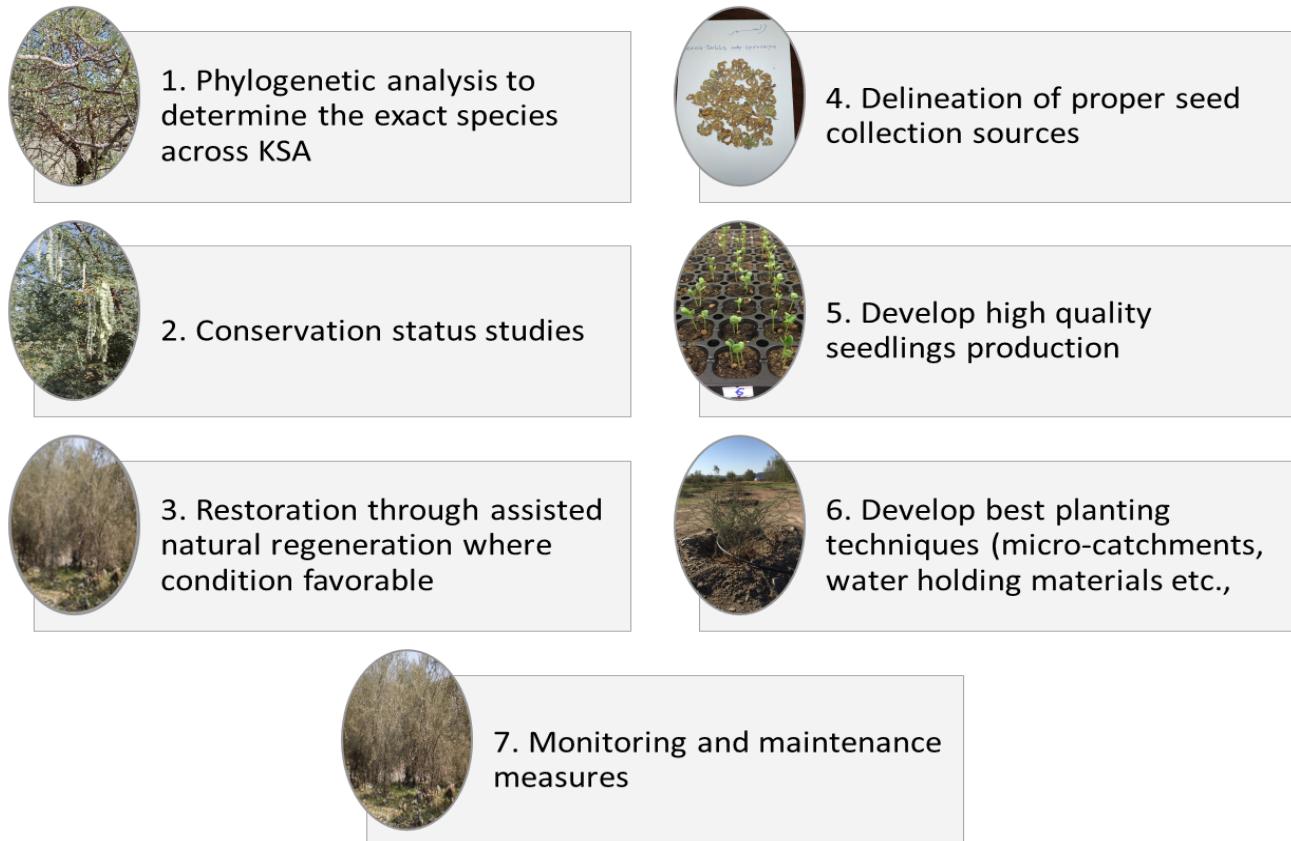


Fig. 3. Suggested steps to be followed for further studies in the two genera (*Vachellia* & *Senegalia*) for conservation, restoration or rehabilitation in KSA.

### Conclusion and Perspectives

The review consistently highlights the fundamental ecological importance of the two genera *Vachellia* and *Senegalia* (previously placed under *Acacia* s. lat.) as the largest forest communities in the Kingdom of Saudi Arabia (KSA), thriving across diverse environments from arid plains to high mountainous regions. Approximately 10 of the 14 historically known *Acacia* species in KSA now belong to *Vachellia*, while 4 belong to *Senegalia*. *V. tortilis* is the species with the widest range, while *V. origena* is found at the highest altitude. Morphological distinctions, such as *Vachellia*'s globular inflorescences and true spines versus *Senegalia*'s spicate flowers and prickles, aid in their differentiation. These genera possess significant multipurpose values, offering environmental, medicinal, and economic benefits. They are crucial for combating desertification, mitigating climate change, and hold immense potential to contribute to KSA's ambitious Green Saudi Initiative objectives, including planting 10 billion trees and protecting 30% of the terrestrial and marine ecosystems. However, there are many uncertainties related to the exact number of species, subspecies and varieties and their exact natural range and extend and magnitude of variation among and within different populations. In addition, the conservation status of many species is declining. This decline is driven by various factors, including insect pests (e.g., bark beetles, seed borers), invasive species (e.g., *Prosopis juliflora* and *Rhiza stricta*), forest fires, human disturbances, and the overarching effects of climate change.

To address these critical challenges and unlock the full potential of these genera for KSA's ecological future, a concerted and integrated research and conservation strategy is imperatively needed including:

- Robust phylogenetic analysis is highly recommended to definitively determine the exact number of species and their precise taxonomic relationships across Saudi Arabia, resolving existing controversies.
- Comprehensive conservation status studies are essential to quantify their decline and inform targeted restoration, rehabilitation or protection strategies.
- Further studies are recommended on assisted natural regeneration (ANR), high-quality seedling production, and proper arid land planting techniques, such as water micro-catchments, to ensure successful restoration or rehabilitation and contribute to large-scale greening initiatives. The following chart (Fig. 3) shows suggested further studies and investigations.

### References

Abdul Wali, A., A. Nageeb, D. Mustafa and A. Saleh. 2016. Trees of Al-Baha and areas in vicinity. Food and Agriculture Organization (FAO), Rome and Ministry of environment water and Agriculture, Riyadh: pp 207.

Ahoyegbe, L.Y., P.E. Ogwang, E.L. Peter, A.G. Mtewa, F.M. Kasali, C.U. Tolo and K.F. Pakoyo. 2021. Therapeutic potentials of *Vachellia nilotica* (L.) extracts in Hepatitis C infection: A review. *Sci. Afr.*, 13:00918. <https://doi.10.1016/j.sciaf.2021.e00918>.

Alajmi, M.F., P.A. Alqasoumi, N.A. Siddiqui, O.A. Basudan, A. Hussain, F.M. Husain and A.A. Khan. 2017. Comparative anticancer and antimicrobial activity of aerial parts of *Acacia salicina*, *Acacia laeta*, *Acacia hamulosa* and *Acacia tortilis* grown in Saudi Arabia. *Saud. Pharm. J.*, 25 (8): 1248-1252. <https://doi.org/10.1016/j.jsp.2017.09.010>.

Alanazi, N.A., M. Ghorbel, F. Brini and K. Mseddi. 2022. The Life Cycle of the Xylophagous Beetle, *Steraspis speciosa* (Coleoptera, Buprestidae), Feeding on *Acacia* Trees in Saudi Arabia. *Life*, 12: 2015. <https://doi.org/10.3390/life12122015>.

Alanazi, N.A. 2024. Tree resources decline in Saudi Arabia: Climate change or pest attack causes? *J. For. Sci.*, 70(5): 223-234. DOI:10.17221/9/2024-JFS.

Aldhahran, A. and F. Althobaiti. 2019. *Acacia Gerrardii* Leaf Extracts Inhibit Genetic Diversity Induced by Streptozotocin in Male Rats. *Biomed. & Pharm. J.*, 12(4): 1915-1922. DOI:10.13005/bpj/1823.

Al-Ghamdi A.A., T.Y. Tadesse and N. Adgaba. 2020. Evaluation of major Acacia species in the nursery towards apicultural landscape restoration around Southwestern Saudi Arabia. *Saud. J. Biol. Sci.*, 27(12): 3385-3389. <https://doi.org/10.1016/j.sjbs.2020.09.002>.

Al-Ghamdi, A.A. and M.J. Ansari. 2020. Biological and therapeutic roles of Saudi Arabian honey: A comparative review. *J. King. Saud. Uni. of Sci.*, 33(2): 101329. <https://doi.org/10.1016/j.jksus.2020.101329>.

Alzubaidi, A.I., A.A. Elfeel and A.A. Bakhshwain. 2022. Assessment of population structure and regeneration status of different communities of *Acacia tortilis* in Makkah Region, Saudi Arabia. *Pak. J. Bot.*, 54(3): 969-976. doi: [http://dx.doi.org/10.30848/PJB2022-3\(16\)](http://dx.doi.org/10.30848/PJB2022-3(16)).

Amandine Antoine-Michard, Céline Charbonnel, Isabelle Jaouen, Christian Sanchez, Michaël Nigen. 2023. Maturation of demineralized arabinogalactan-proteins from *Acacia seyal* gum in dry state: Aggregation kinetics and structural properties of aggregates. *Int. J. Biol. Macromol.*, 233: 123509. <https://doi.org/10.1016/j.ijbiomac.2023.123509>

Anonymous. 2014. Manual of Arriyadh Plants. High Commission for the development of Arriyadh

Anonymous. 2020. Global forest resources assessment, country report, Saudi Arabia (Desk Report). Food and Agriculture Organization of the United Nations (FAO), Rome, Italy, p. 55.

Anonymous. 2022. Technical guidance on desert locust-Early warning system and sustainable management of transboundary pests, with special reference to desert locust (*Schistocerca gregaria* [Forskål]) in South Asia. Bangkok. <https://doi.org/10.4060/cc0147en>

Arbonnier, M. 2004. Trees, shrubs and lianas of West Africa Dry Zones. CIRAD, MARCRAF Publishers, pp 572.

Aref, I., H. El-Atta and A. Ghamde. 2011. Effect of forest fires on tree diversity and some soil properties. *Int. J. Agric. Biol.*, 13(5): 659-664.

Bastit, P.F., M. Brunette and C. Montagné-Huck. 2023. Pests, wind and fire: A multi-hazard risk review for natural disturbances in forests. *Ecol. Econ.*, 205: 107702. <https://doi.org/10.1016/j.ecolecon.2022.107702>.

Chaudhary S., A. Al-Jawaid and A. Al-Saeid. 2022. Vegetation of the Kingdom of Saudi Arabia, 3<sup>rd</sup> edition. National Agricultural and Animal Research Center, Ministry of Agriculture and Water, KSA: 406 pp.

Chaudhary, S.A and A.A. Al-Jowaid. 2013. Vegetation of the Kingdom of Saudi Arabia, 2<sup>nd</sup> edition. National Agricultural and Animal Research Center, Ministry of Agriculture and Water, KSA: 688pp.

Chaudhary, S.A. 1983 *Acacia* and Other Genera of Mimosoideae in Saudi Arabia. National Herbarium Regional Agriculture and Water Res. Center. Alkhaled Offset Press, Riyadh.

Chen, S.S. Wu and M. Ma. 2023. Ecological restoration programs reduced forest fragmentation by stimulating forest expansion. *Ecol. Indic.*, 154: 110855. <https://doi.org/10.1016/j.ecolind.2023.110855>.

Doran, J.C., J.W. Turnbull, D.J. Boland and B.V. Gunn. 1983. Handbook on seeds of dry-zone *Acacias*. FAO, Rome.

Dyer, C. 2014. New names for the African Acacia species in *Vachellia* and *Senegalia*. *Southern Forests: (A Journal of Forest Science)*, 76.4: iii-iii. DOI: 10.2989/20702620.2014.980090.

Elfeel, A.A. and R.A. Abohassan. 2016. Compost effects on leaf area index and seed production enhancement in an important arid land leguminous tree (*Acacia tortilis* subsp. *raddiana*). *Legum. Res.*, 39(5): 748-754. DOI:10.18805/lr.v0i0F.3546.

Elghaly, M. 2021. New phytoconstituents, anti-microbial and cytotoxic activities of *Acacia etbaica* Schweinf. *Nat. Prod. Res.*, 35:24, 5571-5580, DOI: 10.1080/14786419.2020.1797725.

Elgorashi, E.E., I.M.S. Eldeen, T.J. Makhafola and J.N. Eloff and L. Verschaeve. 2022. Genotoxic effects of Dukhan: A smoke bath from the wood of *Acacia seyal* used traditionally by Sudanese women. *J Ethnopharmacol.*, 1; 285: 114868. doi: 10.1016/j.jep.2021.114868. Epub 2021 Nov 23. PMID: 34826541.

Elsafori, A.K. 2006. Ecological Study on the Vegetation Cover of Um Rimmitta area, White Nile State, Sudan. Ph.D. thesis, University of Khartoum. Khartoum.

Elshamy, S. H. Handoussa, M. El-Shazly, E.D. Mohammed and N. Kuhnert. 2024. Metabolomic profiling and quantification of polyphenols from leaves of seven *Acacia* species by UHPLC-QTOF-ESI-MS. *Fitoterapia*, 172: 105741. doi: 10.1016/j.fitote.2023.105741. Epub 2023 Nov 10. PMID: 37951277.

Shakil, M., M.S. Aktar, S. Rahman and S. Ahmed. 2023. A novel vegetable tannin for eco-leather production: separation, characterization and application of facile valorized indigenous *Acacia nilotica* bark extract. *Biores. Technol. Rep.*, 23: 101591.

Fayed1, A. and K. Zayed. 1989. Vegetation along Makkah -Taif Road (Saudi Arabia). *Sci. Res.*, 7(3): 97-117.

Guegan, J.F., B. Thoisy, M. Gomez-Gallego and H. Jactel. 2023. World forests, global change, and emerging pests and pathogens. *Curr. Opin. Environ. Sustain.*, 61: 101266. <https://doi.org/10.1016/j.cosust.2023.101266>.

Hnini, M., K. Taha and J. Aurag. 2023. Botany, associated microbiota, traditional medicinal uses, and phytochemistry of *Vachellia tortilis* subsp. *raddiana* (Savi): A systematic review. *J. Agric. Food. Res.*, 12: 100566. <https://doi.org/10.1016/j.jafr.2023.100566>.

Joshi, N.R., S.R. Joshi, E Udas, B.S. Karky, D.H. Kutil and R.M. Kunwar 2024. Effect of assisted natural regeneration on forest biomass and carbon stocks in the Living Mountain Lab (LML), Lalitpur, Nepal. *Environ. Chall.*, 14: 100858. <https://doi.org/10.1016/j.envc.2024.100858>.

Kalam A., A.G. Al-Sehemi, S. Alruman, M.A. Assiri, A.M. Alfaify and M.F. Moustafa. 2021. Antimicrobial properties of silver nanoparticles prepared by *Acacia etbaica* (Schweinf.) valve extract, *Mater. Lett.*, 300: 130233. <https://doi.org/10.1016/j.matlet.2021.130233>.

Kayed, A.M., E.A.M. Genady, H.A. Kadry and E.M. Elghaly. 2021. New phytoconstituents, anti-microbial and cytotoxic activities of *Acacia etbaica* Schweinf. *Nat. Prod. Res.*, 35(24): 5571-5580. doi: 10.1080/14786419.2020.1797725.

Khan, S., F. Al-Qurainy, A. Al-hashimi, M. Nadeem, M. Tarroum, A.M. Salih, A.M. and H.O. Shaikhdein. 2022. Comparative study on genome size and phytochemical profile of three potential species of *Acacia*: Threatened and endemic to Saudi Arabia. *Hort.*, 8: 994. <https://doi.org/10.3390/horticulturae8110994>.

Kyalangalilwa, B., J.S. Boatwright, B.H. Daru, O. Maurin and M. Van Der Bank. 2013. Phylogenetic position and revised classification of *Acacia* s.l. (Fabaceae: Mimosoideae) in Africa, including new combinations in *Vachellia* and *Senegalia*. *Bot. J. Linn. Soc.*, 172(4): 500-523. <http://dx.doi.org/10.1111/bj.12047>.

Maslin, B.R., J.T. Miller and D.S. Seigle 2003. Overview of the Generic Status of *Acacia* (Leguminosae: Mimosoideae). *Aust. Syst. Bot.*, 16: 1-18. <http://dx.doi.org/10.1071/SB02008>

Ndiwe, B., A. Pizzi, B. Tibi, R. Danwe, N. Konai and S. Amiro. 2019. African Tree Bark Exudate Extracts as Biohardeners of Fully Biosourced Thermoset Tannin Adhesives for Wood Panels. *Ind. Crops. Prod.*, 132: 253-268. <https://doi.org/10.1016/j.indcrop.2019.02.023>.

Mewoli, A.E., C. Segovia, A.E. Njom, F.B. Ebanda, J.J.E. Biwôlé, C. Xinyi, A. Ateba, P. Girods, A. Pizzi and N. Brosse. 2023. Characterization of tannin extracted from *Aningeria altissima* bark and formulation of bioresins for the manufacture of *Triumfetta cordifolia* needle-punched nonwovens fiberboards: Novel green composite panels for sustainability. *Ind. Crops and Prod.*, 206: 117734. <https://doi.org/10.1016/j.indcrop.2023.117734>.

Oweis, T.Y. 2022. Micro-catchment Rainwater Harvesting. In: Qadir, M., Smakhtin, V., Koo-Oshima, S., Guenther, E. (eds) Unconventional Water Resources. Springer, Cham. [https://doi.org/10.1007/978-3-030-90146-2\\_4](https://doi.org/10.1007/978-3-030-90146-2_4).

Owino, Jesse and Jackline, Kemboi and M. Muturi. 2021. Rangeland rehabilitation using micro-catchments and native species in Turkana County, Kenya. *J. Ecol. Nat. Environ.*, 13: 30-40. [10.5897/JENE2020.0833](https://doi.org/10.5897/JENE2020.0833).

Plant Diversity of Saudi Arabia. 2024 <https://www.plantdiversityofsaudiarabia.info/index.htm>, Flora of Saudi Arabia, Herbarium (KSU), dept. of Botany & Microbiology, King Saud University, Riyadh, KSA (accessed in Dec., 2024).

Rajapakshe, R., J. Karthigesu, S. Thavananthan, S. Sivachandiran, V. Navaneetham and S. Sinnamani. 2024. Restoring a dry tropical forest through assisted natural regeneration: enhancing tree diversity, structure, and carbon stock. *Trees For. People*, 17: 100616, <https://doi.org/10.1016/j.tfp.2024.100616>.

Rather, L.J, Shahid-ul-Islam and M. Faqeer. 2015. *Acacia nilotica* (L.): A review of its traditional uses, phytochemistry, and pharmacology. *Sustain. Chem. Pharm.*, 2: 12-30. <https://doi.org/10.1016/j.scp.2015.08.002>.

Richardson, D.M., E. Marchante and J.J. Le Roux. 2023. Australian *Acacia* species around the world: historical, social, evolutionary and ecological insights into one of the planet's most widespread plant genera. *Wattles*, 1-26. <https://doi.org/10.1079/9781800622197.0001>.

Ross, J.H. 1973. Towards a classification of the African *Acacias*. *Bothalia*, 11 (1 and 2): 107-13. DOI: 10.4102/abc.v11i1/2.1982.

Sheila, C. 1985. An Illustrated Guide to the Flowers of Saudi Arabia. Scorpion Publishing Ltd; First Edition.

Thiele, K. 2011. The *Acacia* debate. The XVIII International Botanical Congress held in Melbourne from 23-30 July 2011.

Thomas, J., M.A. El-Sheikh, A.H. Alfarhan, A.A. Alatar, M.S., M. Basahi, S. Al-Obaid, R. Rajakrishnan 2016. Impact of alien invasive species on habitats and species richness in Saudi Arabia. *J. Arid Environ.*, 127: 53-65. [doi.org/10.1016/j.jaridenv.2015.10.009](https://doi.org/10.1016/j.jaridenv.2015.10.009).

Timberlake J., C. Fagg and R. Barnes. 1999. Field Guide to the *Acacias* of Zimbabwe. CBC Publishing, Harare. Pp 160.

International Dendrology society 2024. Trees and Shrubs Online. <https://www.treesandshrubsonline.org/accesed> (accessed January 2024).

Tropical Plant Database. 2024. National Tropical Botanical Garden <https://ntbg.org/database/plants/accesed> (accessed January 2024).

Van Lierop, P., E. Lindquist, S. Sathyapala and G. Franceschini. 2015. Global forest area disturbance from fire, insect pests, diseases and severe weather events. *For. Ecol. Manag.*, 352: 78-88. <https://doi.org/10.1016/j.foreco.2015.06.010>.

Waly, N.M. and H.M. Emad. 2012. Taxonomical Studies of Some *Acacia* spp. Growing in Saudi Arabia. *J. Amer. Sci.*, 8(3): 264-275.

Wang, Z., B. Sun, X. Wu and S. Yin. 2023. A new pod record of *Acacia* (Leguminosae) from the Fotan Group, middle Miocene, Southeast China. *Rev. Palaeobot. Palynol.*, 317: 104966. <https://doi.org/10.1016/j.revpalbo.2023.104966>.