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The most important natural plant species in the Middle Euphrates Basin and their importance in agroforestry systems

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ABSTRACT

The main aim of this review is to attract the attention of plant breeders, agriculturists, farmers, and others within the Euphrates River States to the benefits of exploiting halophytes and to raise their profile as economically important plants in a world now facing an increase in soil salinity. Halophytes can contribute to a sustainable agriculture as staple foods, as forage, as medicinal plants. During the period from 2021-2023, an inventory of the most important plant species growing on the river islands in the central Euphrates Basin region of Raqqa Governorate was carried out. The most important natural plant species growing on the river islands of the Middle Euphrates Basin were identified as follows: Aeluropus littoralis, Atriplex halimus, Glycyrrhiza glabra, Halocnemum strobilaceum, Juncus maritimus, Lycium barbarum, Phragmites australis, Populus euphratica, Prosopis farcta, Salix alba, Suaeda vermiculata, Tamarix tetragyna. These plant species can be used in Agroforestry systems Agroforestry systems deliver livelihood security and multiple ecosystem services to sustain societies and environments. Many multi-purpose forest trees having food, timber, medicinal and industrial value have been introduced in different agroforestry systems in many countries of to sustain livelihood and environmental security. Taking care of natural plants is necessary for the sustainability of natural forest resources, as the natural resources is a unit and cannot be divided to be dialed with, thus will be not possible to develop forest resources separately, out of the framework of land resources (the productive capacity of the soil), the climatic environment (the rainfall regime, temperature fluctuation, humidity, radiation) and other available investable resources, in addition to the social and economic conditions prevailing in the region, moreover the focus on human development, which is the starting and the end point of all activities. During past four decades, agroforestry has come of age and begun to attract the attention of the international scientific community, primarily as a means for sustaining agricultural productivity in marginal lands and solving the second-generation problems such as secondary salinization.

Keywords: Natural plant, Euphrate, Agroforestry.

Introduction

The Euphrates Valley contains natural forests that extend for many miles along the river's course and within its banks (islands). The main plant species that dominate are Populus euphratica and Tamarix tetragyna. Euphrates poplar forests are arranged

within the type of dense, almost pure forests. References indicate that the area covered by the Euphrates poplar forests in the Euphrates Valley and Khabur regions is much larger than it is now.

This is due to the random and irregular cutting of its trees and the conversion of these forests into irrigated agricultural lands (Nahal et al. 1997, Majeed Agha 2002)

Statistics from the Ministry of Agriculture and Agrarian Reform indicate that the current area of Euphrates poplar forests in its natural areas of distribution is about 2,346 hectares. (Agricultural Statistical Group, 2016).

The Euphrates poplar forests were and still are a major source of fuel wood, house roof poles, the manufacture of handles for agricultural tools, and some simple wood industries.

References indicate that its wood can withstand breakage and pressure, is not resistant to insects and diseases, and can be manufactured and fumigated easily. It can withstand blows and vibrations a lot. (Al-Zaghat 1966, Helwa 1991).

Euphrates poplar forests have suffered significant deterioration as a result of multiple human activities and irrational and irrational exploitation of the resources of this system, whether through unjust felling, fires or deforestation with the aim of investing land for agriculture or construction.

After these forests constituted an integrated, biological community in the Euphrates Basin region, we no longer see only scattered individuals here and there and deteriorating communities within the river banks. (Majid Agha and Hanna, 1995)

Euphrates poplar is found in China, Monvolia, Kazakhstan, Tajikistan, Kyrgyzstan, Pakistan, Afghanistan, India, Iran, Iraq, Syria, Algeria, Palestine, Egypt, Libya, Morocco, Spain, and Turkey. It is spread in Kenya across the equator. (Shiji et al,1996)

Poplar Euphrates is found in India in association with many species, including: Salix alba, Ephedra sp , Juniperus sp, Hippophae sp, Myricaria sp, Carragona sp In northern India and Kashmir on the banks of the Indus River and the Shayake River At altitudes of 3000-4000 m, and there are no statistics for the areas it constitutes in this country.

(Shiji et al.,1996) .

In Iran, it is an important species spread along the banks of rivers in Arabistan, parallel to the Arabian Gulf and the Sea of Oman. The area is estimated at about 20,000 hectares, with diameters ranging from 30-50 cm and heights up to 15 m. Combined with white Poplar and Lycium and Berries and Christ's Thorn Jujube (Mofidabadi et al., 2001)

Agroforestry, , has grown into important tool for sustainable land-use in many parts of the world, especially in developing countries where these practices have proved means of poverty alleviation, particularly for rural peoples (Mead, 2009).

During past four decades, agroforestry has come of age and begun to attract the attention of the international scientific community, primarily as a means for sustaining agricultural productivity in marginal lands and solving the second-generation problems such as secondary salinization due to waterlogging and contamination of water resources due to the use of excess nitrogen fertilizers and pesticides (Dagar et al., 2020)

The aims of this study was to detect and investigate plant species that are spread naturally on the banks of the Euphrates River. In order to be aware of the importance of these species and exploit them in sustainable development programs due to their various benefits, as well as preserving and protecting them from greedy investment, overgrazing, or logging, as well as developing proposals that contribute to preserving these species and protecting them from various dangers.

Materials and Methods

The most important plant species in the Middle Euphrates Basin region were identified based on field trips and inventory records Relevés that have been done in the region This is during the period 2021-2023.

Based on the taxonomic and environmental information available in specific botanical references and studies, As well as the approved standards through which these species can be used in agroforestry systems. The results included the following information:

- Taxonomic status of species, scientific name according to genera and families.
- Botanical description of these species, leaves, flowers, fruits, and flowering time.
- The geographical affiliation of the species and the uses to which each of these species is used.
- The importance of agroforestry systems compatible with these plant species.

The search and investigation process was carried out in 19 sites spread throughout the central Euphrates Basin region As shown in Table (1).

Table (1): Site names, their area, and the dominant species in each site in the Middle Euphrates Basin

N	The site	Area/ha	Dominant species
1	Western orchid	376.3	*Populus- Salix- Atriplex- Phragmites*
2	Oriental orchid	222.7	*Populus- Salix- Juncus*
3	Abu Qubay (Hilala)	78.3	*Populus- Salix- Halocnemum*
4	Al Khatuniya Reserve	504.9	*Populus- Tamarix*
5	Carrot (coast flower)	103.5	*Populus- Tamarix- Lycium*
6	A pound	5	*Populus—Salix-- Juncus*
7	Kasra Muhammad Agha	75	*Populus- Salix- Atriplex*
8	Hamra Ghanem	69.1	*Populus- Tamarix*
9	Dalha	29.4	*Populus- Tamarix- Juncus Typha -*
10	Shannan	158.6	*Populus- Tamarix*
11	Al-Rahbi	140.4	*Populus- Salix- Aeluropus*
12	Al-Sharida	337.2	*Populus- Salix- Atriplex*
13	Mountainous	504	*Populus- Tamarix Suaeda*
14	Shamar Zor	220	*Populus- Tamarix- Juncus*
15	Al-Akershi	660	*Populus- Tamarix Aeluropus*
16	New as a wall	65	*Populus- Tamarix*
17	New Khabour	140	*Populus- Salix Prosopis*
18	Module	65	*Populus- Salix Atriplex*
19	Dakour chebli lettuce	274	*Glycyrrhiza Populus- Salix-*

Results and Discussion

1- Main plant species:

1-1. Aeluropus littoralis (Gouan) Pari: Perennial , with flowering culms Up to 30 cm . Basal leaf-sheaths glabrous , leaf-blades of flowering lanceolate-acuminate, subulate at apex, stiff, more or less spreading . Panicle 3-10 cm, spike-like, consisting of several spikelet-bearing branchletes , the upper often crowded , the lower usually spaced. Spikeletes 3-4(-5) mm, glabrous, 5-9(-11)- flowered, ovate-oblong, Glumes subequal, glabrous, lemma 2-3mm, oblong-lanceolate, abruptly apiculate, membranous- margined, glabrous or very sparsely pilose. (Zohary,1986)

Fl: April-July.

Area: Mainly Mediterranean and Irano-Turanian

This species is one of characteristic plants of saline soils of the Euphrates River .It is resistant to high salinity , and one of its Adapatation is exudation of onto leaf surface .In spite high salt content the plant is grazed by animals (Zohary,1986).

1-2. Atriplex halimus L: Shrub with vesicular hairs, about 1-2 m. Stems erect, much branched, woody, terete or angular , whitish , Leaves 1-6×0.5-4 cm , altemate , sometimes opposite below, ovate to ovate-rhombic to triangular , sometimes cuneate or hastate at base , entire or obsoletely repand-lobed of dentate , silvery -white, without prominent nerves, the upper narrower , lanceolate , petiole 0.3-1.2 cm, Flower clusters densely spicate, spikes in terminal , almost leafless panicles. Staminate flowers inconspicuous, with 5 membranous tepals, generally at top of cluster. Pistillate flowers at base of cluster, with valves 4-5 mm. long and broad ,Not sitipitate, scarcely united at base , orbicular or somiorbicular or reniform to short-cuneate at base, entire or dentate, smooth or reticulate but not tubereculate . Stigmas filiform , free. Seeds 1-2 mm. in diam., vertical, lenticular, dark brown , (Zohary,1966)

Fl: April-October.

Area: Mainly Mediterranean and Saharo -Arbian

Atriplex halimus is especially common in inundated saline depressions and around aoses of the Euphrates River. Rather a palatable browse shrub, the leaves are sometimes eaten by hungry shepherds the salt content of the leaves increases with the aridity of the habitate, which makes the plant less palatable. The ash of Atriplex halimus is used for manufacture of soap. Believed to be the of the Bible. Leaves oblong , deltoid to orbicular, mealy-scurfy. Inflorescences axillary and terminal forming interrupted spikes. Valves deltoid, rarely campanulate, mostly tuberculate on appendiculate on bank. , (Zohary,1966).

1-3. Glycyrrhiza glabra L: Erect perennial herb , viscid ,50-100 cm. Stems many . sparingly branching . Leaves 5-15 cm, stipules oblong, hairy, mostly inconspicuous or 0, leaflets 4-8 pairs .3-5×1-2 cm , oblong to oblong -ellipical, acute or obtuse, viscid beneath. Racemes shorter than or as long as

subtending leaves , loose , cylindrical, Calyx teeth often longer than tube, equal , linear-or triangular-lanceolate .Corolla blue or violet with whitish standard . Ovary glabrous or glandular-hairy. Pod (1) 2-3×0.4-0.7 cm., flattened, oblong to linear, glabrous or sparsely or densely glandular, (1-) 2-to many seeded. (Zohary,1972)

Fl: May-October.

Area: Mediterranean , Euro-Siberian and Irano-Turanian.

The dried rhizomes and roots are the liquorice (sweet wood) of commerce, used in the tobacco industries, also in pharmacy , a refreshing drink named (sus) is prepared from the roots and sold in Orient.

1-4. Halocnemum strobilaceum (Pali.) Bieb: Glabrous, fleshy dwarf-shrub, 20-5- cm. Stems ascending to erect , much branched. Branches with short , thick , cylindrical to club-shaped internodes ending with 2, about 1 mm . long , obovate , more or less obtuse, scarious -margined leaves , connate at base, often subtending short , sterile, globular, bud-like branches , with 4 rows of very short, rounded, sessile leaves , broader than long. Bracts of flower clusters . reniform to orbicular, shed after flowering . Spikes lateral and terminal, sessile , opposite, cont-like or globular to oblong . Perianth about 1.5 mm. Seeds about 0.5-1 mm., compressed, brown, smooth to minutely tuberculate (Zohary, 1966).

Fl: May-September

Area: Mediterranean, and Irano-Turanian, and Saharo Arabian, extending into the Euro- Siberian region. The great importance of this plant lies in the fact that it is a product with multiple economic benefits and can be produced in environments that are not suitable for growing crops or other plants due to its great tolerance to degrees of soil salinity.

The plant ash is also rich in sodium bicarbonate, so it is used in soap manufacturing, it is also a pastoral plant that is grazed by camels. Figure (1)

Figure (1): Halocnemum strobilaceum

1-5. Juncus maritimus Lam: Perennial ,50-100 cm . Stems numerous , in rows along horizontal creeping rhizomes ,pith continuous. Leaf-sheaths brown , blades terete , not septate, pungent . Inflorescence pseudolateral ,many-flowered ,with more or less erect branches. Lower involucral bract subulate , pungent ,shorter to longer than inflorescence , Flowers aggregated in few-flowered heads ,Perianth – segments straw-coloured ,outer segments somewhat longer, boat-shaped, ovate, acute ,short-mucronate, inner segments flat, oblong ,rounded and narrowly hyaline-margined at apex. Stamens 6, rarely3, anthers about twice as long as filaments. Capsule 2.5-3.5 (-4)×1.75-2 mm . broadly ellipsoid to ovoid , mucronate, as long as or slightly longer than perianth ,yellow to pale brown. Seeds caudate , with long or short appendages (Zohary,1986).

Fl.: June-September.

Area: Euro-Siberian (C. and E.Europe) and : Mediterranean Slightly exetending into the W.Irano-Turanian .

used in folk medicine and has multiple industrial uses

1-6. Lycium barbarum L: Shrubs or small trees, often with spiny brachyblastes. Flowers solitary or in cymose clusters . Calyx persistent , cupuliform or tubular , 5-dentate or sub 2-labiate with 2-3 teeth , fruiting calyx not accrescent or only slightly so. Corolla hypocrateriform or infundibular . Stamens exserted or included , filaments filiform, longer than anthers .Fruit aberry Eighty to ninety species in temperate and subtropical regions, the majority in S. American .Flowering calyx tubular , 3-5 mm. teeth equal. Pedicels calyx, young branches and leaves usually grey-tomentose.rarely glabrous. Berries red. Desert shrubs (Zohary,1978) Figure (2)

Lycium barbarum (wolfberry, goji) is a deciduous shrub growing to 2.5 m, spreading up to 4 m, developing the long arching branches, with the side branches often reduced to a short leafless spines. It flowers from June to August, and the fruit is orange or dark red berry, 2 cm in diameter, ripen from August to October (Maughan and Black, 2015). Goji plants are native to China, where they grow from the subtropics in the south to the cold, dry climate of Inner Mongolia (Thorogood,2017).

Berry: Red or orange-yellow, oblong or ovoid,. Seeds usually 4-20, brown-yellow, ca. 2 mm.

Flower: Pedicel 1-2 cm. Calyx campanulate, 4-5 mm, usually 2-lobed, lobes 2- or 3-toothed at apex. Corolla purple, funnelform; tube8-10 mm, obviously longer than limb and lobes; lobes 5-6 mm, spreading, margin glabrescent.

Stem and leaf: 0.8-2 m tall. Stems and branches glabrous, branches thorny. Leaves solitary or fasciculate, lanceolate or long elliptic (Yao et al., 2018). It is a suitable plant for landscaping in open areas and is used as a dominant plant, for planting in hills, stabilizing slopes, and improving the environment., It is also a pastoral and nectar plant.

Figure (2): ***Lycium barbarum***

1-7. Phragmites australis (Cav): Perennial,3-6 m, Rhizome long. Culms leafy , smooth and glabrous, 1 cm thick at bas or thicker , woody. Leaf-blades generally broad and long , glabrous, auriculate, sheaths glabrous, appressed to culm, ligule long-hairy.

Panicle 20-40 (-60) cm, dense, brownish before flowing, silky-hairy and yellowish lowish during flowering , erect or somewhat nodding , branches and pedicels capillary , pedicels shoter than spikelet. Spikelets 10-15-mm. widely gaping during flowering, 2-7 flowered, rachilla silky with long hairs . Glumes very unequal ,lower glume about 1/2 length of the upper, upper glume oblong , obtuse to 3-denticulate, lemma smooth and glabrous , lemma of lower (sterile) floret lanceolate ,acute, about twice as long as upper glume, devoid of bearded callus, lemma of upper (fertile) florets lanceolate , acuminate, with along hairy callus (Zohary,1986).

Fl: mainly October-January

Aewa of subsp : Mediterranean, and Saharo -Arbian and Trop. This plant has industrial uses and helps combat water pollutants

1-8. Populus euphratica Oliv: Tree with spreading to ascending branches . Twigs and erect buds somewhat puberulent . Leaves 1.5-10 ×1-8 cm , long -petioled, broadly ovate or triangular , sometimes deltoid-rhombic or suborbicular , cuneate or rounded or obsoletely subcordate at base, glabrous , glaucous , irregularly acute-dentate towards apex, those of young and lower branches oblong -lanceolate to linear, almost entire. Bracts caducous , incised-dentate. Pedicels as long as longer than flowers, spreading.Nectariferous disk cupuliform or patelliform, irregularly incised-lobed .Stamens 12-24, anthers purple, about as long as filaments. Ovary sessile, stigmas 3 ,2-partite, purple. Capsule 0.9-1.3 cm, ovoid, glabrescent or villosa (Zohary,1966) Figure (3).

Fl :February-April.

Area: Irano-Turanian and Saharo -Arbian.

Resin of bank used in popular medicine, timber soft and suitable for some kinds of carpentry, fast growing.

Figure (3): ***Populus euphratica***

1-9. Prosopis farcta (Banks et Sol) Macbride: Shrub or dwarf shrub, 0.4-1 m., usually branching from base and propagating by suckers,Roorts and rhizomes very long, often reaching adpth of 15 m . or more. Branches slender, prickly all along, the younger hairy. Leaves up to 5 cm, ovate, 2-pinnate with (4-) 5-7 pairs of pinnae, stipules caducous, herbaceous ,oblong-arcuate, leaflets 10-15 pairs ,3-7 ×2-3 mm, subsessile , oblong, acute, short-hairy. Spikes up to 7 cm., axillary, pedunculate, many-flowerd, cylindrical.Flowers short-pedicelled. Calyx 5-toothed , one fifth as long as corolla 4-5 mm., 5-parted, pale yellow . Stamens somewhat exserted. Pods 1-2 on each raceme, (1-) 2-5×1-3 cm ., ovoid to ellipsoidal , with with Spongy mesocarp, dark brown when ripe. Seeds few, dark brown. 2n= 28. (Zohary, 1972)

Fl: (April-) May- August.

Area: W .Irano-Turanian, with extensions into the Mediterranean

and Saharo -Arbian territories.

1-10. Salix alba L: Mostly a tree 10 m, with rigid , somewhat fragile, more or leas glabrous , yellow-green or chestnut-brown branches , sometimes white-and appressed-tomentosa when young. Buds small, glabrous or frequently white-pilose at apex. Leaves up to 11(-13) × 2.5(-3.5) cm, short -petioled, lanceolate ,rarely almost ovate , tapering at both ends, acuminate and sometimes oblique at apex,

almost entire and more less appressed white-silky on both sides when young , the adult ones minutely denticulate or glandular-serrulate, more or less glabrous, sometimes appressed-pilose above and pruinose beneath, stipules generally shorter than petiole, soon deciduous , narrowly lanceolate, denticulate, Staminate catkins 3-6.5cm , on short ,leafy peduncles , densely flowered , flexuous, barcts soon deciduous, small, oblong-lanceolate, green, yellow or brown , hairy. Pistillate catkins less densely flowered and slightly shorter ,bracts soon deciduous, ovate-lanceolate,villose. Stamens 2 (very rarely 3), about twice as long as bracts , filaments villose at base. Style almost 0, stigmas divaricate, notched at apex Pedicel almost 0,stigmas divaricate,notched at apex,Pedicel almost0 when young, later almost as long as or sometwhat longer than nectar gland . Capsule ovoid, to short conical,glabrous (Zohary, 1966).

Fl: March-June.

Var. alba. Branches yellow-green, more or less glabrous. Leaves thin, lanceolate to oblanceolate, rarely oblong-lanceolate (=f.latifolia), more or yong, later glabrescent, minutely serrulate. Leaves at base of catkins more or less white-silky when young later glabrescent, minutely serrulate .Leaves at base of catkins more or less entire,Bracts greenish to yellowish. Capsule sessile or on a pedicel almost as long as nectar gland.

Area of species : Mediterranean, Euro-Siberian and Irano-Turanian,

Honey plant, wood used for inferior capentry, bark for tanning-and alsomadicinally.

1-11. Suaeda vermiculata Forssk: Half-shrub, glabrous at base, papillose-hirsute in younger parts,20-50 cm . Stems glaucous, divaricately and very profusely branched. Branches whitish. Leaves 0.3-1×0.1-0.4 cm ., succulent , the lower obovate-oblong, the upper nearly globular or lenticular, obtuse. Bracts and upper leaves somewhat recurved, becoming black after desiccation. Clusters axillary, sessile, 1-or 2-3 flowered, forming loose, short, spike-like inflorescences. Flowers hermaphrodite, shorter than bracts. Fruiting perianth about 1mm. in diam., ovoid, segments connivant. Stigmas 3, yellow. Seeds vertical, not beaked . (Zohary,1966)

Fl: March-April.

Area: Saharo -Arbian extending into adjacent Sudanian territories

A pastoral plant grazed by camels, This plant is also used for bioreclamation of saline soils.

1-12. Tamarix tetragyna Ehrenb: Small tree or shrub with purple to blackish -brown bark, papillose to glabrous ,1.5-4 m. Leavs 1.5-6 mm , sessile , oblong-subulate not amplexicaul , Vernal inflorescences solitary lateral racemes ,4-10×(0.4-)0.8-1.2cm, aestival inflorscences 0, rarely present and then shorter and narrower, all with papillose rhachis Bracts oblong to linear -oblong , the lowest truncate with ashort obtuse point, the upper acuminate , all longer than the pedicels and calyces and sometimes equalling the flowers in length. Pedicels somewhat longer to shorter than the calyx. Calyx urceolate ,sepals 4-5, ovate to elliptical , mostly with afew teeth at apex , the outer 2 acute, about 2 mm, the inner ones somewhat shorter, obtuse. Corolla caducous, rarely subpersistent, petals 4-5, 3.5-5 mm, spreading to deflxed, white , narrowly obovate to elliptical , tapering or short-clwed at base. Stamens 4-5, epispalous, rarely with 1-3 additional. epipetalous stamens, filaments arising at the top of the entire or retuse disk lobes. Styles 4 . Capsule 3-5×1.5-2 mm, pyramidal (Zohary, 1972) Figure (4).

Fl. December-April.

Area of species: Mediterranean and Saharo -Arbian.

This plant tolerates all critical conditions, including drought, salinization, waterlogging and pollution, It is a pastoral plant and its wood is used as fuel.

Figure (4): *Tamarix tetragyna*

2- Agroforestry systems, poplar, tamarisk: This system of agroforestry spreads in particular on the banks of rivers, especially in Syria on the Euphrates basin and its timber is the major source of fuel and home roof making. Now a days, the area of Euphrates poplar in Syria is around 2,346 hectares, with the trees number of 2,356,000 (Agro-statistics Group 2016), distributed on the banks of the Khabur and Euphrates in the Jazira moreover, on the banks of Yarmouk and Hemah in southern Syria, where the most important Euphrates poplar sites are at Hawija

(isolated inland in the river in Arabic) Ayyash, Hawija Abu Hardoub, Ayyash, Al Mariya, Al Muhaid, Al Mayadin and Al-Tabani sites, in addition to Jarablus area in Aleppo countryside. It is necessary to point out that as an essential source of income and livelihood enhancement, hundreds of families adjacent to the Euphrates River villages depend on this type of agroforestry agriculture. Each hectare can be planted with up to 10,000 trees, and needs to be under care for a period of at least 7 years before harvesting.

Euphrates poplar considered as one of the species tolerant to salinity and dry weather, as it can be a main source of wood production in saline soils in dry countries where it is difficult to plant other trees (Nahal, 2002). Poplar agroforestry provides many benefits, such as wood of medium density can be used in pulp industry, moreover its branches are used to clean teeth, as well as in carpentry, upholstery and panels, furthermore the manufacturing of boxes, containers, light tools, sulfur, paper pulp and their derivatives. Being tolerant to soil salinity and dry weather, it is possible to be a source of wood production in saline locations where it is difficult to plant other trees. Stabilizing the marginal floodplain soils on the banks of the river, as well as protecting them from winds of sandstorms and the damages of soil erosion. Poplars are very fast-growing and surprisingly resilient, so it is an ideal solution for supporting animal husbandry, fish farming, tree planting and gardening activities in general where wheat, parley, cotton and vegetables in additions to legumes fodder crops will be recognized. It has multiple social services such as the construction of wooden roofs, dwellings, shading, and crop protection, in addition to being a viable source of vital energy. There is no doubt that the involvement of local small farmers in new activities to generate income, so it is one of main tools for livelihood improvement.

The tamarisk plant is used to stabilize sand dunes and prevent soil erosion and sand sweeping. It is also used as a windbreak in dry and semi-arid areas, as it maintains constant permeability throughout the year. In this area, it has been used as a windbreak in southeastern California, where the summer temperature is as high as 50 degrees Celsius and as low as Winter up to -10°C. It is also considered an environmental model adapted to severe and critical conditions such as drought, salinization, waterlogging, pollution...etc., (Public Authority for Environmental Affairs and UNEP, 2001) and it can be used for afforestation in similar areas. It is also a pastoral plant Figure (5).

Figure (5): A camel grazes tamarisk plant

3-Evidence for environmental Services:

3-1. Biodiversity maintenance: Tree branches and leaves provide a suitable and safe environment for birds to nest, and tree cavities are suitable burrows for some animals to hide. Because it tolerates varying environmental conditions, it is suitable for agricultural and forestry systems to decorate the edges of fields and farms and create protective barriers to reduce wind speed and reduce noise.

Agroforestry can increase biodiversity in food production systems, including soil microbial diversity (Udawatta et al., 2019; FAO 2017), agroforestry systems (AFS) that combine trees and crops on the same land, including silvopastoral systems (SPS), the combination of trees and pastures/cattle in the same production unit, can increase productivity in the short and long term. AFS can serve an important role in climate change mitigation, due to carbon sequestration in woody components of the systems, as well as in soils.

AFS can assist farmers as they seek to adapt to climate change due to the ameliorating effects of trees on local air temperatures (Montagnini and Nair, 2004; Roshetko et al. 2007; Verchot et al. 2007; Murgueitio et al. 2011).

3-2. Carbon sequestration: Forests also help stabilize the global climate by absorbing one-third of carbon dioxide emissions from burning fossil fuels annually – approximately 2.6 billion tons. Because forests also store carbon, deforestation is responsible for releasing nearly a quarter of global greenhouse gas emissions into the atmosphere. Single-species artificial forests absorb 70% less carbon than diverse natural forests According to the researchers, planting one type of fast-growing tree has become one of the main tools for removing

excess greenhouse gases from the Earth's atmosphere, and it has become clear that planting forests with four types of trees increases the speed of carbon dioxide absorption by four times. Therefore, agroforestry systems in the Middle Euphrates Basin region play a crucial role in carbon sequestration, as there is a wide diversity of plant species that provide a suitable environment for this, such as agricultural afforestation activities with Euphrates poplars and other species mentioned above, along with planting with various types of fruit trees or crops.

3-3. Soil conservation: For soil protection and conservation forest and agroforestry activities considered to be the most efficient methods in addition to the other environmental function provided

Trees preserve and protect the soil from the risk of water and wind erosion. Undoubtedly, these play an important role in soil conservation, even if it is found on a slope, where agroforest forms the barrier between rain and soil, for the canopy formed by its leaves and branches above the soil surface, so the trees receive the first shock of rain water, then it flows quietly on the leaves and trunks, and reaches the soil surface, where root aggregates give a cohesive structure to the soil, leading to the reduction of soil erosion in the forest to a minimum, moreover, the litter formed from the remnants of fallen leaves and branches forms a barrier resistant to the impact of rain and at the same time has a high absorbent force and increases the ability of the soil to infiltrate, and the decomposition of the litter material enriches the soil with humic acids, which in turn leads to the formation of highly stable soil complexes that improve the porosity and permeability of the soil (Dusan, 1982).

Euphrates poplar is able to regulate and transport salt ions under high levels of salinity in the soil and for long periods (Chen , 2001).. It was found that the concentration of salts under the crown of the tree is about 2-3 times higher than its surroundings, as the roots of the Euphrates poplar absorb salts from the soil and concentrate them on the surface and the salt accumulated on the ground prevents the growth of any neighboring plants.

The high costs of salinized lands reclamation demand the need to find highly salinity-tolerant plant species to be used, furthermore, the biological method of saline soils reclamation comes to the fore, in conditions of water scarcity, and considered to be the ideal solution for management of saline soils in arid and semi-arid areas (Kamel and Walid 2001).

3-4. Watershed protection: Watershed hydrologic behavior can be affected by forests and trees, in particular the quantity and quality of stream flow, erosion, and sedimentation. In general, natural forests harvest the highest quality of water of any ecology. In natural conditions, the lowest erosion and sedimentation levels are commonly associated with forested watersheds , Usually surveyed as indications of watershed degradation are the physical appearances of problems such as polluted water, soil erosion, evidence of frequent flooding, sediment-filled channels and reservoirs, and shortages of potable water. Natural phenomena, human activities, or some combination of the two often cause watershed degradation and resulting upland and downstream impacts

Recommendations

1. The Middle Euphrates Basin region is full of important natural plant species, most notably: Aeluropus littoralis, Atriplex halimus, Glycyrrhiza glabra, Halocnemum strobilaceum, Juncus maritimus, Lycium barbarum, Phragmites australis, Populus euphratica, Prosopis farcta, Salix alba, Suaeda vermiculata, Tamarix tetragyna.
2. Adopting salinity-tolerant forest species that are useful for agroforestry as genetic sources of seeds and cuttings that can be used for afforestation in similar locations in terms of salinity and drought, as well as the production of seedlings in specialized nurseries in order to expand their cultivation and dissemination in all available areas, and increase the plant density through them
3. Supporting agroforestry by encouraging the population to adopt this type of agriculture and developing a policy that encourages the use of alternatives that meet the needs of the local population.
4. Diversify the sources of income for the local people, link them to the forest economy, and make the forest their main source of livelihood.
5. Work to aware and guide the local population, especially those around the forest area about the economic importance of agroforestry, and support them financially and morally in managing, protecting and developing it (for example, supporting them with complementary and complementary fodders for their animals, providing them with fuel, securing seeds and

planting grazing plants appropriate to the conditions of their areas).

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