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Goods and Services Provided by Native Plants in Nile Delta, Egypt: in the Viewpoint of Conservation

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THE NILE Delta is one of the oldest and largest deltas in the world covers 4 % of Egypt's area and occupies 63 % of the Egyptian cultivated land. The present study focuses on the goods and services offered by Delta's natural ecosystem. Thirty field trips were conducted to different locations to cover the study area from spring 2020 to summer 2022. Based on field observation and information gathered from residents and herbalists (60 people from the study area were interviewed, ranging in age from 30 to 60 years old) the goods, services and threats of the recorded species were assessed. Forty-nine were recorded and their roles in goods and services; identified threats that cover the gradual change in the study area were recorded. Recorded species offer many goods such as grazing (36 species), medicinal (26) and human food (15). Also, they provide environmental benefits that ruderal and segetal weeds are the most commonly offered service, followed by bank retainer (16 species) and weed controller (6 species). Thirty-six species (73% of recorded species) suffer from at least one type of threat; over-collecting and over-cutting were the most common threat (46.9%), then habitat loss (40.8%), browsing and over-grazing (34.7%), clearance for agriculture (24.5%) species) and disturbance by cars or trampling (10%). Authors recommended that Nile Delta natural flora need continuous monitoring and conservation, as this region faces deteriorating habitat loss and even extinction of plants; which offer many goods and services for humans and the environment.

Keywords: Ecological services, Medicinal plants, Nile Delta, Threats.

Introduction

The Nile Delta is one of the largest river deltas in the world. It extended from Alexandria in the West to Port Said in the East covering 240km of the Mediterranean coastline and considered the main region for Egyptian agriculture. It also extends from the North to the South about 160km in length beginning slightly downriver from Cairo. This Nile Delta is mainly a delta formed in Northern Egypt (Lower Egypt) where the Nile River spreads out and drains into the Mediterranean Sea (El-Ramady et al., 2019). At Cairo, the Nile spreads out with deposits to form a fertile delta about 250km wide at the seaward base and about 160km from north to south (Zeidan, 2006). The climate of the Nile Delta is hot in general; however, the northern part is slightly humid. The temperatures reach the peak of hotter summer days in July and August with a maximum of 43°C. Winter temperatures are mainly between the range of 9°C at night and 19°C during the day (Negm et al., 2016).

Nile Delta represents about 4% of Egypt's area and it is inhibited by 48% of the Egyptian population, it composes about 63% of all cultivated lands (Negm et al., 2017). Moreover, the quality of agricultural soils is degraded due to many reasons including low investment and management of the agricultural drainage since the 1950s, the loss of soil fertility due to crop intensification, and the most dramatic reason is the absence of silt from

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the Nile after the construction of High Dam, in addition to the rising level of groundwater (Khalifa & Moussa, 2017).

The cultivated land of the Nile Delta is rich in silt, which has been carried down from the Ethiopian Highlands; which ranged from 7 to 10m in Aswan and the northern delta, respectively (Abdel-Fattah et al., 2017). In general soils of the Nile Delta are of a light to heavy clay texture (Omran, 2019). Soils in the Nile River and Delta are silt-clay mixtures of good quality, deposited during thousands of years of Nile flooding. Most cultivated soils in Egypt are clayey to loamy in texture, and only about one million feddans (420,000ha) are sandy and calcareous (FAO, 2005).

The River Nile is considered the main freshwater supply because of the arid climate of Egypt which is characterized by high evaporation rates (1,500–2,400mm/year) and very low rainfall (5–200mm/year). However, the favorable climate of Egypt around the year is ideal for a wide variety of crops. This made it possible to adopt an intensive cropping system and thus permitted the production of more than one crop per year in most of the cultivated areas. The Delta has a hot desert climate as the rest of Egypt (Abdel-Fattah et al., 2017).

Floristically, the Nile Delta of Egypt is an agroecosystem, one of the oldest and most successful systems in the world, that is dramatically changed by human impact during the last 5000 years, thus its vegetation is mainly weeds associated with cultivated lands and urban habitats (Shaltout et al., 2010). Several recent studies were concerned with the Nile Delta land and habitat alteration, such as Elhag et al. (2013), and Abd El Fatah et al. (2022) who differentiated the Delta region into five areas; agricultural land, urban area, desert, fish farms, and surface water. Their results indicated a decrease of around 14% in the desert and an increase of 7, and 6, in agricultural land, urban area respectively, Ahmed et al. (2016) monitored the changes in land use around Damietta promontory throughout 1987, 1999, 2003, and 2015. The results indicated that the agricultural land decreased from 16 to 13% between 1987 and 2015, respectively, while the urban areas increased from 9.7 to 11.2% for the respective dates. Ezzeldin et al. (2016) studied the change in the Nile Delta from Damietta Branch to Suez Canal from west and east, respectively, and from El-Manzala Lake to the Cairo-Suez Desert Road from north to south, respectively. Five dates were used: 1984, 1990, 1998, 2006, and 2015. Their results revealed that the agricultural and fallow lands classes increased by 9% between 1984 and 2015 whereas urbanization increased by 5% mainly on agricultural land.

Climate changes can influence different soil eco-services. Therefore, soil and other environmental sciences can determine future climate change impacts on soils and terrestrial ecosystems. Hence this study tries to provide information about the ecosystem services provided by native plants in Nile Delta, Egypt as a step to determine the future climate change effects.

Materials and Methods

Study area

Nile Delta is a classic delta with a triangular shape; its length from south to north is 170km, and its northern width from west to east is 220km (Fig. 1). The area of this region (about 22000km) comprises about 63% of Egypt's productive land (Abu Al – Izz, 1971). Its agroecosystem is one of the oldest and most successful in the world. Human impact has been recognized as the most important influence on the composition of the flora and vegetation of this region during the last 5000 years, thus its vegetation is mainly weeds associated with the crops in the cultivated lands and urban habitats such as banks of canals and drains, roadsides, railways and wastelands (Shaltout et al., 2010). Thirteen habitats can be recognized in the study area: dunes, Sand flats, Salt marshes, Railways, Highways Wasteland, Abandoned field Orchards, Summer crops, Winter crops, Canals, Drains, and Lake Burullus (Shaltout et al., 2010).

Data collection

Thirty field trips are conducted to different locations to cover the study area from spring 2020 to summer 2022. Two fresh specimens were collected for identification and preparation of the herbarium sheet. Herbarium sheets were deposited in Tanta University Herbarium (TANE). Species, population characteristics and threats were recorded. Plants were identified according to Boulos (1999, 2005), and the identification and nomenclature were updated according to the Plants of the World Online website (POWO: http://powo.science.kew.org/).

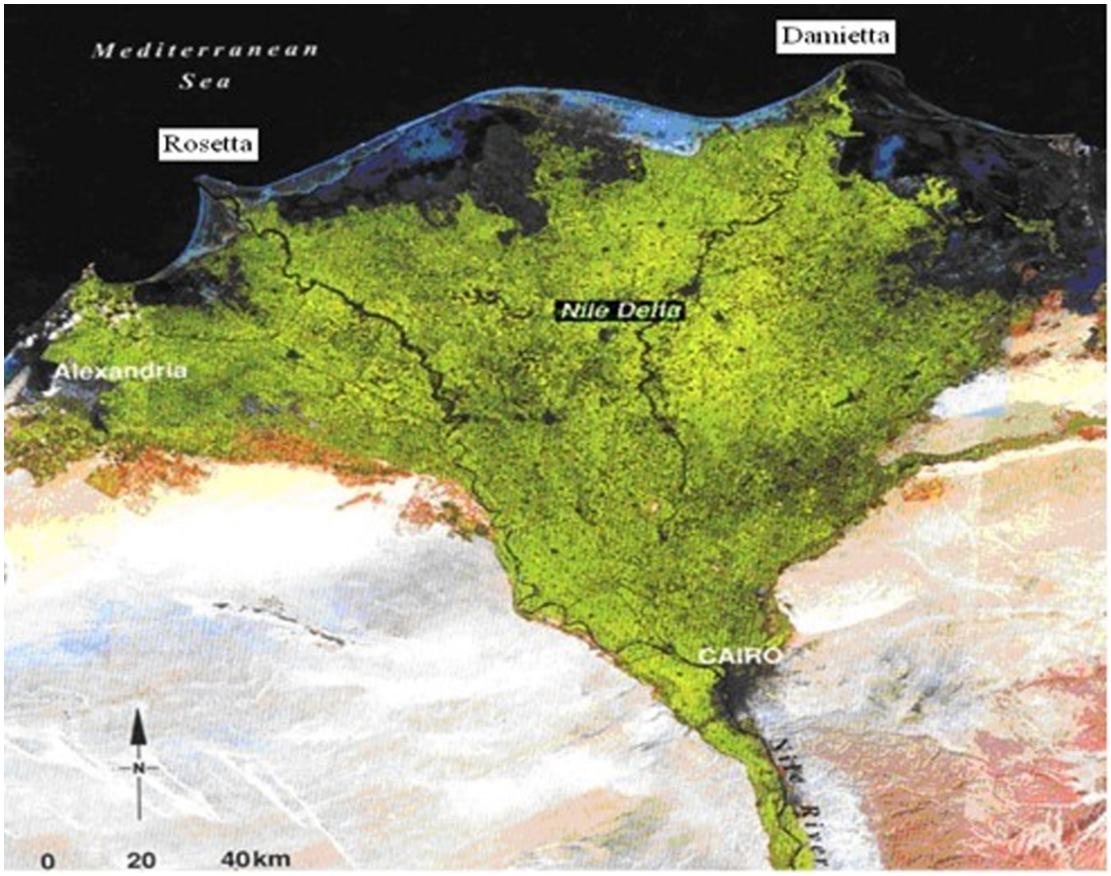

Fig. 1. Map of Nile Delta (Google Earth)

Goods and Services

PEcosystem services are the benefits people obtain from ecosystems (Balvanera et al., 2016; Millennium Ecosystem Assessment, 2005) and ethnobotanical uses (Ahmed et al., 2013). Goods of natural flora in the ecosystem include species and their parts, as well as products that grow in the wild and are directly used for human benefits (Shaltout & Ahmed, 2012; Daily et al., 1997). Field observation and information gathered from residents and herbalists were used to evaluate the potential and actual goods of the recorded species. About 60 people from the study area were interviewed, ranging in age from 30 to 60 years old. Their knowledge stems from their agricultural activities, where they learned plant names, locations, usage and collection methods. Additional information was gathered from 20 famous herb shops located in the markets of different governorates in the Nile Delta (e.g. Khedr El-Attar, Al-Attar Al-Hindi, Abu Haraz in Cairo, Khodier Alattar, and Al Rizq Alattar in Damietta, Shaded Alattar and Alfatatry in Gharbia, Gamal El-Din and Alkheir we Albaraka in Menofia…… etc.).

In addition to data collected from local inhabitants, herbalists, and herbal shops, literature including, textbooks, journals, proceedings, and databases written in English on Plant life in Nile Delta were used to collect relevant data about natural plant species; furthermore, their beneficial uses, goods and services, (Boulos, 1983; Batanouny, 1999; Gonzalez-Tejero et al., 2008; Hadjichambis et al., 2008; Shaltout et al., 2010; Shaltout & Ahmed, 2012; Ahmed et al., 2014; Bidak et al., 2015; Bedair et al., 2020; Ahmed et al., 2020; Aremu & Pendota, 2021; El-Darier et al., 2021; El-Khalafy et al., 2021; Almushaghub et al., 2022). The recognized goods are sorted into 6 categories: medicinal, grazing, human food, fuel, timber and other uses (e.g. baskets, beach beds, hats, mats, soap manufacture and dye extraction).

The priceless, consistent benefits that these plants offer are known as services of the natural flora (Turner & Daily, 2008). According to field observations and reference checks (Zahran & Willis, 2009; Heneidy & Bidak, 2004; Shaltout et al., 2010; Shaltout & Ahmed, 2012; Bidak et

al., 2015), the documented species' services were assessed. The following fourteen service-related characteristics are listed: segetal weeds, ruderal weeds, sand controller, bank retainer, weed controller, water purificator, wind-breaking, poisonous, water invader, sand binder, dune and hummock former, shaders, nitrogen fixers 'soil fertility', ruderal invader)

Threats

Threats are both direct and indirect causes of ecosystem depletion and species extinction. In the study area, **five** types of threats were identified during field trips depending on the authors' observations and Shaltout et al. (2010):

1. Disturbance by cars or trampling
2. Mining and quarrying
3. Clearance for agriculture
4. Browsing and over-grazing
5. Habitat loss and
6. Over collecting and over cutting.

Data analysis

Collected data were expressed using simple descriptive statistics and expressed in the form of graphs and tables using Excel software v. 2019.

Results

Floristic composition and Geographical Distribution

The recorded species were 49 plant species (Table 1) belonging to 44 genera and 15 families. The vegetation consists mainly of therophytes 34% of the recorded species (seventeen species), followed by geo-helophytes 24% (twelve species) that represent a considerable proportion of the plants inhabiting the study area, chamaephytes 14% (seven species), hemicryptophytes and phanerophytes 12% (six species), and hydrophytes 4% (two species) (Fig. 2).

The flora of the study area is rich in terms of geographical distribution, where the Mediterranean and Irano–Turanian regions had the maximum values: 61 % of the recorded species (30 species) and 51 % (25 species), respectively. In addition to Saharo-Arabia, Euro– Siberian, and palaeotropical with values ~ 27 % (13, 12, and 10 species), respectively. Furthermore, neotropical and Sudano–Zambezian with values ~ 16% (8 and 7 species); less than 4 % of the recorded species belonged to Saharo-Sindian, Borealo – tropical and Australian geographical distribution**.**

Goods and services

Most of the species recorded have many ecological and economic uses (Table 1), and more than 14% of species (twenty-nine species) recorded had at least one known economic use (goods); furthermore, four percent of the recorded species (two) had none. The goods of the recorded species could be arranged in descending order as follows grazing (72%) thirty-six species > medicinal (52%) twenty-six species > human food and other uses (30%) fifteen species > fuel (18%) nine species > timber (8%) four species (Fig. 3a).

In addition to their essential economic roles, they play ecologically vital roles (services) provided by the recorded species as flows also, in descending order: ruderal weed (36%) eighteen species > segetal weed sixteen species (32%) > bank retainer (16 %) eight species > weed controller (12%) six species > water purificator one species, poisonous three species, windbreaker three species and sand binder three species (6%) > water invader two species, dune and hummock former two species, sand controller two species and shader (4%) two species > nitrogen fixer one species, water purifier one species and ruderal invader (2%) one species (Table 1, Fig. 3b).

The graphical distribution of all recorded species was also recorded and listed in Table 1. In the present study, 52% of recorded species were of medicinal importance (twenty-six species), listed in Table 2; in addition to the recorded ways of uses in folk medicine.

Threats

Despite being both economically and ecologically significant, native species face threats that challenge their existence in the upcoming years mentioned in Appendix 1. Thirty-six species (73% of the total economic species recorded) suffer from at least one type of threat, whereas thirteen species (26% of recorded species) had no threats recorded. The stresses on the recorded species could be arranged in descending order: over-collecting and over-cutting (twenty-three species) > habitat loss (twenty species) > browsing and over-grazing (seventeen species) > clearance for agriculture (twelve species) > disturbance by cars or trampling (five species) (Fig. 4).

TABLE 1. List of species recorded in the study area: Economic value (goods) recorded as follows: GR: grazing, ME: medicinal, HF: human food, FU: fuel, TI: timber and OT: other uses. The geographical distribution of floristic regions is abbreviated as follows: ME: Mediterranean, IR – TR: Irano – Turanian, SA – AR: Saharo Arabian, ER – SR: Euro – Siberian, SU – ZA: Sudano – Zambezian, NEO: Neotropical, PAL: Palaeotropical, Temp: Temperate region and PAN: Pantropical; Threats are: Browsing and overgrazing (B); Over collecting and over cutting (C); Clearance for agriculture (A), Habitat loss (L); Disturbance by cars or trampling (D); and mining and quarrying (Q)

Species	Family	Economic value (Goods)	Ecological importance	Geographical distribution	Threats
Phanerophytes					
Calligonum polygonoides subsp.*comosum*	Polygonaceae	FU + TI	Ruderal weed & sand binder	SA-AR+ IR-TR.	C+ A+ Q
Convolvulus lanatus	Convolvulaceae	GR		SA – AR	C+ A
Phoenix dactylifera	Palmae	GR + ME + HF + FU + TI +OT		SA-AR+ SU – ZA.	
Ricinus communis	Euphorbiaceae	ME + HF + FU + OT	Wind breaks	SU – ZA	C
Sesbania sesban	Leguminosae	GR + ME + FU + TI + OT	Ruderal weed and Shader	SU – ZA	B+ C+ Q
Tamarix nilotica	Tamaricaceae	GR + ME + FU + TI + OT	Ruderal weed, shader & wind breaks	SA-AR + IR-TR	C+ L+ D
Chamaephytes					
Arthrocnemum macrostachyum	Chenopodiaceae	GR + FU	Bank retainer, weed controller & Sand controller	ME + SA-AR	B+ C+ A
Ipomoea carnea	Convolvulaceae	GR + HF	Ruderal weed & poisonous	NEO	
Limbarda crithmoides	Compositae	ME	Bank retainers	ME +ER-SR +SAAR	C+ A+ L
Suaeda pruinosa	Chenopodiaceae	GR	Bank retainer	ME	
Suaeda vera	Chenopodiaceae	GR	Bank retainer	SA-AR+ ME.	L
Withania somnifera	Solanaceae	ME	Ruderal weed &poisonous	ME+IR-TR + PAL	
Zygophyllum album	Zygophyllaceae	GR + OT	Sand controller	SA –AR+ ME	L+ Q
Hemicryptophytes					
Alhagi graecorum	Leguminoseae	GR + ME + HF + FU + OT	Ruderal weed, bank retainer & sand binder	IR-TR + ME + SA-SI	
Artemisia monosperma	Compositae	GR + ME + OT	Sand binder	SA – AR + ME	L+ D
Launaea nudicaulis	Compositae	GR + OT	Segetal weed	SA-AR + SU– ZA +IR-TR	B+ L+ Q
Phyla nodiflora	Verbenaceae	GR	Ruderal weed and weed controller	ME + IR-TR + PAL+ NEO	B
Silene succulenta	Caryophyllaceae	GR		ME	B+ A + L
Silybum marianum	Compositae	GR+ME+HF		IR-TR+ER-SR+ ME	B+ C

TABLE 1. Cont.

Species	Family	Economic value (Goods)	Ecological importance	Geographical distribution	Threats
Geo-Helophytes					
Arundo donax	Gramineae	GR + FU	Ruderal weed,bank retainers & weedcontroller	ME +IR- TR + ER-SR	B+ C+ L
Cynodon dactylon	Gramineae	ME + HF	Ruderal weed and weed controllers	Borealo – Tropical	
Cyperus alopecuroides	Cyperaceae	GR + OT	Ruderal weed and invader	PAL+ NEO	L
Cyperus laevigatus	Cyperaceae	GR	Ruderal weed & weed controller	Cosmopolitan	B+ L+ D+ Q
Juncus acutus	Juncaceae	GR + ME + OT	Ruderal weed, dune and hummock formers	ME+ IR-TR + Australian.	B+ C
Juncus rigidus	Juncaceae	GR + ME + OT	Ruderal weed	ER-SR+ME+IR-TR.	B+ C
Leptochloa fusca	Gramineae		Segetal weed & water invader	Palaeotropical	L + Q
Panicum repens	Gramineae	GR + ME + HF	Ruderal weed & bank retainer	PAL+ NEO + ME.	
Panicum turgidum	Gramineae	GR + ME + HF + OT	Sand controller and dune & hummock former	SA-SI + SU–ZA	C+ L
Phragmites australis	Gramineae	GR + ME + HF + FU + OT	Ruderal – water invader &water purificator	ME + IR-TR +SAAR+ PAL + NEO	
Saccharum spontaneum	Gramineae	GR + ME	Weed controller, sand binder & wind breaks	ME+IR-TR +SAAR + PAL	C + L
Typha domingensis	Typhaceae	GR + ME + HF + OT	Ruderal weed & water purificator	ME + IR-TR + PAL	B+ C+ A+ L
Hydrophytes					
Ceratophyllum demersum	Ceratophyllaceae	GR + ME	Water purifier	Cosmopolitan	
Eichhornia crassipes	Pontederiaceae	GR + OT	Water purificator	Neotropical	
Therophytes					
Ammi majus	Umbelliferae	HF	Segetal weed	IR-TR + ME.	
Ammi visnaga	Umbelliferae	ME	Segetal weed	ME+IR-TR	C+ A+ L

TABLE 1. Cont.

Species	Family	Economic value (Goods)	Ecological importance	Geographical distribution	Threats
Bassia indica	Chenopodiaceae	GR	Ruderal weed	SU–ZA + IR-TR	B+ C
Dichanthium annulatum	Gramineae	GR	Ruderal weed & bank retainer	PAL + NEO	
Echinochloa stagnina	Gramineae	GR	Ruderal weed & water invader	Palaeotropical	
Euphorbia peplis	Euphorbiaceae		Poisonous plant	ME +ER – SR + IR-TR	C + L
Euphorbia helioscopia	Euphorbiaceae		Segetal weed &poisonous	ER-SR+ME+IR TR+SU – ZA	C+ L + D
Fumaria parviflora	Fumariaceae	ME	Segetal weed	ER-SR +ME+ IR-TR	A + L
Lotus halophilus	Leguminosae	GR		ME+ SA-AR	B + A + L+ Q
Malva parviflora	Malvaceae	GR + ME + HF	Segetal weed	ME +IR-TR	
Portulaca oleracea	Portulacaceae	GR + ME + HF	Segetal weed	Cosmopolitan	B + C+ A
Ranunculus sceleratus	Ranunculaceae	ME	Ruderal weed &poisonous	ER-SR+ ME + IR-TR.	C
Raphanus raphanistrum subsp. *raphanistrum*	Cruciferae	ME + HF	Segetal weed	ME +ER-SR	C
Rumex dentatus	Polygonaceae	GR + ME + HF	Segetal weed	ME + IR-TR + ER-SR	B + C
Sonchus asper	Compositae	GR + HF	Segetal weed	ME + IR-TR.	B + A
Trifolium resupinatum	Leguminosae	GR	Segetal weed, weed controller & nitrogen fixer	R-TR +ER-SR + ME.	B + A+ L + Q
Urtica urens	Urticaceae	ME	Segetal weed	ER-SR +ME +IR-TR	C

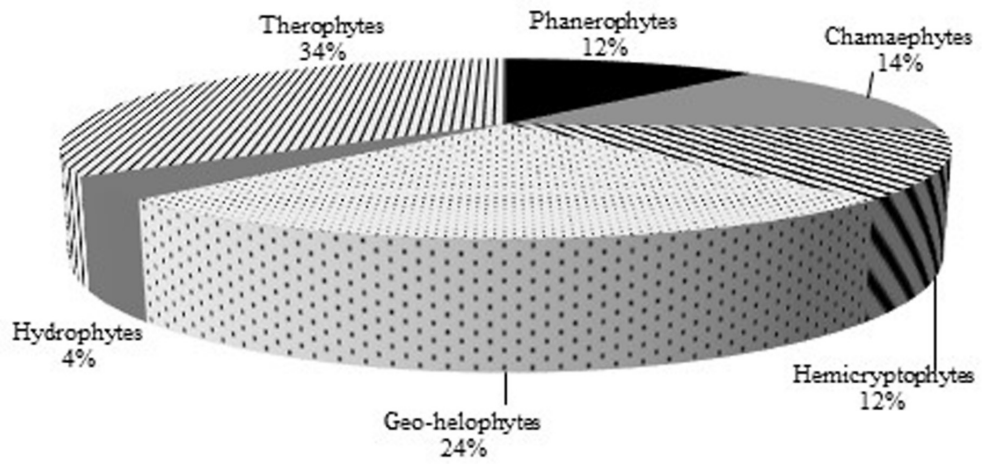

Fig. 2. Life form (%) of recorded species in the Nile Delta, Egypt.

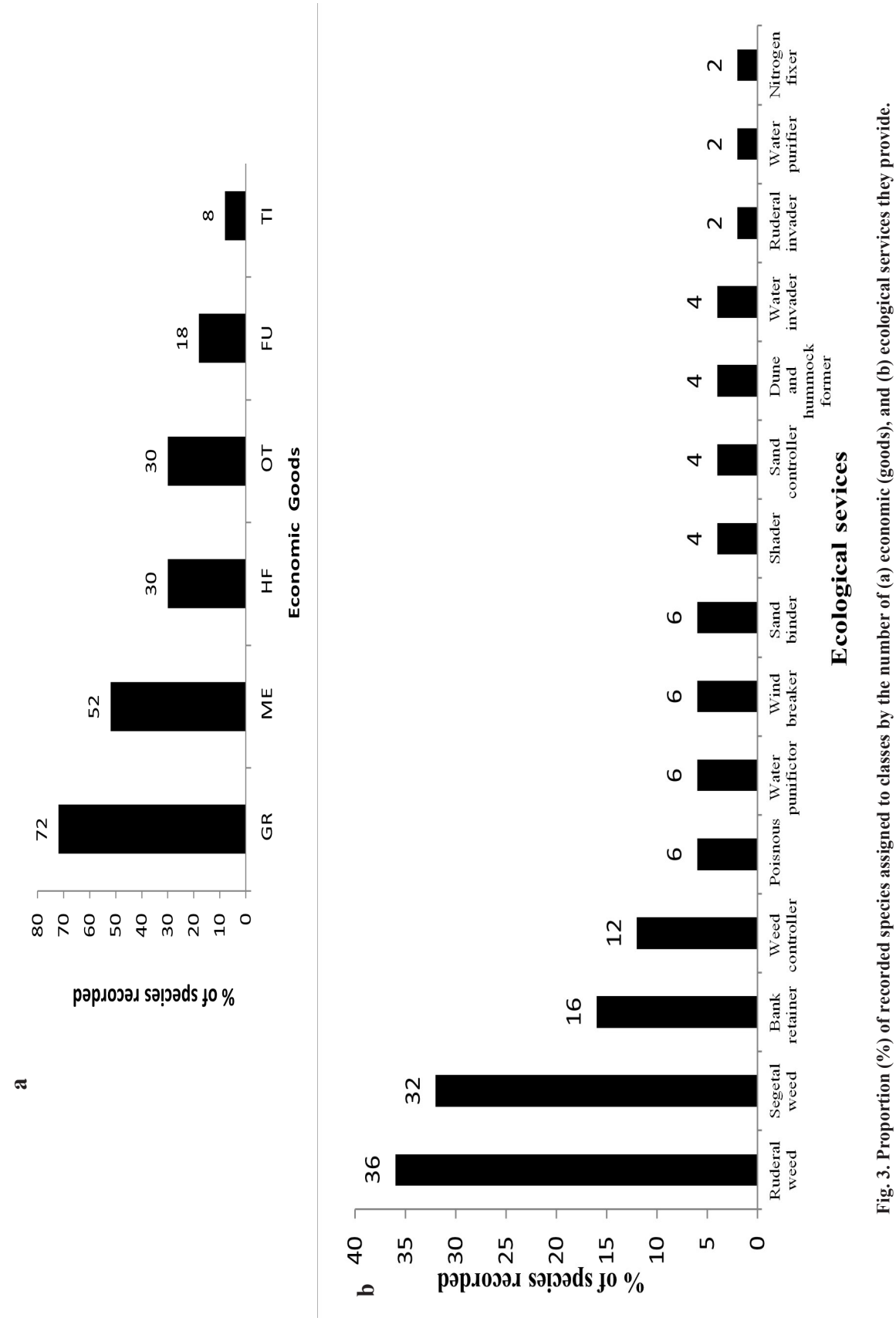

Fig. 3. Proportion (%) of recorded species assigned to classes by the number of (a) economic (goods), and (b) ecological services they provide.

TABLE 2. Therapeutic uses, parts used treatment method and supporting references for selected medicinal plants recorded in the study area

Species	Therapeutic uses	Part used & treatment method	Reference
Phoenix dactylifera	have antitussive, expectorant, demulcent, laxative, diuretic, and restorative effects. used as ooling, laxative. used to intreating diarrhea and genitourinary diseases.	Fruit pulp Sap Gum	(Khare, 2007)
Ricinus communis	Used as an Analgesic (for toothache); musculoskeletal (inflammation). Oil from ground seeds is used as an ointment leaves as a compress for pains and rheumatism and toothache (as a compress on the cheeks, also can be used as pain relief for stomachache Leaves are heated and placed on painful knees/joints, and can be used fresh for the treatment of stomachache Compress leaves are used for headaches, pain, inflammation, and sprains. Warm leaves are wrapped around a child for stomachache Oil squeezed from the fruits is used to ear to relieve earache	Leaves, seeds, and fruit	(Aremu & Pendota, 2021)
Sesbania sesban	Traditionally been used as purgative, demulcent, maturant, anthelmintic and for all pains and inflammation as a result of its ability to astringent, or contract body tissues. used also for, menorrhagia, spleen enlargement, diarrhea, anthelmintic and also used as an astringent, emmenagogue, and anti-inflammatory.	The leaves and flowers	(Evans & Rotar, 1987; Evans & Macklin, 1990; Goswami et al., 2016)
Tamarix nilotica	expel fever, relieve headache, draw out inflammation, and as an aphrodisiac aperient, sudorific, ulcer, expectorant, carminative, astringent, diuretic an antiseptic agent. In Egypt; the leaves and young branches are cooked for edema of the spleen and mixed with ginger for uterus infections, while the bark, when boiled in water within vinegar is used as a lotion against lice. It is also, has been used in Egyptian traditional medicine as an antiseptic agent. This plant has been known since pharaonic times and has been mentioned in medical papyri to expel fever, relieve headache, draw out inflammation, and as an aphrodisiac. stem bark used for the treatment of hemorrhoids The leaves and young branches are cooked for oedema of the spleen and mixed with ginger for uterus infections, while the bark, when boiled in water with vinegar is used as a lotion against lice. The bark is used to treat eyes sore from scratches or blows, also it is used for hemorrhoids.	The leaves and young branches stem bark	(Boulos, 1983) (Kamal, 1967) (Elhardallou, 2011)

TABLE 2. Cont.

Species	Therapeutic uses	Part used & treatment method	Reference
Limbarda crithmoides	Syn. Golden samphire (*Inula crithmoides*L., is used as a tonic by poor coastal families. It is also "a remedy for overeating at a feast. Used the following day is claimed to ease the congestion of the bowels and counteract liver swelling.	root stewed root	(Zurayk & Baalbaki, 1996)
Withania somnifera	Leaf poultices are applied externally to treat rheumatism. Musculoskeletal (inflammation). For treating inflammation. Leaf infusions are used to treat stomach ailments	Leaves and roots	(Aremu & Pendota, 2021)
Alhagi graecorum	general tonic, anthelmintic, aperients, jaundice, arthritis, rheumatic pains, bilharziasis, liver disorders, gastrointestinal disorders, laxative, diuretic, treating cataracts & eye infections, migraine relax the ureter, renal stones, aphrodisiac hemorrhoids, migraine, warts opacity of the cornea	whole plant decoction	(Heneidy et al., 2017)
Artemisia monosperma	had its antispasmodic, anthelmintic and anti-hypertensive properties		(Sharaf et al., 1959; Chakravarty, 1976; Wagner & Wolff, 1977)
Imperata cylindrica	Diuretic, anti-inflammatory.		(Khare, 2007)
Juncus acutus subsp. *acutus*	This is a toxic plant, but rarely a decoction of seeds is used for treatment diarrhea, anemia, and as hypoallergenic, and a decoction of roots is used in the treatment of some skin diseases.	seeds root	(Khatib et al., 2021)
Panicum turgidum	healing-wound, antidiabetic, antipyretic, antitussive, dysuria, renal stones, eye infection	powder of whole plants	(Heneidy et al., 2017)
Phragmites australis. subsp. *australis*	diuretic, respiratory problems, emetic, skin diseases & lesions, bronchitis cholera, food poisoning antidote, antiemetic, antipyretic, refrigerant anti-asthmatic, antitussive, depurative, febrifuge, lithotriptic, sedative, sialagogue, stomach aches, diarrhea, lung abscesses, urinary tract infections foul sores, styptic	leaves decoction of flowers stem root taken orally leave ashes	(Heneidy et al., 2017)

TABLE 2. Cont.

Species	Therapeutic uses	Part used & treatment method	Reference
Saccharum spontaneum subsp. *aegyptiacum*	cooling, astringent, diuretic, galactagogue. Used in the treatment of burning sensation, dysuria, dyscrasia, kidney and bladder stones, dysentery, and bleeding piles. diuretic, galactgogue	Plant Root	(Khare, 2007)
Ceratophyllum demersum	Purgative, antibilious, antibacterial.	Whole plant	(Khare, 2007)
Ammi visnaga	Muscle relaxant. Dilate coronary vessels and the ureter. For mild anginal symptoms. For Urinary Tract Disorders: - Diuretic - Renal colic In the postoperative treatment of conditions associated with the presence of urinary calculi. - Lithotriptic agent (to break up renal stones). Supportive treatment for mild obstruction of the respiratory tract in asthma or spastic bronchitis. For skin disorders (psoriasis and vitiligo). As emmenagogue to regulate menstruation. i) Treatment of gastrointestinal cramps and painful menstruation. commonly used for colic and gastrointestinal cramps, kidney stones and painful menstruation is used in the treatment of mild angina. as a supportive treatment for respiratory conditions such as asthma, bronchitis, cough and whooping cough as a diuretic and for relieving liver and gall bladder disorders.	The fruits and leaves.	(Hashim et al., 2014; EDA, 2021)
Portulaca oleracea	Refrigerant (reduces body heat), mild spasmodic, diuretic, antiscorbutic. Used in scurvy and in diseases of the liver, spleen, kidney and bladder; also in dysuria, stomatitis and dysentery. is applied to swellings, erysipelas, burns and scalds. Seeds—diuretic, antidysenteric; applied externally to burns and scalds.	whole plant A paste of leaves	(Khare, 2007)
Ranunculus sceleratus	highly acrid, rubefacient, vesicant and toxic; causes inflammation of the digestive tract. Used as a homoeopathic medicine for skin diseases.	fresh plant dry (after dying plant)	(Khare, 2007)
Rumex dentatus subsp. *dentatus*	—astringent; used in cutaneous disorders.	Plant	(Khare, 2007)
Urtica urens	Rheumatism, eczema and diuretic	Aerial parts and leaves	(Bidak et al., 2015)

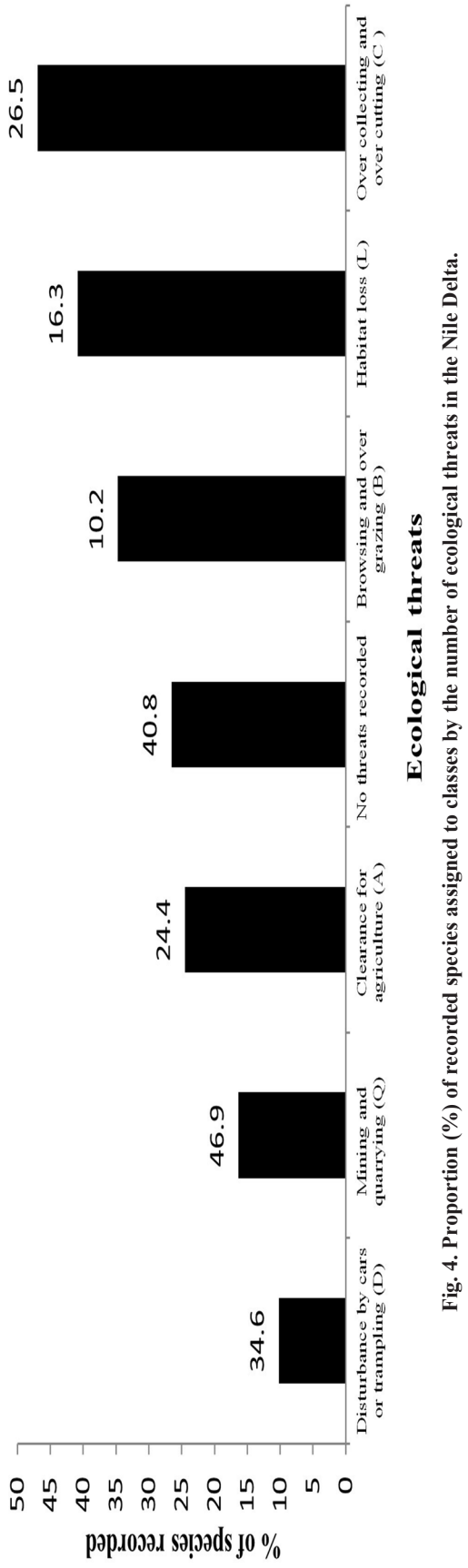

Fig. 4. Proportion (%) of recorded species assigned to classes by the number of ecological threats in the Nile Delta.

Discussion

The change from virtually uninfluenced natural sites to strongly altered man-made sites is often gradual with many different influenced vegetation types. Alterations of natural habitats' has been studied on many levels including energy flows, nutrient cycles, water and material budgets, the characteristics of urban climate, soil, and wildlife adapted to the man-made environment (Sukopp & Werner, 1983; Shaltout & El-Sheikh, 2002).

According to Taylor (2012), human-induced disturbance associated with activities such as vegetation clearance and road construction provides a source of disturbance in many plant communities and this form of disturbance has produced negative impacts including vegetation damage and loss, weed invasion, and habitat fragmentation. By increasing the intensity of destruction, the number of species would be decreased, and the community structure and species composition would be changed. Also, anthropogenic disturbance decreased the amount of organic matter (carbon and nitrogen) according to the degree of man-made disturbances. Therefore, a comprehensive program should be considered (Shawky & Mohamed, 2022).

The natural vegetation cover in the study area spares with low diversity, as it was recorded only 49 plant species of goods and services usage, while in previous studies as Shaltout et al. (2010) reported 302 species with goods and services usage and 260 species with environmental importance. Many recorded plants in previous studies were considered threatened species, now became naturalized, such as *Suaeda pruinosa*, and *Calligonum polygonoides*; while *Convolvulus lanatus*, and *Raphanus raphanistrum* subsp. *raphanistrum* becomes rare and/or not recorded. The majority of species are therophytes and according to Raunkiaer (1937) a therophyte survives unfavorable conditions as a seed and this is expected due to the harsh weather conditions especially in summer and winter, as the northern and southern parts of the Nile Delta belongs to arid and hyperarid climate regions respectively (Anonymous, 1980). The response of life forms reflects the response of vegetation to variations in certain environmental factors. in addition, life form is considered either hereditary or adjusted to the environment (Heneidy & Bidak, 2004). The therophytes are the most common life form in this study, this could be a direct result of climatic change and global warming as

the dominance of therophytes was recorded in several studies as a response to dry hot climate, topographic variations and biotic influence (Ayyad & El-Ghareeh, 1982; El-Demerdash et al., 1994; Heneidy & Bidak, 2004), Furthermore, according to Bidak et al. (2015), the plant species *Artemisia monosperm* as an example can tolerate salinity and recode as a sand fixer and studies northwestern coastal desert of Egypt, indicates the devastating consequences in terms of the Nile Delta's soil fertility.

Delta's flora goods

Grazing and fuel

Thirty-six species were exploited for grazing purposes; to begin example: *Tamarix nil1ica* is used at different growing stages, as the small branches and flowers are favorable for camel and sheep respectively (Shaltout & Al-Sodany, 2000; Shaltout & Ahmed, 2012), Ayyad (1998) reported that *Sesbania sesban* is cultivated for its shade and used as fodder, besides *Phragmites australis* is a well-known excellence livestock forage, especially as an unmatured plant for a wide range of farm animals (cattle, goats, sheep and horses), but at mature stage replacing this fodder plant is a must due to its toughness and couldn't be consumed by the animals (Ayyad, 1998; Eid, 2009; Shaltout & Ahmed, 2012).

Timber and other uses

To begin with, timber plants are of limited resources in Egypt (Shaltout & Ahmed, 2012). It is reported only 4 species (8% of the total economic species) are economically appropriated as timber such as *Phoenix dactylifera* and *Tamarix* trees (Heneidy & El-Darier, 1995; Shaltout & Ahmed, 2012).

Fifteen plant species (30% of the total economic species) provide non-agricultural uses; *Juncus acutus*, *Juncus rigidus*, and *Phoenix dactylifera* are used in rob making, handicrafts supplies (Bidak et al., 2015; Shaltout & Al-Sodany, 2002), Also, *Tyha domingensis* and *Phragmites australis* are used for handy-craft purposes (weaving mats, baskets barrels and casks manufacture) (Sculthorpe, 1985). *Phragmites australis* also has been recorded as a supporting building stem material for houses and rafts during the Ancient Egyptians era (Eid, 2009).

Delta's flora services

Ethnobotanical findings are mainly concerned with the relationship between local inhabitants and plants utilizations for medical, both human and animal feeds, fuel, and other household purposes (Ahmed et al., 2013). In the present study, thirty six species were used in grazing; Bidak et al. (2015) and Shaltout & Ahmed (2012) reported *Alhagi graecorum*, *Artemisia monosperma*, *Arthrocnemum macrostachyum*, *Bassia indica*, *Calligonum polygonoides*, *Convolvulus lanatus*, *Cynodon dactylon*, *Lotus halophilus*, *Malva parviflora*, *Panicum turgidum*, *Phoenix dactylifera*, *Phragmites australis*, *Rumex dentatus*, *Trifolium resupinatum*, and *Typha domingensis* used for grazing purposes at the northwest coastal and southern mediterrean deserts of Egypt respectively.

Eighteen species were find of ecological vital roles; for example *Suaeda pruinosa* is indispensable in maintainaing soil from erosion (Bedair et al., 2020; Ahmed et al., 2023), furthermore *Alhagi graecorum*, *Artemisia monosperma*, *Arthrocnemum macrostachyum*, *Convolvulus lanatus*, *Phragmites australis*, and *Typha domingensis* are windbreakers (Bidak et al., 2015).

Threats affect plants

Besides excessive unplanned usage for previously mentioned ecological services, another reason for potential threats to natural habitats is the collection of medicinal plants, Urban development's destructing natural habitats, and invasive agricultural practices. These reasons are discussed below.

Over-collecting

A. Medicinal plants

Two of the 13 wild pharmaceutical plants in Egypt are present in the study area: *Ammi majus*, and *Ammi visnaga* (Batanouny, 1999; EDA, 2021). *Ammi visnaga* is a very common treatment of bronchial complaints in Egypt (Evans & Trease, 2009). In addition to 19 plant species of medicinal application; for example, *Withania somnifera* leaf extract is widely used for treating inflammation (Aremu & Pendota, 2021). Many other plants identified in the study are used for various medicinal applications: as antibacterial, skin diseases, and eczema; *Ceratophyllum demersum, Ranunculus sceleratus, and Urtica urens,* respectively (Khare, 2007; Bidak et al., 2015).

B. Human food

We recorded fifteen species (30% of the total economic species) consumed as desirable food. For example, *Sonchus asper* and *Portulaca oleracea*

are used as salad side dishes. *Silybum marianum* green plant is eaten raw or cooked as stew. Fruit is also eaten raw (Al-Eiswi & Takruri, 1989). For *Phragmites australis* and *Typha domingensis* underground parts are also recorded eaten (Shaltout & Al-Sodany, 2000). *Ammi majus* young shoot eaten raw (Al-Eiswi & Takruri, 1989). *Malva parviflora* is consumed cooked especially leaves and young shoot (Shaltout et al., 2010). *Portulaca oleracea* and *Rumex dentatus* plants are also eaten raw as a salad or side dish or cooked (Al-Eiswi & Takruri, 1989). *Sonchus asper* is eaten raw (Al-Eiswi & Takruri, 1989).

Urban development's destructing natural habitats

Urban development is proceeding along the Nile Delta at an alarming rate, especially in the last four decades, where construction of new roads like the Cairo-Alexandria Agriculture road, remote sensing studies (Shalaby, 2012) indicated that during the period from 1984 to 2006, total expansion of urban area amounted to 2536.3 km^2, another study done by El-Kawy et al. (2011) who indicated that land degradation found to be mainly due to human activities, such as the formation of quarries, free water bodies, and sabkhas (a specific type of land cover found on dry lands and salt-affected soils). Another study indicated that recently unplanned, unpermitted constructions done by people during the lack of general security of the Egyptian revolution elevated the impact of land cover change and urban sprawl, the results showed that most of the Egyptian Delta governorates have been significantly affected by the different classes of land use/land cover change due to agriculture activities, urban growth as a result of human activities dynamic impact (Elagouz et al., 2020). Furthermore, it was reported that small-scale vegetation clearance in narrow strips of roadside vegetation such as roadside vegetation maintenance and fence-line maintenance in essential threatened plant habitats, besides Inappropriate maintenance and establishment of walking trails in essential threatened plant habitats (Taylor, 2012).

Several studies have reported similar findings, for instance: Ahmed et al. (2023) and Shaltout & Ahmed (2012) indicated that intensive human activities such as summer resorts construction in the Omayed and Alamein caused the habitat loss of *Lygeum spartum* plant communities, and a dramatic loss in the sand dunes (about 75%) in the Western Mediterranean desert of Egypt, respectively.

The Egyptian government is taking drastic measures to maintain control of urban encroachment and the loss of agricultural land by applying horizontal urban expansion and reclaiming more land along the desert areas and near the fringes of the Nile Delta (Hegazy et al., 2008).

Intensive agricultural practices

Productive lands in Egypt are finite and irreplaceable (FAO, 2002), consequently due to the limitation of good quality land all over Egypt, only 5.4% of the land resources in Egypt are of excellent quality, while about 40% are of poor quality mainly due to the development of salinity and sodicity problems (Abdallah et al., 2017), many cultivated areas especially the Nile Delta suffers from intensive agricultural practices causing salinity problems in the fertile soils (Alfiky et al., 2012), and application of fertilizer in or adjacent to essential or potential habitat, are expected to contributes to the rise and salinisation of water tables in areas of essential or potential threatened plant habitat (Taylor, 2012), These practices are the main cause of natural populations fragments that can lead to declining genetic viability, that likely to impact on processes involving the transfer of genetic material that may potentially lead to a decline in the affected plant populations and communities (Debinski & Holt, 2000; Fahrig & Merriam, 1994), furthermore, to meet the demanding and uprising human needs of agricultural goods lead to more intensive land use, resulting in reduction in diversity of natural flora as the agricultural practices will gradually replaces the natural plants as reported by Ahmed et al. (2014).

Conservation of the Nile Delta

Physical threats would have a dramatic effect on the structure of the Nile Delta, according to Haars et al. (2016) whose work indicated that climate change would lead to increasing sea level, and salinity; coastal erosion and seawater intrusion, would cause underground water of the delta to become salty and land lost as a consequence would indeed affect ecological services of the Nile Delta as a result of deficiency of cultivated lands, and land quality deterioration; activities that contribute greenhouse gases to the atmosphere would restrict the ability of plants to extend or shift distribution in response to a changing climate (Taylor, 2012).

Food production is one of the most important ecosystem services that will be affected by these threats (El-Nahry & Doluschitz, 2010). With a

Sea Level Raise of 0.5m, 13% of the agricultural land will be lost, together with increasing saltwater intrusion into groundwater reserves (Sušnik et al., 2014); while Sefelnasr & Sherif (2013) anticipated that the loss would be dramatic between 19% and 32% for a 1m rise in sea level.

Conclusion

It is found a range of ecosystem services supported by the Nile Delta's natural flora, and a wide range of ethnobotanical utilization including food, fodder, and medicine. In addition to, the natural ecosystem benefit, the region faces deteriorating habitat loss and even extinction as a possible outcome of alarming man-made or environmental threats. A better understanding of these factors which promotes soil disturbance in areas of essential habitat susceptible to soil erosion is needed to guide the development of more environmentally friendly measures for developing countries, and to understand how ecosystems will respond to challenging global issues such as global warming climate change.

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السلع والخدمات التي تقدمها النباتات المتوطنة بمنطقة دلتا النيل - مصر: من وجهة نظر الصون

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دلتا النيل بمصر هي واحدة من أقدم وأكبر الدلتات في العالم حيث تغطى 4٪ من مساحة مصرالكلية، وتشغل 63٪ من الأراضي المصرية المزروعة. تهدف الدراسة الحالية إلى تقييم السلع والخدمات التي يوفرها النظام البيئي الطبيعي لتلك المنطقة، تم إجراء ثلاثين رحلة ميدانية إلى مواقع مختلفة لتغطية منطقة الدراسة من ربيع 2020 إلى صيف 2022. وقد تم تسجيل 49 نوعا نباتي لهم أدوار فى السلع والخدمات وذلك بناءً على الملاحظة الميدانية والمعلومات التي تم جمعها من السكان المحليين والعشابين حيث تمت مقابلة 60 شخصًا من منطقة الدراسة، تتراوح أعمارهم من 30 إلى 60 عامًا، ومن ثم تم تقييم السلع والخدمات والأخطار التي تهدد النباتات المسجلة والتي تؤدي إلى التغيير التدريجي في البيئة الطبيعية. تقدم الأنواع المسجلة العديد من السلع مثل الرعي (36 نوعًا) الاستخدامات الطبية (26 نوعا) و الغذاء للانسان (15 نوعا). كما انها توفر خدمات بيئية تتمثل في الحشائش المنتشرة في البيئات الحضرية والبيئات الزراعية وكانت هي الاكثر تمثيلا، يليها تثبيت جدر الترع والقنوات (16 نوعا) وتقليل نمو الحشائش الضارة (6 أنواع). كما سجلت الدراسة 36 نوعا (73٪ من الانواع المسجلة) تتعرض إلى نوع واحد على الاقل من التهديدات؛ كان الإفراط في الجمع والقطع هو التهديد الأكثر شيوعًا (46.9٪)، ثم فقدان البيئات (40.8 ٪)، الرعي الجائر (34.7٪)، كذلك ازالتها كليا لزيادة المساحة المنزرعه (24.5٪)، كذلك دهس النباتات بواسطة السيارات (10٪). أوصى المؤلفون أن النباتات المتوطنة في دلتا النيل تحتاج إلى مراقبة مستمرة وحفظ، حيث تواجه المنطقة تدهورا مستمرا يؤدي إلى تدمير البيئات وانقراض النباتات بها؛ وهي التي تقدم العديد من السلع والخدمات للانسان والبيئة.