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Biodiversity of Halophytic Vegetation in Chott *Zehrez* Lake of Djelfa (Algeria)

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ABSTRACT

Mediterranean large lakes play an important role in providing a range of ecosystem functions and supporting biodiversity. The conservation and management of these lakes require more detailed knowledge of their ecology and environment-vegetation relationships. Chotts are probably the most poorly understood lake ecosystems. Chott *Zehrez* (Djelfa) as a large, shallow lake ecosystem in Algerian steppes, where wetlands are important part of their productivity. Despite the status of chott *Zehrez* lake as a Ramsar site, the main threat to its conservation is the private nature of surrounding land holdings in addition to the lack of knowledge and awareness by the local population of the importance of lake ecosystems. A wealth of halophytic flora exists which can be exploited for an array of uses like fodder, fuel wood, oilseed, medicines, landscaping, and environment conservation through carbon sequestration. A total 112 species belonging to 26 families and 39 genera were recorded. The sabkha flora includes 9 endangered and endemic species such as *Avena bromoides*, *Cutandia divaricata*, *Herniaria mauritanica* and *Salicornia arabica*. In this paper we mainly discussed characteristics and importance of Chott *Zehrez* lake ecosystem, its vegetation potentialities and economic usages will be also presented and discussed. Finally conservation strategy and restoration of this ecosystem are suggested.

Keywords: Algeria; Chott *Zehrez*; Endemic Species; Economic Potential; Halophytes; Sebkha

1. Introduction

Lakes in Algeria have, for a long time, been a source of water for humans and their livestock, especially during dry seasons. They also support a rich biodiversity and are of major importance for migratory birds and constitute wintering grounds for thousands of ducks, coots, geese, and flamingos. Currently 42 out of the 300 lakes in Algeria are listed under the Ramsar Convention covering an area of 3 million ha [1].

The most characteristic types of lake in Algeria are endorheic lakes. They consist of chotts and sebkhas, as known in Arabic, also referred to as Athalassic salt lakes. The term athalassic denotes saline waters which are isolated from the sea, or which were once connected to the sea, but which have dried out before being re-flooded by water of non-marine origin [1]. The chotts and sebkhas are typically seasonal lake which dry out in summer and re-flood in winter. According to [2], sebkha is the central zone of saline lake dominated by water and devoid of vegetation due to high salt concentrations. The chott is the surrounding zone which forms a vegetation ring around the water. This vegetation is mainly composed of halophytic, succulent and perennial species. In these environments the main factors controlling vegetation are water salinity in the growing season and the depth and period of flooding. Vegetation at the edges of the Chotts comprises mainly members of the Chenopodiaceae family (such as *Atriplex* ssp., *Salsola* ssp., *Suaeda* ssp. and *Salicornia* ssp.) Among the most important chotts in Algeria is Chott *Zehrez*, the second largest Chott in North Africa [1]. However, as far as we know, there has not been a lot of research conducted on these systems.

Several efforts were made to compile a list of the halophytic flora of the world [3] as well as a list of regional halophytes. However, the information regarding halophytes is still far from complete. The flora of Algeria is near completion and also has information about the halophytes. Currently, effort is being made to compile a list of halophytes in Algeria, with their distribution, ecology and potential economic usages.

Halophytes and other salt-tolerant plants may provide sensible alternatives for many developing countries [4]. These plants can grow in saline to extremely saline habitats and have particular characteristics which enable them to evade and/or tolerate salinity by various eco-physio-

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logical mechanisms. These plants are naturally grown in salt affected lands such as in salt lakes, marshes, sloughs, saline soils and seashores. The vegetative yields of halophytes and other salt-tolerant plants species could have great economic potentialities in the arid and semi-arid areas [5]. There are many halophytes and salt-tolerant shrubs and grasses which could be established in saline lands (e.g. *Kochia* sp., *Juncus* sp., *Acacia* sp., *Suaeda* sp., *Salsola* sp. and *Atriplex* sp.). Although economic consideration of halophytes and other salt-tolerant plants is just beginning, they are now receiving increased attention particularly in arid regions where salinity problems are very crucial.

Despite their international importance in Algeria, Chott Lakes have attracted little attention concerning their floristic composition and ecological processes. The objectives of this study are to focus on 1) the understanding the Chott *Zehrez* as a large, shallow lake ecosystem where wetlands are important and its ecological threats 2) to identify the different plant communities present in the area of Chott *Zehrez* lake and 3) to describe the economic potential use of a wide range of halophytes and other salt tolerant vegetation.

2. Site Description

The study was undertaken in a salt Chott of *Zehrez* Djelfa, which is located to the north of Algeria (3˚03'E longitude, 34˚36'N latitude) (**Figure 1**). The Chott area is about 50.985 ha and the altitude ranges from 840 m to 825 m. The geology consists mainly of cretaceous, with deposits of quaternary. According to [2] principal type of soils in Chott *Zehrez* wetland are the calci-magnesic solontchak and hydromorphic soils (gley). The Sebkha soils are characterised by saline silts, prone to flooding in winter and covered by salty crusts in summer [6]. The endorheic nature of the area and the flat relief induce water accumulation in the Chott from winter rainfall. The saline soils (solontchaks) are poorly developed and contain a high amount of exchangeable sodium and soluble salts. The texture changes from silt-clays to silt-sands [7]. Soil salinity ranges from 1.99 to 4.47 $dS \cdot m^{-1}$. The water table varies from 1 to 3 m below the surface (**Figure 2**). The climate of Chott *Zehrez* is typically Mediterranean, characterised by wet winters and hot dry summers with a mean annual precipitation of 250 $mm \cdot year^{-1}$ (2000-2010). The average minimum winter and maximum summer temperatures are 5˚C in January and 26˚C in July, respectively. The rainy season is generally from mid-October to May [8].

The natural vegetation is represented by halophytes such as *Atriplex halimus*, *Suaeda fruticosa*, *Salsola vermiculata* and *Salicornia fruticosa*. A number of rare and endemic plant species are found, including: *Herniaria mauritanica*, *Salicornia arabica*, *Avena bomoides*, *Hordeum maritimu*, *Juncus bufonius*, *Launaea resedfolia*, *Polygonum equisetforme* and *Reaumuria venniculata* [9].

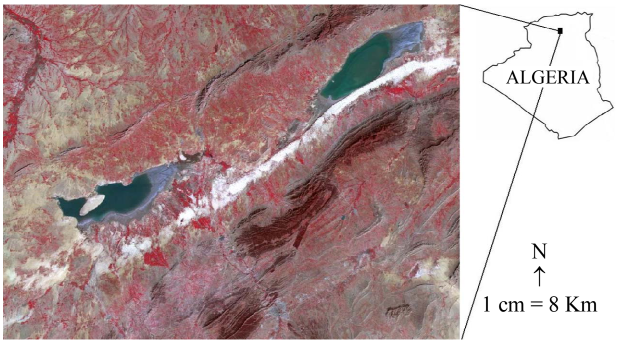

Figure 1. Location of the study area (Image LANDSAT 2001).

Figure 2. *Salicornia* sp. is often the dominant species on Chott *Zehrez* Lake, The pools of water in the foreground indicate the high level of the groundwater (Photo Senni R., 2010).

The Chott *Zehrez* lake is very important for breeding and over-wintering of many bird populations. There is a diversity of species many of which are rare and threatened. These include Outarde (*Chlamydotis undulata*), different types of ducks: *Anas penelope*, *Anas clypeata*, *Anas platyrhynchos* and other birds such as *Falco tinnunculus*; *Columba livia* and *Tyto alba*. This relatively diverse flora and fauna was a critical factor in the designation of the Chott as a RAMSAR site.

3. Halophytic Vegetation Description

The region of Chott *Zehrez* lake investigated in this study is characteristic of the salt marshes (Sebkha and Chott) situated in the northern part of Algeria (Djelfa). The results demonstrated that halophytic and hydrohalophytic communities constitute the natural vegetation of the area. 112 species belonging to 26 families and 39 genera were recorded (**Table 1**). Nine of the recorded species were endemic representing 8% of the total species. The richest

Table 1. Alphabetical listing of vegetation in Chott *Zehrez* lake of Algeria (Those with an asterisk (*) are endemic in Algeria, with two asterisks (**) are rare species).

Nbr	Species	Family	Plant type[1]	Life form[2]
01	*Aeluropus littoralis*	Poaceae	Hydrohalophyte	Chamaephyte
02	*Agropyron orientale*	Poaceae	Xerophyte	Therophyte
03	*Aizoon hispanicum*	Aizoaceae	Xerohalophyte	Therophyte
04	*Ammochloa palaestina*	Poaceae	Psammophyte	Therophyte
05	*Anacyclus clavatus*	Asteraceae	Weedy	Therophyte
06	*Anacyclus cyrtolepidioides**	Asteraceae	Xerophyte	Therophyte
07	*Artemisia campestris*	Asteraceae	Psammophyte	Phanerophyte
08	*Artemisia herba-alba*	Asteraceae	Psammophyte	Phanerophyte
09	*Arthrocnemum indicum*	Chenopodiaceae	Hydrohalophyte	Phanerophyte
10	*Arthrophytum schmittianum*	Chenopodiaceae	Halophyte	Phanerophyte
11	*Arthrophytum scoparium*	Chenopodiaceae	Halophyte	Phanerophyte
12	*Astragalus cruciatus*	Fabaceae	Xerohalophyte	Chamaephyte
13	*Astragalus tenuifoliosus*	Fabaceae	Xerohalophyte	Chamaephyte
14	*Atractylis carduus*	Asteraceae	Psammophyte	Chamaephyte
15	*Atriplex glauca*	Chenopodiaceae	Xerohalophyte	Phanerophyte
16	*Atriplex halimus*	Chenopodiaceae	XeroHalophyte	Phanerophyte
17	*Atriplex portulacoides*	Chenopodiaceae	XeroHalophyte	Phanerophyte
18	*Avena bromoides***	Poaceae	Weedy	Hemicryptophyte
19	*Bassia muricata*	Chenopodiaceae	Xerohalophyte	Therophyte
20	*Beta macrocarpa*	Chenopodiaceae	Xerohalophyte	Phanerophyte
21	*Biscutella auriculata*	Brassicaceae	Xerophyte	Therophyte
22	*Bupleurum semicompositum*	Apiaceae	Weedy	Therophyte
23	*Centaurium pulchellum*	Gentianaceae	Psammophyte	Chamaephyte
24	*Cordylocarpus muricatus**	Brassicaceae	Weedy	Therophyte
25	*Coronopus squamatus*	Brassicaceae	Xerohalophyte	Therophyte
26	*Cressa cretica*	Convolvulaceae	Hydrohalophyte	Chamaephyte
27	*Ctenopis pectinella*	Poaceae	Psammophyte	Therophyte
28	*Cutandia dichotoma*	Poaceae	Psammophyte	Therophyte
29	*Cutandia divaricata***	Poaceae	Psammophyte	Therophyte
30	*Cynodon dactylon*	Poaceae	Weedy	Chamaephyte
31	*Diplotaxis harra*	Brassicaceae	Psammophyte	Therophyte
32	*Enarthrocarpus clavatus**	Brassicaceae	Xerophyte	Therophyte
33	*Erodium glaucophyllum*	Geraniaceae	Xerophyte	Therophyte
34	*Euphorbia falcata*	Euphorbiaceae	Weedy	Therophyte
35	*Frankenia pulverulenta*	Frankeniaceae	Psammophyte	Therophyte
36	*Frankenia thymifolia**	Frankeniaceae	Psammophyte	Therophyte
37	*Halocnemum strobilaceum*	Chenopodiaceae	Xerohalophyte	Phanerophyte

Continued

38	*Halogeton sativus*	Chenopodiaceae	*Xerohalophyte*	*Phanerophyte*
39	*Halopeplis amplexicaulis*	Chenopodiaceae	*Xerohalophyte*	*Phanerophyte*
40	*Hedypnois cretica*	Asteraceae	Weedy	Therophyte
41	*Helianthemum hirtum**	Cistaceae	Psammophyte	Chamaephyte
42	*Helianthemum kahiricum*	Cistaceae	Psammophyte	Chamaephyte
43	*Helianthemum lippii*	Cistaceae	Psammophyte	Chamaephyte
44	*Herniaria fontanesii*	Paronychioideae	Xeropgypsophyte	Chamaephyte
45	*Herniaria hirsuta*	Paronychioideae	Xeropgypsophyte	Hemicryptophyte
46	*Herniaria mauritanica**	Paronychioideae	Xeropgypsophyte	Chamaephyte
47	*Hordeum maritimum***	Poaceae	Hydrohalophyte	Chamaephyte
48	*Hutchinsia procumens*	Brassicaceae	Xerohalophyte	Therophyte
49	*Inula crithmoides*	Asteraceae	Hydrohalophyte	Chamaephyte
50	*Imperata cylindrica*	Poaceae	Psammophyte	Phanerophyte
51	*Juncus bufonius***	Juncaceae	Hydrohalophyte	Therophyte
52	*Juncus maritimus*	Juncaceae	Hydrohalophyte	Phanerophyte
53	*Koeleria pubescens*	Poaceae	Psammophyte	Therophyte
54	*Koelpinia linearis*	Asteraceae	Weedy	Therophyte
55	*Launea nudicaulis***	Asteraceae	Xerohalophyte	Chamaephyte
56	*Launea resedifolia***	Asteraceae	Psammophyte	Chamaephyte
57	*Limoniastrum guyonianum**	Plumbaginaceae	Xerohalophyte	Chamaephyte
58	*Limonium echioides*	Plumbaginaceae	Hydrohalophyte	Phanerophyte
59	*Limonium pruinosum*	Plumbaginaceae	Hydrohalophyte	Therophyte
60	*Limonium sinuatum*	Plumbaginaceae	Hydrohalophyte	Phanerophyte
61	*Limonium thouini*	Plumbaginaceae	Hydrohalophyte	Therophyte
62	*Loefflingia hispanica*	Caryophyllaceae	Psammophyte	Therophyte
63	*Lolium rigidum*	Poaceae	Psammophyte	Phanerophyte
64	*Lotus corniculatus*	Fabaceae	Psammophyte	Phanerophyte
65	*Lygeum spartum*	Poaceae	Psammophyte	Phanerophyte
66	*Malva aegyptiaca*	Malvaceae	Xerophyte	Therophyte
67	*Morettia canescens*	Brassicaceae	Xerophyte	Therophyte
68	*Nitraria retusa*	Zygophyllaceae	XeroHalophyte	Chamaephyte
69	*Noaea mucronata*	Chenopodiaceae	XeroHalophyte	Chamaephyte
70	*Onopordon arenarium**	Asteraceae	Psammophyte	Hemicryptophyte
71	*Papaver hybridum*	Papaveraceae	Xerophyte	Therophyte
72	*Peganum harmala*	Zygophyllaceae	Psammophyte	Chamaephyte
73	*Pholiurus uncurvus*	Poaceae	Weedy	Therophyte
74	*Phalaris minor*	Poaceae	Hydrohalophyte	Therophyte
75	*Phragmites communis*	Poaceae	Hydrohalophyte	Phanerophyte
76	*Pistacia atlantica**	Anacardiaceae	Xerophyte	Phanerophyte

Continued

77	*Plantago albicans*	Plantaginaceae	Psammophyte	Therophyte
78	*Poa bulbosa*	Poaceae	Psammophyte	Chamaephyte
79	*Polygonum equisetiforme***	Polygonaceae	Xerohalophyte	Chamaephyte
80	*Pteranthus dichotomus*	Paronychioideae	Xerogypsophyte	Therophyte
81	*Puccinella distans*	Poaceae	Hydrohalophyte	Chamaephyte
82	*Reaumuria vermiculata***	Tamaricaceae	Hydrohalophyte	Chamaephyte
83	*Salicornia arabica***	Chenopodiaceae	Hydrohalophyte	Therophyte
84	*Salsola sieberi*	Chenopodiaceae	Xerohalophyte	Chamaephyte
85	*Salsola tetragona*	Chenopodiaceae	Xerohalophyte	Phanerophyte
86	*Salsola tetrandra*	Chenopodiaceae	Xerohalophyte	Phanerophyte
87	*Salsola vermiculata*	Chenopodiaceae	Xerohalophyte	Phanerophyte
88	*Schismus barbatus*	Poaceae	Psammophyte	Therophyte
89	*Schoenus nigricans*	Cyperaceae	Hydrohalophyte	Phanerophyte
90	*Scirpus holoschoenus*	Cyperaceae	Hydrohalophyte	Hemicryptophyte
91	*Sisymbrium coronopifolium*	Brassicaceae	Xerophyte	Therophyte
92	*Sisymbrium runciatum*	Brassicaceae	Xerophyte	Therophyte
93	*Sisymbrium torulosum*	Brassicaceae	Xerophyte	Therophyte
94	*Spergularia diandra*	Paronychioideae	Xerohalophyte	Phanerophyte
95	*Spergularia marginata*	Paronychioideae	Xerohalophyte	Phanerophyte
96	*Sphenopus divaricatus*	Poaceae	Hydrohalophyle	Therophyte
97	*Stipa barbata*	Poaceae	Psammophyte	Phanerophyte
98	*Stipa lagascae*	Poaceae	Psammophyte	Phanerophyte
99	*Stipa parviflora*	Poaceae	Psammophyte	Phanerophyte
100	*Stipa tenacissima*	Poaceae	Psammophyte	Phanerophyte
101	*Suaeda fruticosa*	Chenopodiaceae	Xerohalophyte	Phanerophyte
102	*Suaeda mollis*	Chenopodiaceae	Xerohalophyte	Phanerophyte
103	*Tamarix africana*	Tamaricaceae	Xerohalophyte	Phanerophyte
104	*Tamarix boveana*	Tamaricaceae	Xerohalophyte	Phanerophyte
105	*Telephium imperati*	Paronychioideae	Xerophyte	Hemicryptophyte
106	*Thapsia garganica*	Apiaceae	Weedy	Hemicryptophte
107	Thymelaea microphylla*	Thymelaeaceae	Psammophyte	Chamaephyte
108	*Thymelaea virgata*	Thymelaeaceae	Psammophyte	Chamaephyte
109	*Traganum nudatum*	Chenopodiaceae	Xerohalophyte	Chamaephyte
110	*Trifolium fragiferum*	Fabaceae	Psammophyte	Chamaephyte
111	*Vicia monantha*	Fabaceae	Hydrohalophyte	Therophyte
112	*Zygophyllum cornutum**	Zygophyllaceae	Xerohalophyte	Phanerophyte

[1]Plant type: This category is based on the habitats in which the taxon is distributed: Hydrohalophyte: Present in salt marshes; Xerophyte: Desert specie; Xerogypsophyte: Plant found on gypsum soils; Xerohalophyte: Salt desert specie; Psammophyte: Sand loving plant found on inland sand dunes; Weedy: Fugitive species; [2]Life form: Only one life form is assigned per species, even though many species show a certain amount of plasticity in this regard: Phanerophyte: The buds were located at more than 50 cm of the soil (>50 cm tall); Chamaephyte: The buds were located at less than 50 cm of the soil (<50 cm tall); Therophytes: Germination occurs during the rainy season; Hemicryptophyte: The buds were located on the surface of the soil.

families were Chenopodiaceae, Poaceae and Plumbaginaceae. Phanerophytes, Chamaephytes and Therophytes were the most frequent life forms. The highest number of halophyte species is present in the Chenopodiaceae family (19), followed by Poaceae (6), Plumbaginaceae (5), Fabaceae (3) and Tamaricaceae (3), while other families are represented by less than 16 halophytes (**Table 1**).

4. Utilization and Economic Potential of Halophytes

Halophytes have their greatest potential not so much in contributing to the world's food supply but primarily in their utilization of the growing areas of saline land for a range of different goals. The most important opportunities relate to reforestation or replanting and ecological recovery of saline areas that have fallen into disuse, coastal development and protection, and the production of cheap biomass for renewable energy, climate improvement and CO_2 sequestration [10].

Halophytes seem to have much potential as a land cover cannot be denied, which is not only aesthetically pleasing but also checks land erosion and degradation. The more important opportunities relate to reforestation or replanting and ecological recovery of saline areas that have fallen into disuse, coastal development and protection, production of cheap biomass for renewable energy, environment conservation through carbon (C) sequestration, stabilization of coasts and beaches; and support to development of wild-life sanctuary and recreation areas [11].

4.1. Food

The only conventional crops species consumed by human beings as food, which tolerate salinity to a certain extent are beets (*Beta vulgaris*) and the date palm (*Phoenix dactylifera*), which can be irrigated with brackish water. The young leaves and shoots of *Sesuvium portulacastrum*, *Atriplex halimus* and *A. hortensis*, have also been used for vegetables, salads in various parts of the country [10].

4.2. Forages and Fodders Production

Halophytes are naturally adapted to vast areas of salt-affected range lands [12,13] and they have been grazed or browsed by animals for a long time. Halophytic grasses, shrubs and trees are all potential sources of fodder. The greatest potential of halophytes probably rests with their utilization as forages and fodder.

The foliage of such species as *Atriplex* spp., *Salsola* spp. and *Puccinellia* spp., are used cattle feed. Many species of *Salicornia* spp., *Chenopodium* spp., *Suaeda* spp. and *Kochia* spp. are common fodder shrubs. Among grasses, *Aeluropus litorallis*, *Poa bulbosa*, *Phragmites communis*, *Schismus barbatus*, and *Puccinellia distans* are common species found in saline and alkaline areas and used as forages [14].

Many of the halophytic plant species and salt-tolerant species provide a valuable reserve feed for grazing animals particularly under drought conditions or fill regular gaps in feed supply caused by seasonal conditions [15]. The value of certain halophytic species has been recognized by their incorporation in pasture improvement programs in many salt-affected regions throughout the world [16]. There have been recent advances in selecting species with high biomass and protein levels and the ability to survive a wide range of environmental conditions including salinity [17]. *Atriplex halimus* has been field tested for domestic livestock and found to produce good fodder with biomass varied from 0.5 to 5 $t \cdot DW \cdot ha^{-1}$. This productivity is mainly related to the water availability and soil depth [17].

4.3. Oil Seeds

Seed of many halophytes contain appreciable amount of edible oils [18]. Seeds of various halophytes, such as *Suaeda fruticosa*, *Arthrocnemum* spp., *Salicornia* spp. and *Halogeton* spp. possess a sufficient quantity of high quality edible oil with unsaturation ranging from 70% - 80% [19]. Thus, the exploration of economically important halophytes species may constitute an alternative source of edible oil.

4.4. Fuel Wood and Coal

Moderately to highly salt-tolerant trees, which can provide a range of wood and non wood products as well as other benefits are available. One of the most common uses of trees biomass is firewood [20].

In many developing countries people rely on wood for cooking and heating. Quite often fuel wood is obtained from salt tolerant trees and shrubs, which may include species of *Prosopis* spp., *Tamarix* spp., *Salsola* spp., *Atriplex* spp. *and Suaeda* spp. In addition species like *Tamarix aphylla*, *and T. africana* could provide good quality wood and also contribute to charcoal production [14].

In areas of moderate to high salinity, highly salt tolerant species, especially within the genus *Acacia*, which may have fuelwood value, may be used. The use of woody halophytes like mangrove as a source of charcoal for many years is a good example of using halophytes as fuel crop. Nevertheless, the anthropogenic impact, particularly the overcutting of these mangrove trees for wood, is increasing desertification in these areas [20].

4.5. Medicinal Uses

Many workers have reported the medicinal uses of halophytes while describing the economic importance of plants [21,22]. Halophytic plants are known to provide relief in the following diseases: *Limonium* spp.: Stop bleeding, promote urination and astringe; *Glycyrrhiza spp.*: Stop coughing, clean lungs; *Apocynum venetum*: Reduce blood pressure, strengthen heart and promote urination; *Nitraria* spp.: Normalize menstruation, promote blood circulation, help digestion and strengthen the spleen; *Atriplex halimus*: Antidiabetic effects; *Plantago spp.*, *Zygophyllum* spp.: Flu and cough; *Salsola tetrandra*: Vermifuge; *Plantago major*: Diuretic [14].

5. Restoration

Globally, the ecology and importance of Chott lake ecosystems have been largely neglected. Chotts are probably the most poorly understood ecosystems, being neither good land, nor good water. Despite the status of Chott *Zehrez* as a Ramsar site, the main threat to its conservation is the private nature of surrounding land holdings in addition to the lack of knowledge and awareness by the local population of the importance of chott ecosystems. The development of any Chott conservation strategy in Algeria is also hindered by the lack of coordination between the ministries of environment and agriculture, as is common in many Mediterranean countries [1]. Furthermore, engaging local stakeholders in the development of conservation strategies often occur in the absence of any consideration of biodiversity issues. In Algeria for instance, there is no restriction on farmers to grow crops next to the Chott, neither is there a limit to livestock numbers. Therefore, continuing degradation by grazing and cultivation is resulting in the loss of habitats and associated species.

The local authorities should consider stricter control on damaging activities to these plant communities such as vegetation removal, cultivating or grazing. At the same time campaigns promoting the value of such ecosystems, the involvement of local communities and educational programs are necessary to raise local awareness and assist in the long term conservation of these ecosystems.

It is concluded that salt marshes are an integral component of the Chott lake ecosystem, serving as important areas of primary production for inland food chains. They are also an important habitat for the production of grazing animals. However, the diversity of the halophytes and other natural recourses in the salt lake in Algeria are, unfortunately, facing dangerous impacts due to the uncontrolled human interference. Many plant, animal, bird's species are either endangered or even exterminated. Such bad environmental situation and interference need urgent solutions through the conservation and sustainable use of the halophytic vegetation and its ecosystem in the salt marshes by applying several approaches such as:

1) Preserve the genetic resources of these species in the Algerian National Gene Bank,

2) Restoring the endangered species in its habitats,

3) Cultivating the economic halophytes species or crops of salinity resistant in habitat by using saline and brackish water of the lakes, and

4) Cultivating the multi-purposes halophytic species.

The feasibility of growing halophytes on salt Chott can be maximized with plant species that in addition to its primary product can also provide indirect and economical benefits.

The conservation and sustainable utilization of Chott lake ecosystem can be achieved through the development of appropriate legislation and laws to improve local community participation in decision-making, regulating access and utilization of rangelands. In addition, information and dissemination systems, and cooperation and coordination mechanisms should be established among national institutions.

6. Conclusions

Chott *Zehrez* lake, located in the north of Algeria, is a good example as a Ramsar site of international importance. The future conservation and management of the site therefore, require more detailed knowledge of their ecology and biodeversity. This review summarized the benefits and the constraints of halophytes and other salt-tolerant plants as economic potential resources in Chott *Zehrez* lake. It is concluded that:

- Halophytes and salt-tolerant species yield high edible biomass in saline lands where non-halophytic species cannot grow.
- The study has provided a clearer vision and recommendations to researchers and policy makers with regard to underutilized halophytic species and the importance of exploiting the potential of same in the future.
- In the view of the previous forecasts, it is necessary to emphasize that Chott lake ecosystem in fact demands urgent management action to conserve its threatened and unique ecosystem.

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