INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 11, No. 5, p. 237-250, 2017
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Assessment of the effect of major anthropogenic factors and current conservation status of indigenous vegetation in degraded rangeland of Cholistan desert, Pakistan

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Article published on November 30, 2017

Key words: Vegetation, Anthropogenic factors, Conservation status

Abstract

Assessment of Anthropogenic factors and current conservation status of indigenous flora of Cholistan desert is the main aim of this study. Questionnaire based survey; key informant interviews, direct observation and group discussion were used for data collection from ten range sites. 62 range species which belongs to 47 genera and 24 families were identified which includes 06 species of trees, 14 species of shrubs, 3 species of subshrubs, 20 species of herbs,1 species of sedge and 18 species of grasses. Family importance index showed that Poaceae is most dominant family with 18 species followed by Aizoaceae, Chenopodiaceae, and Mimosaceae having 4 species each. By Raunkiaerian life form, recognized species were found as therophytes (37%), phanerophytes (26%), chamaephytes (19%), hemicryptophyte (16%) and cryptophyte (2%) respectively. Anthropogenic factors showed that 07 species (11.29%) were exploited by all four factors (TW, FW, M, F), 13 species (20.91%) were exploited by three factors (FW, M, F), 18 species (29.03%) were exploited by two factors (M,F) and 24 species (38.7%) were exploited by single factor (F). Grazing is main cause of floral degradation. Conservation status of indigenous vegetation in current findings revealed that 11 species (17.74%) were found as "Least Concern", 22 species (35.48%) were found as "Near Threatened" 20 species (32.48%) were found as "Vulnerable", 7 species (11.29%) were found as "Endangered" and 2 species (3.22%) were found as "Critically Endangered". It is concluded that the vegetation of Cholistan is in pressure due to deforestation, removal of medicinal plants and overgrazing. The vegetation cover is at edge of extinct from the whole rangeland. Conservation of Cholistan flora is highly recommended for future generations.

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Introduction

Ecosystems which carry natural and native vegetation of scattered trees, shrubs, grasses and herbs those are suitable for grazing and browsing for livestock are called rangeland (Mannetje, 2002). Globally 18% to 80% of the total earth's land surface are rangelands (Mitchell and Joyce, 2000; Lund, 2007). According to Society for Range Management (2005), globally rangelands are divided by vegetation types as follows: woodland 12%, shrubland 23%, and grassland 42%, while other vegetation types occupy 23% of the earth's land surface. Total geography area of Pakistan, is 79.6 million hectares. Approximately 60 percent of these total areas are rangelands which is 52.3 million ha. Only 5 percent (2.35 million ha) of this rangeland area situated in the high precipitation receiving mountainous region such as Alpine pastures and Himalayan grazing lands but remaining 95 percent (50 million ha) are arid or semi-arid rangelands (FAO,2016). These arid or semi-arid rangelands are characterized by degraded vegetation, high temperature, high rate of evaporation, low precipitation and topographic limitations but on the other side these are providing approximately 60 percent of feed for goats, sheep and cattle and nearly 20 percent for horses, donkeys, and camels (Iqbal *et al*., 2000).

Rangeland degradation shows an undesirable variation towards diminished sustainability. Environmental destruction, uncontrolled grazing, long term agriculture practices and change in land use pattern are the major's reasons of desertification (Reynolds *et al*., 2007). Rangelands ecosystem faces several anthropogenic threats such as population pressure, urbanization, social changes, rotational settlement of nomadic peoples, over exploitation of medicinal plants and high stocking rate beyond carrying capacity. These factors increase the rate of soil erosion, deforestation, water depletion and salinization. In result, 20% of the world's rangeland is degraded, including 22% of Asia's and 25% of Africa's (Abdi *et al*., 2013). Pakistani rangelands are also degrading due to nomadic grazing, excess of unpalatable species, unpredicted climatic conditions, deforestation and unscientific management of water resources (Iqbal *et al*., 2000).

Cholistan was once green and flourishing land, where cultivation was practiced. The source of irrigation water was Hakra River (Akbar *et al.,* 1996). The climate of this area is arid, hot subtropical and monsoonal rainfalls are very inconsistent both in quantity and duration with prolonged droughts common every 10 years (Farooq *et al.,* 2010). The vegetation consists of xerophytes, adapted to extreme seasonal temperatures, moisture fluctuations and wide variety of edaphic conditions in this region. These plant species, though very slow growing, respond very well to the favorable climatic conditions and provide ample biomass for consumption by livestock and wildlife (Akbar and Arshad, 2000; Arshad *et al*., 2006). But now its productivity potential is on the decline in spite of the fact that the number of animals in the desert is on the increase whereas bio-resources are on the decrease. Habitat degradation due to various anthropogenic factors like Continuous increase in human population, change in land use pattern, multiplying number of livestock and illegal cutting of woody plants by the local inhabitants for construction purpose, fuel wood and cloth washing has extremely damaged the vegetation cover of the area (Iqbal *et al*., 2000). Therefore, floral diversity of Cholistan rangelands had declined to one third. Surface temperature has been increased due to reduction in vegetation. As a result, evaporation rate of limited rainfall has been increased during the last two decades and finally reduced the effective rainfall availability for range vegetation and groundwater recharge, which is recognized as self-reinforcing feature for desertification (Abdullah *et al*., 2013)

Vegetation cover of Cholistan desert is shrinking day by day due to sever climatic conditions, anthropogenic factors, nomadic grazing and over exploitation of range resources. Already no conservational steps have been taking in Cholistan desert because of unavailability of baseline data. In order to preserve the optimal vegetation cover and reasonable usage of range resources in future, information relating key species of Cholistan desert and current conservation status of these species is very important.

Therefore, this study was being planned to identify key species of Cholistan desert, major anthropogenic factors those put adverse impact on vegetation and in result current conservation status of vegetation. On the bases of these findings to chalk out conservation strategy to preserve indigenous flora of Cholistan desert.

Material and method

Description of study area

The present study was conducted in Cholistan desert. It is located in South-West of Punjab (Pakistan) and lies between latitude 27°42' and 29°45' North and longitudes 69°52' and 75°24' East (Fig. 01). This desert is covering 2.6 million hectares, with a length of around 480km and its breadth varies between 32km to 192km (Akhter and Arshad, 2006). The soils of desert are categorized as either saline with pH ranges from 8.2 to 8.5 or saline sodic; with pH varied from 8.9 to 9.7 (Noureen *et al.*, 2008). The climatic condition of Cholistan desert is characterized by high temperature, low rainfall and high evapotranspiration rate. In summer, temperature may reach to 51°C and in winter it drops down below freezing point (Hameed, 2002; Arshad *et al.*, 2008). May and June are the hottest months with mean temperature 36°C. Average annual rainfall varies from 100 mm to 200mm (Fig. 2). 90% of this rainfall is received during monsoon season (June-September) and 10% is contributed by winter rains (January-March) (Arshad *et al.*, 2006). According to existing record, during 2015 Cholistan desert received 511.3mm rainfall which is highest amount of last ten years (Fig. 3).

Vegetation of Cholistan desert mostly consists on xerophytes species which included a wide variety of nutritive species of grasses, shrubs, herbs and trees. Although, these vegetation are slow growing and having short life span but respond very well under favorable climatic conditions and provide ordinary biomass for livestock consumption. Important genera of grasses include Cenchrus, Lasiurus and Panicum and while significant genera of browses include Acacia, Calligonum, Haloxylon, Prosopis and Zizyphus (Naz, 2011).

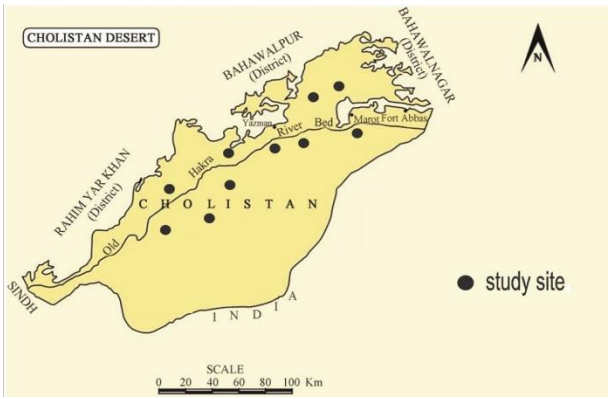

Fig. 1. Map of study area showing study site.

Reconnaissance survey and selection of study sites

Regular reconnaissance surveys was conducted from January 2015 to December 2016. By following topographic map of the area, the entire area was divided into ten study sites to cover the variations of physiognomy and physiography (Table 1). The selection of these study sites were based on the altitude, physiognomy, aspect, degradation stage and floristic composition of the area. The data was collected in all the four seasons.

Table 1. Name, Topography, Coordinates and Elevation of study sites.

Sr. No.	Name of Site	Topography	Coordinates	Elevation
01	Derawar Fort	Interdunal sandy	N: 29°21.462´ E: 071°38.557´	339 ft.
02	Dingarh Fort	Clayey saline	N: 28°59.445´ E: 071°55.912´	370 ft.
03	Chananpir	Interdunal sandy	N: 28°53.824´ E: 071°40.157´	358 ft.
04	Khirsir	Sandunal	N: 29°11.409´ E: 072°18.549´	388 ft.
05	Kalapahar	Clayey saline	N: 29°12.441´ E: 072°07.572´	391 ft.
06	Mansora	Sandunal	N: 29°22.061´ E: 072°19.447´	396 ft.
07	Haiderwali	Clayey saline	N: 29°03.678´ E: 072°11.205´	380 ft.
08	Chaklihar	Interdunal sandy	N: 29°17.415´ E: 071°59.748´	396 ft.
09	Mojgarh Fort	Sandunal	N: 29°03.259´ E: 072°09.206´	383 ft.
10	Januwali	Interdunal sandy	N: 29°07.556´ E: 072°13.967´	413 ft.

Collection of Plants

The study area was thoroughly surveyed and complete specimen of the individual species were collected in triplicate, dried, preserved and mounted on standard herbarium sheets. Identification of the species was carried out with the help of available literature (Nasir and Ali, 1971-1994; Ali and Qaisar, 1995-2004) and confirmed at National Herbarium, National Agriculture Research Council (NARC) Islamabad, and Cholistan Institute of Desert Studies, Islamia University of Bahawalpur. Nomenclature follows mostly after the Flora of Pakistan (Nasir and Ali 1970-1979; Stewart, 1972; Ali and Nasir 1989-1992; Ali and Qaiser, 1993-2007).

Questionnaires Based Survey

Questionnaire contains both open ended and close ended survey questions. To collect the information from ten selected site 100 randomly households were choosen. This questionnaire evaluates the information about major anthropogenic factor through which indigenous vegetation are exploited. The questionnaire was prepared in English and translated to Seraiki (Urdu) language in order to make it understandable to the local respondents. To undertake the questionnaires properly enumerators were recruited and orientation was given.

Life form, Life span and Habit of plants

Life form or bio spectrum is defined as the relative proportion of different life form for a given region. The plants classification into different life form classes found in the area followed by (Raunkiaer, 1934; Mueller-Dumbois and Ellenberg, 1974).

Different life forms are included Therophytes, Geophytes, Hydrophytes, Hemicrytophytes, Chamaeophytes and Phanerophytes. It is calculated by following formula;

$$\text{Bio spectra} = \frac{\text{Number of species falling in a particular life form classes}}{\text{Total number of all the species for that community/stand}} \times 100$$

Life span such as annual and perennial and habit of plants like as herbs, shrubs, subshrubs and trees were also determined.

Conservation Status Assessment (CSS)

The scale of conservation assessment was established according to criteria of IUCN for threatened categories Version 3.1 (IUCN 2001). Six categories in the present study were concentrated which were derived from nine different categories of IUCN.

The plant species were then categorized into Extinct, Critically Endangered, Endangered, Vulnerable, Near Threatened and Least Concern and Data Deficient (Table. 02). Conservation Status Scale

$$\text{(CSS)} = \frac{\text{Total number of individuals of a species at different localities}}{\text{Total number of localities visited}} \times 100$$

Table 2. For different threatened categories CSS value should fall in this ranges.

Extent	0
Critically Endangered	0<CE≤1
Endangered	1<E≤2
Vulnerable	3<V≤3
Near Threatened	3<NT≤4
Least Concern	4<LC≤5
Data Deficient	5<DD≤6

Statistical Analysis

Microsoft Excel spreadsheet analysis (MS OFICE, 2014) was used to tabulate the collected data and calculated simple averages, percentage and mean values to draw graphs (Mc Cullough and Heiser, 2008).

Results and discussion

Floristic Composition

Total 62 species belonging to 47 genera and 24 families were identified from study area. Family importance index (Table 3) showed that Poaceae was dominant family with 12 genera and 18 species (29.03%) followed by Aizoaceae with 4 genera, Chenopodiaceae with 3 genera, and Mimosaceae with 2 genera, having 4 species (6.45%) each, Capparidaceae with 3 genera, Asteraceae with 2 genera, Zygophyllaceae with 2 genera and Fabaceae with 1 genera, having 3 species (4.83%) each, Convolvulaceae with 2 genera, Asclepiadaceae with 2 genera, Rhamnaceae with 1 genera and Boraginaceae with 1 genera, having 2 species (3.22%) each and Tamaricaceae, Scrophulariaceae, Polygonaceae, Salvadoraceae, Papilionaceae, Neuradaceae,

Euphorbiaceae, Molluginaceae, Cyperaceae, Cucurbitaceae, Amaranthaceae, and Brassicaceae with 1 genera each, having 1 species (1.61%) each respectively. The biodiversity of semiarid and arid lands is recently become more important as recognized these dry lands are occupied more than 40 percent of Earth's land surface have to support more than one billion people (Donaldson *et al*., 2003). The natural flora and vegetation being the primary producers play the most pivotal role in every ecosystem by providing food and shelter to the natural fauna and livestock (Xueli and Halin 2003).

Current findings are in line with the floristic studies conducted by Ahmad *et al*., (2017) in biodiversity Park of Derawar Fort (A part of Cholistan desert) in which total 68 plant species belonging to 51 genera and 23 families were recorded. The dominance of Poaceae family is also in line with the findings of Rafay *et al*., (2013). Who reported 27 grass species from Cholistan desert. Similar studies have been carried out in different parts of Pakistan (Arshad and Rao, 1994; Arshad and Rao, 1995; Arshad and Akbar, 2002; Wariss *et al*., 2013; Wariss *et al*; 2014; Wariss *et al*., 2015).

Table 3. Family importance index.

S. No.	Families	No of Genera	No of Species	Percentage
01	Poaceae	12	18	29.03
02	Aizoaceae	4	4	6.45
03	Chenopodiaceae	3	4	6.45
04	Mimosaceae	2	4	6.45
05	Capparidaceae	3	3	4.83
06	Asteraceae	2	3	4.83
07	Zygophyllaceae	2	3	4.83
08	Fabaceae	1	3	4.83
09	Convolvulaceae	2	2	3.22
10	Asclepiadaceae	2	2	3.22
11	Rhamnaceae	1	2	3.22
12	Boraginaceae	1	2	3.22
13	Tamaricaceae	1	1	1.61
14	Scrophulariaceae	1	1	1.61
15	Polygonaceae	1	1	1.61
16	Salvadoraceae	1	1	1.61
17	Papilionaceae	1	1	1.61
18	Neuradaceae	1	1	1.61
19	Euphorbiaceae	1	1	1.61
20	Molluginaceae	1	1	1.61
21	Cyperaceae	1	1	1.61
22	Cucurbitaceae	1	1	1.61
23	Amaranthaceae	1	1	1.61
24	Brassicaceae	1	1	1.61
Total		47	62	100

Plant Habit

This classification shown that out of total 62 species, 06 (10%) species were trees, 14 (22%) species were shrubs, 3 (5%) species were sub shrubs, 20 (32%) species were herbs, 18 (29%) species were grass and1 species (2%) was sedge (Fig. 04). Earlier, Wariss *et al*., (2013) recorded 75 species of herbs, 34 species of grasses, 21 species of shrubs, 10 species of trees, 9 species of subshrubs and 2 species of sedges from this area. Our work also corroborate with the work of some other scientists in this area (Wariss *et al*., 2014; Rafay *et al*., 2013; Abdullah *et al*., 2013).

Life Form

Life form distributions are followed by Raunkiaerian classification. Result revealed as therophytes (37%), phanerophytes (26%), chamaephytes (19%), cryptophyte (2%) and hemicryptophyte (16%) respectively (Fig. 05). Therophytes were the dominant one followed by phanerophytes and chamaephytes. Extreme climatic conditions (Low rainfall, High temperature), overgrazing and anthropogenic pressure are the most important factors in the dominant of therophytes (Raunkiaer, 1934).

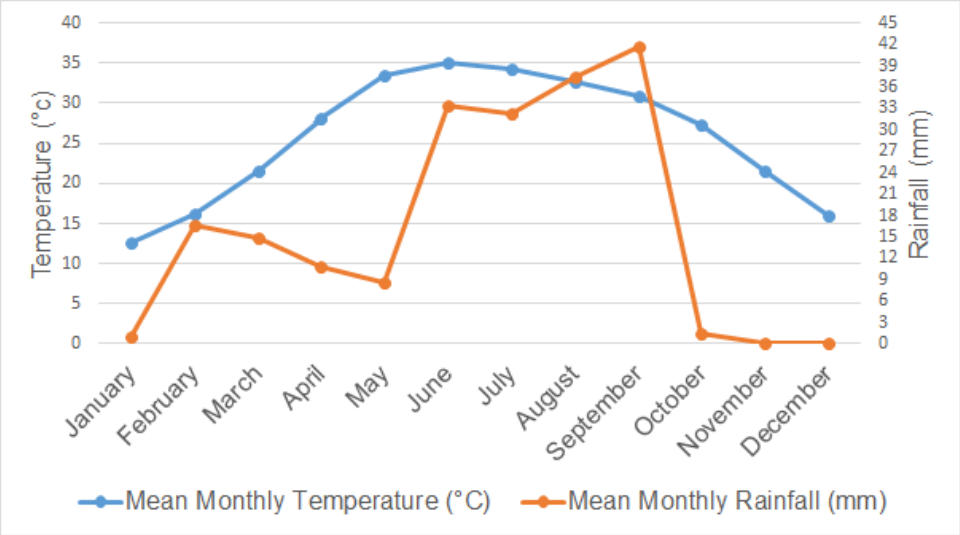

Fig. 2. Ombrothermal diagram of Cholistan desert during 2011-2016

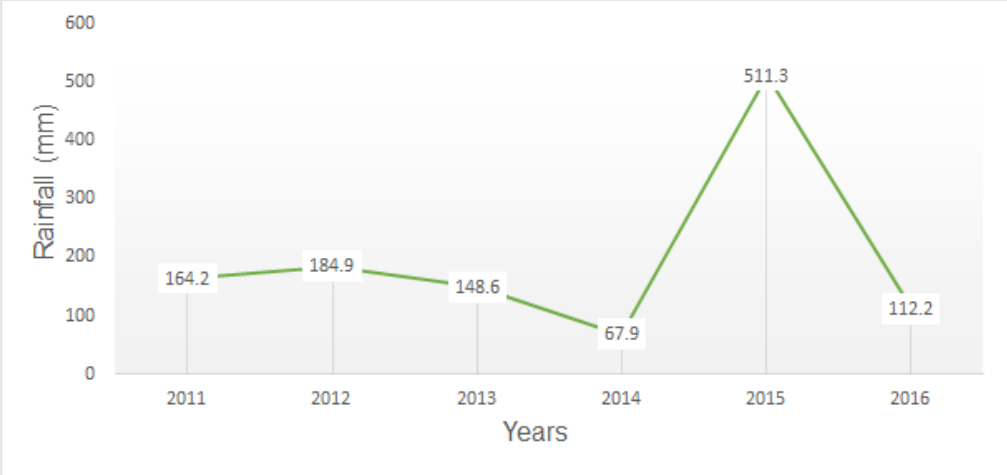

Fig. 3. Mean Rainfall per year during 2011-2016

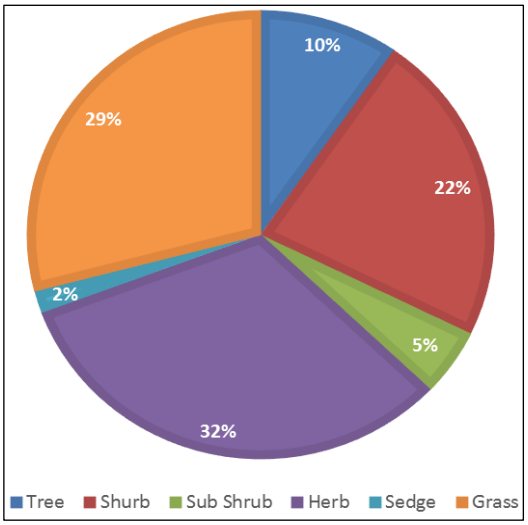

Fig. 4. Habit-wise distribution of identified species.

According to Jafari *et al.*, (2016), therophytes could tolerate adverse ecological conditions, dryness and coldness which are prevailed in many regions of the world. Durrani *et al.*, (2010) revealed that the therophytes were dominant in over grazed and degraded vegetation. Kapoor and Singh (1990) reported that the therophytic species were dominant in nomadic grazing sites while the controlled grazing and less disturbed site showed a shift towards hemi-cryptophytic flora.

Life Span

Result relating to Life span of species shown that 39 species (63%) were perennial and 23 species (37%) were annuals (Fig. 6).

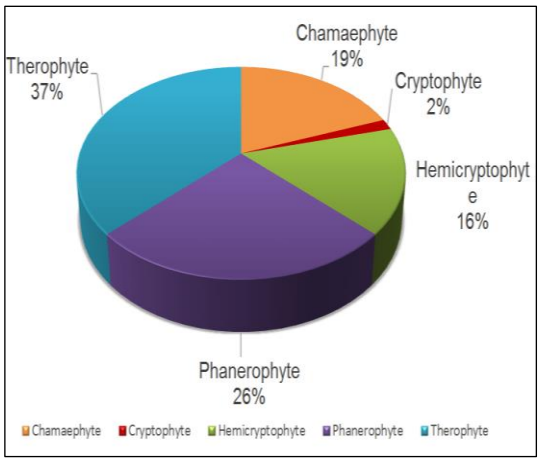

Fig. 5. Life form distribution of identified species.

Rainfall is main environmental factor responsible for plant growing in Cholistan (Arshad *et al*., 2008).

The dominance of perennials plant species is proof of aridity. Cholistan is a hot arid or semi-arid sandy desert whose productivity depends upon monsoon rains (Akhtar and Arshad, 2006).

The dominance of perennials grass species over annuals is in line with the findings of Qureshi *et al.* (2011). Accordingly the presence of perennial plants is an evident of severe climatic conditions. Ashraf *et al.* (2009) also reported that the perennials had more contribution than annuals in feeding livestock of arid rangelands.

Table 4. Identified Species with Family, Vascular name, Local name, Habit, Life form & Span.

Sr. No.	Families	Vascular Name	Local Name	Habit	Life form	Life Span
01	Mimosaceae	*Acacia nilotica* (Linn.) Delile.	Kikar	Tree	Phanerophyte	Perennial
02	Mimosaceae	*Prosopis cineraria* (Linn.) Druce.	Jandi	Tree	Phanerophyte	Perennial
03	Rhamnaceae	*Zizyphus spina christi* (Linn.) Wild.	Beri	Tree	Phanerophyte	Perennial
04	Mimosaceae	*Prosopis juliflora* (Swartz) DC.	Maskit	Tree	Phanerophyte	Perennial
05	Salvadoraceae	*Salvadora oleoides* Decne.	Wan, Pilu	Tree	Phanerophyte	Perennial
06	Tamaricaceae	*Tamarix aphylla* (Linn.) Karst.	Ukhan	Tree	Phanerophyte	Perennial
07	Asclepiadaceae	*Leptadenia pyrotechnica* (Forssk.) Decne.	Khip	Shrub	Phanerophyte	Perennial
08	Asclepiadaceae	*Calotropis procera* subsp. Hamiltonii(Wight) Ali.	Ak	Shrub	Phanerophyte	Perennial
09	Amaranthaceae	*Aerva persica* (Burm. f.) Merr.	kapok	Shrub	Phanerophyte	Perennial
10	Asteraceae	*Pulicaria rajputanae* Blatt. & Hollb.	Bui	Shrub	Phanerophyte	Perennial
11	Capparidaceae	*Cappparis decidua* (Forsskal.) Edgew.	Karir	Shrub	Phanerophyte	Perennial
12	Chenopodiaceae	*Suaeda fruticosa* Forssk. ex J. F. Gmelin	Kali lani	Shrub	Chamaephyte	Perennial
13	Chenopodiaceae	*Haloxylon salicornicum* (Moq.) Bunge ex Boiss.	Lana	Shrub	Chamaephyte	Perennial
14	Chenopodiaceae	*Salsola baryosma* Linn.	Khar booti	Shrub	Chamaephyte	Perennial
15	Chenopodiaceae	*Haloxylon recurvum* Sensu Bunge.	Khar, Saji	Shrub	Phanerophyte	Perennial
16	Mimosaceae	*Acacia jacquemontii* Benth	Banwali	Shrub	Phanerophyte	Perennial
17	Papilionaceae	*Crotalaria burhia* Buch-Ham. ex Benth	Chag	Shrub	Chamaephyte	Perennial
18	Rhamnaceae	*Zizyphus nummularia* (Burm. f.) Wight & Arn.	Beri	Shrub	Phanerophyte	Perennial
19	Polygonaceae	*Calligonum polygonoides* Linn.	Phog	Shrub	Phanerophyte	Perennial
20	Boraginaceae	*Heliotropium crispum* Desf.	Kali Bui	Shrub	Chamaephyte	Perennial
21	Boraginaceae	*Heliotropium strigosum* Willd. subsp. Strigosum	Gorakh Pan	Sub shrub	Therophyte	Perennial
22	Zygophyllaceae	*Fagonia cretica* Linn.	Dramah	Sub shrub	Chamaephyte	Perennial
23	Capparidaceae	*Dipterygium glaucum* Decne.	Fehl	Sub shrub	Chamaephyte	Perennial
24	Aizoaceae	*Limeum indicum* Stocks. ex. T. Anderson	Lonri	Herb	Therophyte	Annual
25	Aizoaceae	*Sesuvium sesuvioides* (Fenzl.) Verdc	Barri ulwaiti	Herb	Therophyte	Annual
26	Asteraceae	*Launaea resedifolia* (Linn.) O. Kuntz.	Dhudhkal	Herb	Therophyte	Annual
27	Aizoaceae	*Zaleya pentandra* Linn.	Itsit	Herb	Chamaephyte	Perennial
28	Asteraceae	*Launaea nudicaulis* Less.	Bhattal	Herb	Chamaephyte	Perennial
29	Aizoaceae	*Trianthema portulacastrum* Linn.	wisah	Herb	Therophyte	Annual
30	Brassicaceae	*Farsetia hamiltonii* Royle	Fareed buti	Herb	Chamaephyte	Perennial
31	Capparidaceae	*Cleome brachycarpa* Vahl. ex. DC	Noli	Herb	Therophyte	Annual
32	Euphorbiaceae	*Euphorbia prostrata* Ait.	Hazar dani	Herb	Therophyte	Annual
33	Convolvulaceae	*Cressa cretica* Linn.	Oin	Herb	Chamaephyte	Perennial
34	Cucurbitaceae	*Mukia maderaspatana* (Linn.) M.J. Roem.	Gwala kakri	Herb	Hemicryptophyte	Perennial
35	Convolvulaceae	*Convolvulus microphyllus* Sieb.ex	Hiran	Herb	Therophyte	Annual

Sr. No.	Families	Vascular Name	Local Name	Habit	Life form	Life Span
		Spreng	buti			
36	Fabaceae	*Indigofera hochstetteri* Baker	_____	Herb	Therophyte	Annual
37	Fabaceae	*Indigofera argentea* Burm. f.	Neel	Herb	Therophyte	Annual
38	Scrophulariaceae	*Anticharis linearis* (Benth.) Hochst. ex Aschers.	Assmani butti	Herb	Therophyte	Annual
39	Molluginaceae	*Glinus lotoides* Linn.	Phatokar	Herb	Therophyte	Annual
40	Neuradaceae	*Neurada procumbens* Linn.	Chappari	Herb	Therophyte	Annual
41	Zygophyllaceae	*Tribulus longipetalus* Viv. Subsp. macropterus (Boiss.)	Bhakhra	Herb	Chamaephyte	Perennial
42	Zygophyllaceae	*Tribulus terrestris* Linn.	Bhakhra	Herb	Therophyte	Annual
43	Fabaceae	*Indigofera sessiliflora* DC	Jantri	Herb	Therophyte	Annual
44	Cyperaceae	*Cyperus conglomeratus* Rottb. subsp. conglomeratus Kukkonen	Monghan	Sedge	Cryptophyte	Perennial
45	Poaceae	*Aristida funiculate* Trin. &Rupr.	Lumb	Grass	Therophyte	Annual
46	Poaceae	*Aristida adscensionis* Linn.	Lumb	Grass	Therophyte	Annual
47	Poaceae	*Aeluropus lagopoides*(Linn) Trin .ex.Thw	kalarghaa	Grass	Hemicryptophyte	Perennial
48	Poaceae	*Cenchrus ciliaris* Linn.	Dhaman	Grass	Therophyte	Perennial
49	Poaceae	*Aristida mutabilis* Trin. &Rupr.	Lumb	Grass	Therophyte	Annual
50	Poaceae	*Cenchrus biflorus* Roxb.	Bhurrat	Grass	Hemicryptophyte	Annual
51	Poaceae	*Aristida hystricula* Edgew	Lumb	Grass	Hemicryptophyte	Annual
52	Poaceae	*Cenchrus prieurii* (Kunth.) Marie	Dhaman	Grass	Hemicryptophyte	Annual
53	Poaceae	*Cymbopogon jwarancusa* (Jones.) schult	Khavi	Grass	Hemicryptophyte	Perennial
54	Poaceae	*Ochthochloa compressa* (Forsskal.) Hilu	Gandeel	Grass	Hemicryptophyte	Perennial
55	Poaceae	*Eragrostis barrelieri* Day.	Makni	Grass	Therophyte	Annual
56	Poaceae	*Enneapogon desvauxii* P.Beauv.	Dhui	Grass	Therophyte	Annual
57	Poaceae	*Lasiurus scindicus* Henr.	Sewen	Grass	Hemicryptophyte	Perennial
58	Poaceae	*Panicum antidotale* Retz.	Morrot	Grass	Hemicryptophyte	Perennial
59	Poaceae	*Stipagrostis plumosa* (Linn.) Munro.ex T. Anders	Lumb	Grass	Therophyte	Perennial
60	Poaceae	*Sporobolus iocladus* (Nees. Ex. Trin.) Nees.	Swag	Grass	Hemicryptophyte	Perennial
61	Poaceae	*Tragus racemosus* (Linn.) All	Swanri	Grass	Therophyte	Annual
62	Poaceae	*Panicum turgidum* Forssk.	Bansi	Grass	Phanerophyte	Perennial

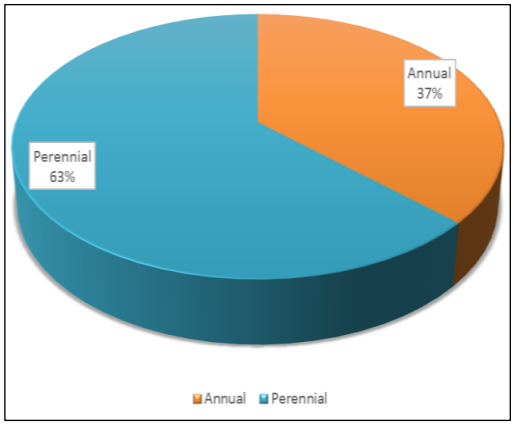

Fig. 6. Graphical representation of Life span of identified species.

Anthropogenic Factors

Major anthropogenic factors are divided into four categories (i) Timber wood (TW), (ii) Fire wood (FW), (iii) Medicinal (M) and (iv) Forage (F) (Table 05). Result shown that 07 (11.29%) species were exploited by all these four factors (TW, FW, M, F), 13 (20.91%) species were exploited by three factors (FW, M, F), 18 (29.03%) species were exploited by two factors (M,F) and 24 (38.7%) species exploited by single factor (F) (Fig. 07).

This finding revealed that indigenous vegetation of Cholistan desert is under heavy stress because one species is demolished more than one anthropogenic factor. Forage or grazing is most dominant anthropogenic factor in Cholistan desert. Khan, (2003) described that in the recent years human induced activities are major causes of destruction of biota, the natural habitats are going to edge of extinction to faster speed. Consumption of palatable plant species by livestock has a major impact and overgrazing is believed to contribute substantially to desertification and land degradation (Dregne *et al,* 1991). Over grazing reduced soil cover and plant vigour, the effects of which increase exponentially with livestock number (Hiernaux *et al,* 1994). Rafay *et al.*, (2015) reported that vegetation of Cholistan desert is under massive pressure of different anthropogenic factors like grazing, browsing and illegal cutting. Removal of natural vegetation for various house-hold purposes are the long term critical issues of desertification especially in the developing world (Dregne, 1986). It has been estimated that 75% of the fuel need in rural areas is met by rangelands plant in Pakistan. Every household uses 15kg to 25kg wood to cook food daily (FAO, 2016).

According to Arshad *et al*., (2008) there is an increasing trend of exploitation of medicinal plants of Cholistan desert due to increase in human population, local hakims and pharmaceutical industry. Illegal and excessive quantities of medicinal plants are removed, which caused land destruction.

Similarly some studies have been documented by (FAO, 1993; Durrani 2000; Durrani & Hussain, 2005; Qureshi, *et al*., 2007; Durrani *et al.,* 2010).

Table 5. Major anthropogenic factors distribution among the identified species.

Sr. No	Species	Major anthropogenic factor			
		Timber wood	Fire wood	Forage	Medicinal
01	*Acacia nilotica* (Linn.) Delile	+	+	+	+
02	*Prosopis cineraria* (Linn.) Druce	+	+	+	+
03	*Tamarix aphylla* (Linn.) Karst.	+	+	+	+
04	*Zizyphus spina christi* (Linn.) Wild.	+	+	+	+
05	*Salvadora oleoides* Decne.	+	+	+	+
06	*Prosopis juliflora* (Swartz) DC.	+	+	+	+
07	*Aerva persica* (Burm. f.) Merr.	-	+	+	+
08	*Calotropis procera* subsp. Hamiltonii(Wight) Ali	-	+	+	+
09	*Haloxylon recurvum* Sensu Bunge.	-	+	+	+
10	*Pulicaria rajputanae* Blatt. & Hollb.	-	-	+	-
11	*Cappparis decidua* (Forsskal.) Edgew.	-	+	+	+
12	*Salsola baryosma* Linn.	-	+	+	+
13	*Haloxylon salicornicum* (Moq.) Bunge exBoiss.	-	+	+	+
14	*Leptadenia pyrotechnica* (Forssk.) Decne	-	+	+	+
15	*Suaeda fruticosa* Forssk. Ex J. F. Gmelin	-	+	+	+
16	*Zizyphus nummularia* (Burm. f.) Wight & Arn.	+	+	+	+
17	*Crotalaria burhia* Buch-Ham. ex Benth	-	+	+	+
18	*Calligonum polygonoides* Linn.	-	+	+	+
19	*Heliotropium strigosum* Willd. subsp.Strigosum	-	-	+	+
20	*Heliotropium crispum* Desf.	-	-	+	+
21	*Fagonia cretica* Linn.	-	-	+	+
22	*Dipterygium glaucum* Decne.	-	+	+	+
23	*Acacia jacquemontii* Benth	-	+	+	+
24	*Limeum indicum* Stocks. ex. T. Anderson	-	-	+	-
25	*Zaleya pentandra* Linn.	-	-	+	+
26	*Trianthema portulacastrum* Linn.	-	-	+	+
27	*Sesuvium sesuvioides* (Fenzl.) Verdc	-	-	+	+
28	*Launaea nudicaulis* Less.	-	-	+	-
29	*Convolvulus microphyllus* Sieb.ex Spreng	-	-	+	+
30	*Cressa cretica* Linn.	-	-	+	+
31	*Cleome brachycarpa* Vahl. ex. DC	-	-	+	+
32	*Farsetia hamiltonii* Royle	-	-	+	-
33	*Launaea resedifolia* (Linn.) O. Kuntz.	-	-	+	-
34	*Mukia maderaspatana* (Linn.) M.J. Roem.	-	-	+	+
35	*Indigofera argentea* Burm. f.	-	-	+	-
36	*Indigofera hochstetteri* Baker	-	-	+	-
37	*Neurada procumbens* Linn.	-	-	+	+
38	*Indigofera sessiliflora* DC	-	-	+	-
39	*Glinus lotoides* Linn.	-	+	+	+
40	*Euphorbia prostrata* Ait.	-	-	+	+
41	*Anticharis linearis* (Benth.) Hochst. ex Aschers.	-	-	+	+
42	*Tribulus terrestris* Linn.	-	-	+	+
43	*Cyperus conglomeratus* Rottb. subsp. conglomeratus Kukkonen	-	-	+	+
44	*Tribulus longipetalus* Viv. Subsp. macropterus (Boiss.)	-	-	+	+
45	*Aeluropus lagopoides* (Linn) Trin .ex.Thw	-	-	+	-
46	*Aristida mutabilis* Trin. &Rupr.	-	-	+	-
47	*Aristida funiculate* Trin. &Rupr.	-	-	+	-
48	*Aristida adscensionis* Linn.	-	-	+	-

49	*Aristida hystricula* Edgew	-	-	+	-
50	*Cenchrus biflorus* Roxb.	-	-	+	-
51	*Enneapogon desvauxii* P.Beauv.	-	-	+	-
52	*Cenchrus prieurii* (Kunth.) Marie	-	-	+	-
53	*Lasiurus scindicus* Henr.	-	-	+	-
54	*Cymbopogon jwarancusa* (Jones.) schult	-	-	+	+
55	*Eragrostis barrelieri* Day.	-	-	+	-
56	*Cenchrus ciliaris* Linn.	-	-	+	-
57	*Ochthochloa compressa* (Forsskal.) Hilu	-	-	+	-
58	*Tragus racemosus* (Linn.) All	-	-	+	-
59	*Stipagrostis plumosa* (Linn.) Munro.ex T. Anders	-	-	+	-
60	*Sporobolus iocladus* (Nees. Ex. Trin.) Nees.	-	-	+	-
61	*Panicum antidotale* Retz.	-	-	+	-
62	*Panicum turgidum* Forssk.	-	-	+	+

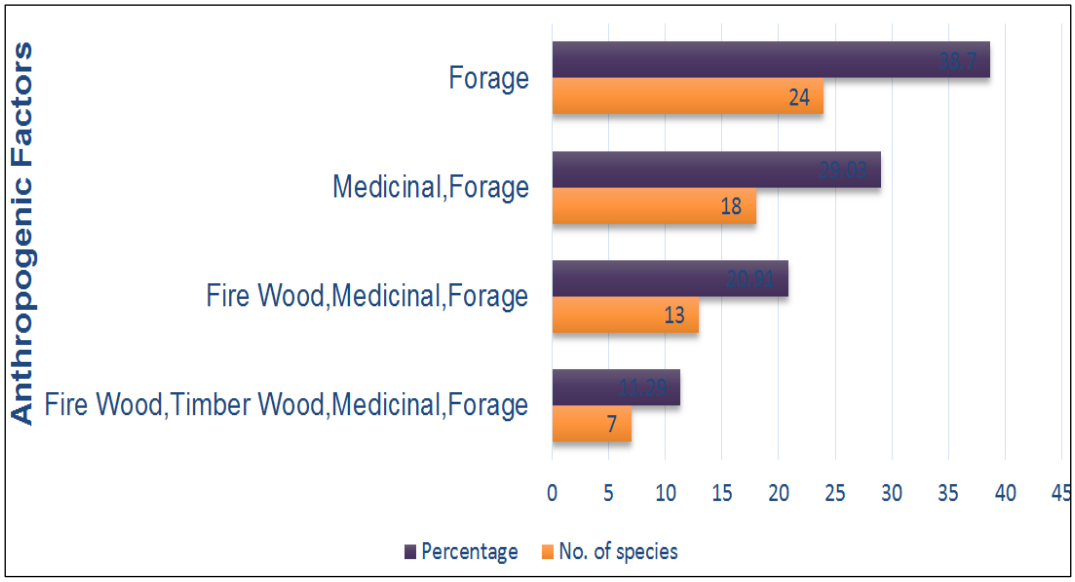

Fig. 7. Graphical distribution of major anthropogenic factors.

Current Conservation Status

The data of 62 species of Cholistan desert was collected by following conservation parameters of IUCN (2001). Current conservation statuses of each species are shown in Table 06. Results revealed that 11 (17.74%) species were found as "Least Concern", 22 (35.48%) species found as "Near Threatened" 20 (32.48%) species were found as "Vulnerable", 7 (11.29%) species were found as "Endangered" and 2 (3.22%) species were found as "Critically Endangered" (Fig 8).

These species were exploited by several anthropogenic factors such as heavy grazing, medicinal purposes, timber wood as well as fuel wood.

Kim (2006) reported that plant resources of Korea are threatened due to the high population density and speedy industrialization since.

The early sixties, in combination with the unlawful gathering of wild plants for decorative, remedial, food purposes, fuel and timber and fodder purposes. Haq (2011) reported 37 taxa from Battagram areas which were either critically endangered or endangered.

This also supported the current work as more than half of the investigated plants were either endangered or vulnerable. Qureshi and Ahmmad (2010) observed that the anthropogenic activities are a continuous threat in Nara desert and as a result, native species are diminishing at an alarming rate therefore, a large number of species were found rare.

Table 6. Current conservation status of indigenous vegetation of Cholistan desert.

Sr. No.	Species	Conservation Status
01	*Prosopis cineraria* (Linn.) Druce	Near Threatened
02	*Salvadora oleoides* Decne.	Endangered
03	*Acacia nilotica* (Linn.) Delile	Least Concern
04	*Zizyphus spina christi* (Linn.) Wild.	Endangered
05	*Prosopis juliflora* (Swartz) DC.	Vulnerable
06	*Tamarix aphylla* (Linn.) Karst.	Vulnerable
07	*Leptadenia pyrotechnica* (Forssk.) Decne	Least Concern
08	*Haloxylon salicornicum* (Moq.) Bunge ex Boiss.	Vulnerable
09	*Haloxylon recurvum* Sensu Bunge.	Near Threatened
10	*Neurada procumbens* Linn.	Critically Endangered
11	*Cappparis decidua* (Forsskal.) Edgew.	Near Threatened
12	*Calotropis procera* subsp. Hamiltonii(Wight) Ali	Least Concern
13	*Crotalaria burhia* Buch-Ham. ex Benth	Vulnerable
14	*Salsola baryosma* Linn.	Near Threatened
15	*Suaeda fruticosa* Forssk. ex J. F. Gmelin	Least Concern
16	*Limeum indicum* Stocks. ex. T. Anderson	Least Concern
17	*Pulicaria rajputanae* Blatt. & Hollb.	Near Threatened
18	*Calligonum polygonoides* Linn.	Least Concern
19	*Zizyphus nummularia* (Burm. f.) Wight & Arn.	Vulnerable
20	*Acacia jacquemontii* Benth	Near Threatened
21	*Heliotropium strigosum* Willd. subsp. Strigosum	Vulnerable
22	*Launaea resedifolia* (Linn.) O. Kuntz.	Least Concern
23	*Fagonia cretica* Linn.	Near threatened
24	*Trianthema portulacastrum* Linn.	Vulnerable
25	*Sesuvium sesuvioides* (Fenzl.) Verdc	Near Threatened
26	*Cressa cretica* Linn.	Vulnerable
27	*Zaleya pentandra* Linn.	Vulnerable
28	*Launaea nudicaulis* Less.	Near Threatened
29	*Glinus lotoides* Linn.	Least Concern
30	*Farsetia hamiltonii* Royle	Vulnerable
31	*Cleome brachycarpa* Vahl. ex. DC	Near Threatened
32	*Convolvulus microphyllus* Sieb.ex Spreng	Least Concern
33	*Heliotropium crispum* Desf.	Near Threatened
34	*Mukia maderaspatana* (Linn.) M.J. Roem.	Least Concern
35	*Euphorbia prostrata* Ait.	Vulnerable
36	*Dipterygium glaucum* Decne.	Near Threatened
37	*Indigofera argentea* Burm. f.	Vulnerable
38	*Indigofera sessiliflora* DC	Endangered
39	*Aerva persica* (Burm. f.) Merr.	Near Threatened
40	*Tribulus longipetalus* Viv. Subsp. macropterus (Boiss.)	Vulnerable
41	*Anticharis linearis* (Benth.) Hochst. ex Aschers.	Vulnerable
42	*Tribulus terrestris* Linn.	Endangered
43	*Indigofera hochstetteri* Baker	Least Concern
44	*Cyperus conglomeratus* Rottb. subsp. conglomeratus Kukkonen	Vulnerable
45	*Aeluropus lagopoides*(Linn) Trin .ex.Thw	Near threatened
46	*Aristida mutabilis* Trin. &Rupr.	Vulnerable
47	*Aristida funiculate* Trin. &Rupr.	Vulnerable
48	*Aristida hystricula* Edgew	Near threatened
49	*Aristida adscensionis* Linn.	Near threatened
50	*Cenchrus biflorus* Roxb.	Near threatened
51	*Cenchrus ciliaris* Linn.	Endangered
52	*Eragrostis barrelieri* Day.	Vulnerable
53	*Cymbopogon jwarancusa* (Jones.) schult	Near threatened
54	*Enneapogon desvauxii* P.Beauv.	Near threatened
55	*Panicum antidotale* Retz.	Endangered
56	*Lasiurus scindicus* Henr.	Near threatened
57	*Cenchrus prieurii* (Kunth.) Marie	Critically Endangered
58	*Ochthochloa compressa* (Forsskal.) Hilu	Near threatened
59	*Panicum turgidum* Forssk.	Vulnerable
60	*Sporobolus iocladus* (Nees. Ex. Trin.) Nees.	Near threatened
61	*Tragus racemosus* (Linn.) All	Endangered
62	*Stipagrostis plumosa* (Linn.) Munro.ex T. Anders	Vulnerable

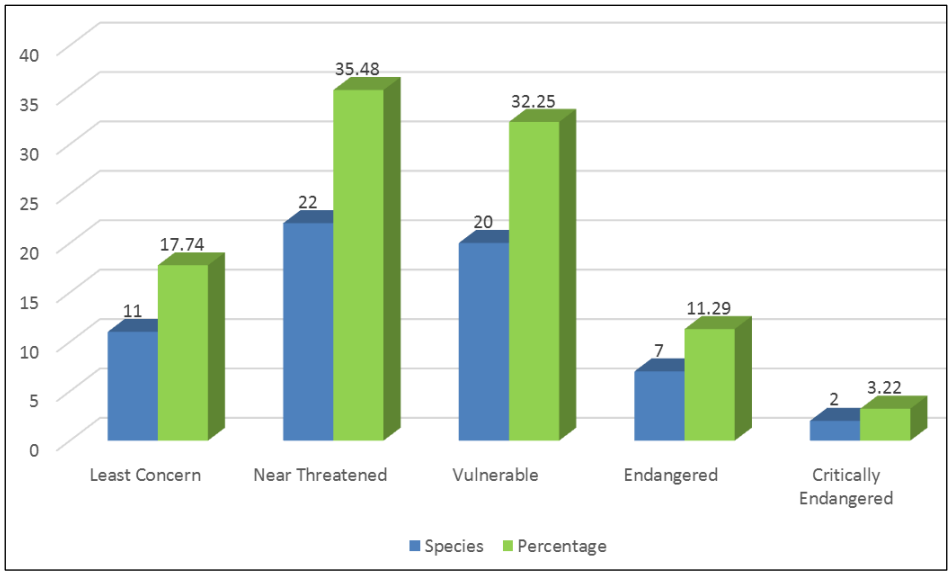

Fig. 8. Conservation status of identified species.

Acknowledgement

This study is part of M. Sc. (Hons.) Thesis of Sohail Akram entitled as "Studies on the Anthropogenic and Grazing effect on Vegetation cover in Cholistan Desert". Authors would like to gratefully acknowledge Dr. Tanveer Hussain for his valuable supervision during the whole work.

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