# SEASONAL ECOLOGICAL CHANGES AND THEIR EFFECTS ON VEGETATION COVER AND SOIL PHYSICOCHEMICAL PROPERTIES IN WADI AL-HAYAT REGION, LIBYA

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# SEASONAL ECOLOGICAL CHANGES AND THEIR EFFECTS ON VEGETATION COVER AND SOIL PHYSICOCHEMICAL PROPERTIES IN *WADI* AL-HAYAT REGION, LIBYA.

**Elssaidi, M.A.; Almathnani, A.M.**

*Environmental Science Dept. Faculty of Engineering & Technology, Sebha University; P.O.Box: 68, Brack Libya.*

## ABSTRACT

*WADI* Alhayat (26, 28 N & 12, 14 E : 463m above sea level) is located southern of Sebha city (the capital of Fezzan state) south of Libya (middle of Sahara desert). The area is classified as an arid desert climate, distinguished by high mean annual temperature, erratic annual rainfall, rapid relative cooling during winter, annual precipitation < 20 mm, hot summer (Jun.-Aug.) is almost rainless and mean annual relative humidity low. This study was conducted to evaluate the changes in the vegetation cover due to environmental and ecological changes and their effects on physicochemical characteristics. The results showed the soil reaction of the area is neutral (pH: 6.7 – 7.5) and poor in organic matter content (0.03 - 0.10%). The most common plants available in the studied area were; *Acacia tortillas, Tamarix nilotica, Calligonum comosum, Nitraria retusa, Tragamum nudatum, Atractylis carduus, Alhagi maurarum, Zygopllum album & Pennisetum divisum*. The qualitative (*Physiognomy, Floristic Composition, Life Forms and Vitality & vigor*) and quantitative (*Density, Frequency, Presence or constancy and Similarity Coefficient*) attributes of *wadi* Alhayat were studied.

## 1. Introduction:

*Wadi* al-Hayat is located in *Fezzan* region of southwestern Libya, at a latitude of approximately 26.5° N. Rainfall in the region is less than 15 mm.yr$^{-1}$ on average, but highly variable during the years (Pallas, 1978). The Wadi itself is bounded by the high cliffs of the Messak plateau to the south, and to the north by a region of dunes up to 300 m above the level of the wadi, known as *Zelaf* sand dunes, Fig. (1).

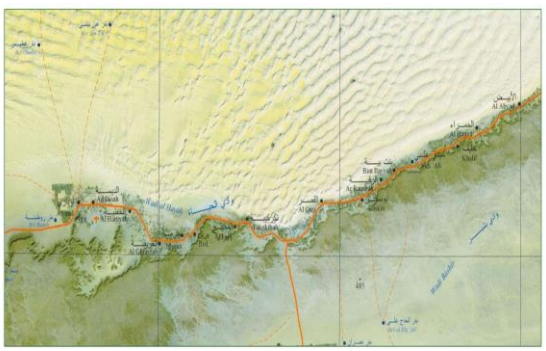

Fig. (1): The map of *Wadi* Alhayat region.

Groundwater levels falls >20 meters since the 1970s, although groundwater levels can exhibit high spatial variability over small scales. Changes in groundwater availability and/or quality are manifested in changing vegetation patterns in the region.

Degraded ecosystems, with damaged biotic components, have diminished control over resources such as soil nutrients and water resources (Davenport et al., 1998). Seriously damaged lands not only lose control over resources, but also lose the capacity for self-repair and are unable to prevent additional degradation (Whisenant, 1999). Thus, they are less resilient to additional stress or damage and provide fewer environmental services (Myers, 1996). As these degrading processes continue, a threshold can be crossed exceeding the ability for the ecosystem to recover and desertification results, a dynamic and self-perpetuating process (Tivy, 1990; Thurow, 1991).

Continued reductions in plant productivity decreased litter and vegetative cover, which in turn increased erosion and desertification (He, 1991; Gao, 2003). An increasingly common goal of ecosystem restoration is to restore the high levels of plant species, traits and functional groups similar to that found in remnant sites (Pywell *et al.,* 2003; Smith *et al.,* 2003). Restoring community structure (e.g. species composition and diversity) and ecosystem processes typically are listed as the two main objectives of restoration and vegetation improvement (Palmer et al., 1997; Lockwood and Pimm, 1999; Smith et al., 2000).

Some researchers have proposed that the proportion of native species and plant diversity should be used to evaluate the success of restoration efforts Bradshaw (1996), Hobbs and Norton (1996), and Martin et al. (2005)

Vegetation conservation and restoration in this region is becoming a significant concern. In this sense, this study was proposed to evaluate the ratio of native plants in the species composition, and plant diversity at the site scale along wadi Al-Hayat region.

## 2. Materials and Methods:

Mechanical analysis of the soil was performed according to the pipette method as described by Dewis and Feritas (1970). The soil reaction (pH) was determined in 1:2.5 soil : water suspension, while sludge pH was determined in 1:5 sludge : water suspension. Electrical conductivity (EC) was determined in a soil paste according to Jackson (1967). Soluble cations and anions were determined in the paste extract of soil and sludge. Available nitrogen was extracted by 1Nsolution of KCl using MgO and Devarda alloy according to Cottenie *et al*. (1982). Organic matter content was determined using Walkley-Black method, Jackson (1967). Available phosphorus was extracted by a 0.5M $NaHCO_3$ solution at pH 8.5 according to Watanable and Olsen (1965) and determined spectrophotometrically using ammonium molybdate and ascorbic acid as described by Murphy and Riley (1962).

Field investigations and sampling were conducted when most of evergreen vegetation was still growing. At the beginning of investigation, all plants species were identified and species composition (total number, life form, native plant ratio) were quantified. Species were classified into different functional groups based on their growth form (Polley et al., 2005). Qualitative and Quantitative characteristics of the vegetation including cover, height, number of individual species, functional groups and plant community were investigated in three 5m x 5m quadrats which were randomly placed in each plot. Simpson's diversity index, Marglef's richness index, and the Pielou evenness index were calculated following the formulas cited by Dong (1997).

## 3. Results:

The area of the study is characterized by dry hot climate. The time of rainfall is variable during the year. The observation of the climate change during 12 years manifest that, in some years there is no rain. The annual average of rainfall does not transcend (2 mm). The highest rate of rainfall registered is 1.96 mm in 1998. The rainfall rates shows that some months are completely dried. These dry months are February, August, July, and November.

The study area showed highest temperature, of 34.3 $^{o}$C registered in August-2002, and the lowest temperature 9.5 $^{o}$C registered in January-1995. Humidity of the area is very low and the trend of wind was southeast.

Table (): *Wadi* Al-Hayat mean temperature (°C) and relative humidity (%) through 1995-2006

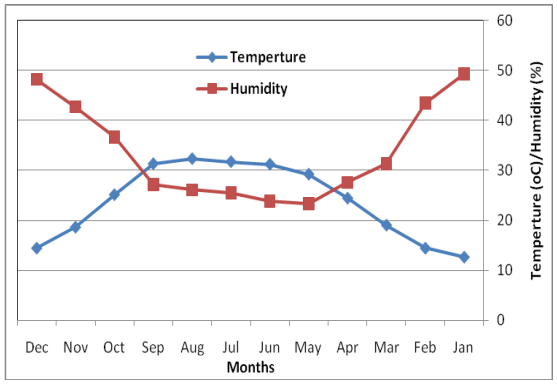


Table (): *Wadi* Al-Hayat mean precipitation (mm) for 1995-2006:

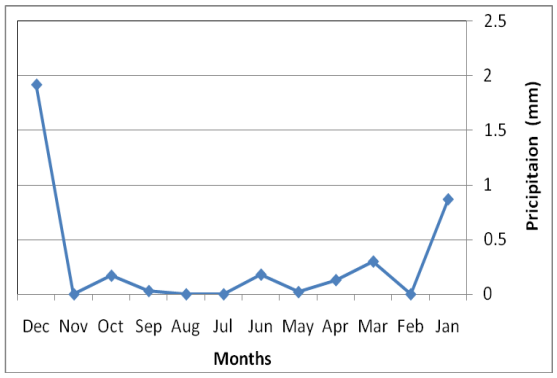


Table (): *Wadi* Al-Hayat mean wind speed (nodes) through 1995-2006:

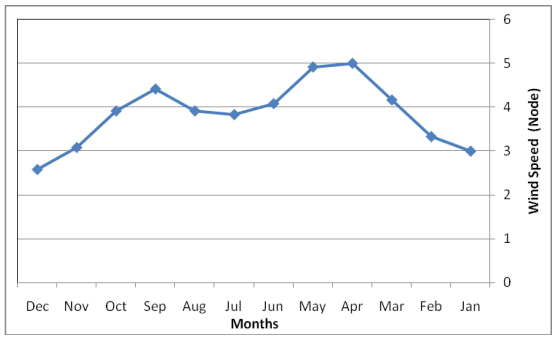


Table (): *Wadi* Al-Hayat groundwater composition:

| Parameter | Unit | Value |
|---|---|---|
| pH | | 6.79 |
| Conductivity | m.S | 92 |
| TDS | mg/L | 56 |
| T. Hardness | mg/L | 40 |
| $Ca^{2+}$ | mg/L | 9.2 |
| $Mg^{2+}$ | mg/L | 4.1 |
| K+ | mg/L | 5 |
| Na+ | mg/L | 5 |
| $HCO_3$ | mg/L | 0.2 |
| CL- | mg/L | 24 |
| Nacl | mg/L | 40 |
| $NO_3$ | mg/L | 26 |
| $SO^{--}_4$ | mg/L | 6 |
| Mn | mg/L | 0.05 |
| Fe | mg/L | 0.11 |

The vegetations are groups of desert plants consists of separated trees, bushes, and grasses. There are nine types of plants in study area. These are given below:

*Acacia Tortillas*

It grows in the east middle part of the valley. It is widely spread, has normal growth and rarely found in along valley.

*Tamarix Nilotica*

It grows in the west end and middle part of the valley. It is widely spread, large size growth in the middle part of the valley but has normal growth in the other parts of the valley.

*Calligonum Comosum*

It grows in the east end of the valley. It has widely spread, powered growing, it was rarely presence in the along valley.

*Nitraria Retusa*

It grows in the west end of the valley. It has widely spread, exhibit large growth and rarely present along the valley.

*Tragamum Nudatum*

It grows in the east end of the valley. It is not so widely spread, better growth and rarely found along the valley.

*Atractylis carduus*

It grows in the east end of the valley. It is widely spread, has normal growth and rarely seen in along the valley side.

*Ahagi Maurarum*
It grows only in the east and west ends part of the valley. It is not widely spread in the valley.

*Zygopllum Album*
It grows in the middle parts of the valley. It is widely spread, has weak growth and rarely present in the along valley.

*Pennisetum Divisum*
It grows only in the east and west ends of the valley. It is widely spread, has better growth in the east part of the valley but low growth in west end side of valley, medium presence along the valley.

The soil of the studied area is rich in nutrient content but poor in organic matter ranging between 0.03-0.1 mg/Kg and pH values ranging from 6.5-7.5. The plants in study were also rich in nutrient contents. The hierarchy of elements in the studied plants was: *Ahagi Maurarum* > *Atractylis carduus* > *Acacia Tortillas* > *Calligonum Comosum*. The above consequence shows that the fork plants concentrated more nutrient elements than the non-fork plants. The short size plant concentrated increasing amount of elements.

The seasonal changes influence to concentrate nutrient content. In general, the spring season was the suitable season of flowering and for better yield for all the plants studied because of high movement of nutrient to flowers and fruits.

The concentration of the mineral and vital elements in the studied plants was vary according to season. The highest concentration of nutrient ions formed in *Calligonum Comosum* and *Atractylis carduus* in the winter season, and the lowest in the spring season. The winter season is considered as the season of dormancy.

The high concentration of nutrient was found in *Acacia Tortillas* and *Alhagi Maurarum* during summer season where the plants are in their full growth with no flowers and fruits. In the winter season plant show dormancy stage where leaves fall down and nutrient elements stored in the roots till spring season.

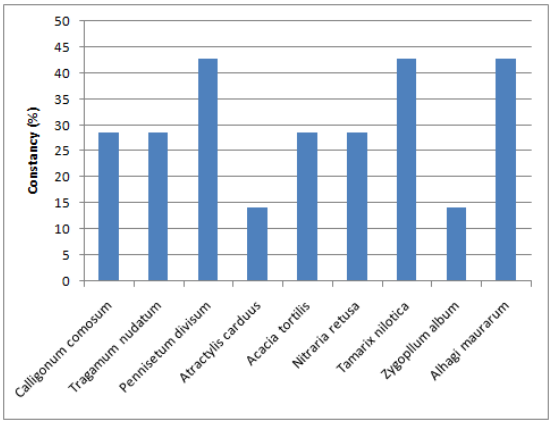

Fig. (): shows plant species constancy (%) in *wadi* al-Hayat.

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**Photographs of the plants studied:**

***Nitraria retusa***

***Pennisetum divisum***

***Calligonum comosum***

***Tamarix nilotica***

***Acacia tortilis***

***Alhagi maurarum Medik***

***Tragamum nudatum***

***Atractylis carduus***

***Zygopllum album***

**Effect of human activities:**

Grazing of *Alhagi maurarum*

Salinty due to irrigation

*Alhagi maurarum* as fodder

Desertification

*Calligonum comosum* ss firewood

Sand dune movements