A study of the Distribution of Sand Sheet on Some Pastures in the Western Desert of Iraq

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Abstract. This research aims to track the spatial extensions of the sand accumulations significantly over the past few years, on the pastoral lands of two regions in the Western Desert of Iraq for the years (2000-2005-2013-2019), depending on the techniques of remote sensing and geographic information system, which covered an area of (1826.5 km²), the satellite visuals of the Landsat sensors (OLI,TM) were used for the selected years of observations, within path 171, row 36 and 37, and the program to build classification equations within the ArcGis9.3 software environment for classification and mapping from the US Geological Survey website analysis, treatment, classification, improvement and calculation of the spread areas of sand accumulation, the results showed the affected areas in the north of Al-Rutba reached 304,443,268 km², either in part of Wadi Al-Ratqah reached 289,346,191 km², 34 grazing plant species belong to 12 families, The vegetative density ranged between 3.7 – 36.0 plant. m⁻², the vegetation coverage was between 9.5-73.8 cm.m⁻² and the total biomass was 28.1 g. m⁻², noting the low values in the sand accumulations. This study emphasizes the need to develop policies, procedures and future plans to reduce the phenomenon of sand accumulation on pasturelands in the study areas.

1. Introduction
Desertification is one of the problems and challenges facing human civilization, there is a difference between the term desertification and desert that the desert is an ecosystem that forms after the end of the rainy age and the advent of the era of dry periods, while the term desertification, according to the United Nations Convention to Combat Desertification, is "land degradation in dry and semi-arid areas, and semi-humid because of various factors, including differences and human activities [1]. [2] explained in his study the patterns of sand movement in the Western Desert in Egypt and its impact on the environment in the study area where the accumulations move 40 meters in three broad directions during the year. The movement of these sand accumulations is related to the prevailing wind system within the region. [3] studied the economic risks of sand dune movement and its impact on agricultural development in southern Siwa Oasis in Egypt. Calculated area affected by sand dunes movement has arrived 50,629 acres and the cost of economic losses from the seriousness and effects of sand accumulation movement has arrived L.E 3206.7 million. Calculating the total costs of protecting roads and drainage channels from the impact of these sand accumulations
was estimated 167.6 million Egyptian junayh. [4] through their study of the role of climate change in determining the phenomenon of sand encroachment in the (Ibzebd) region of Sudan using geographical information technology and remote sensing, it was emphasized on the importance of using this technology in various agricultural applications, which has superior ability to provide abundant information about the features Earth that have role in continuous monitoring of the Earth's surface and its various resources. Satellite data are essential documents in the production of qualitative maps and in monitoring the spatial distribution land phenomena such as sand encroachment and sand dune movement and help in the study phenomena such as drought and land degradation, and provide emergency advice and support research studies in various disciplines with accurate and up-to-date information and the production of digital databases to conduct integrated studies for a specific area. [5] studied the causes of desertification in the province of Babil by diagnosing and analyzing the condition of the region, the causes of desertification to two factors, the natural factor, which includes drought and the encroachment of sand and sand dunes with an area of 4,500 acres, while the other factor is the human factor, which includes the effects of the human factor, population growth and overgrazing.

Analyzing patterns of variation in vegetation cover and sand cover in the Misurata region in Libya by using remote sensing techniques and geographic information systems for years 2001-2009, [6] showed that vegetation cover and land cover are increased at the expense of other. The study recommended providing comprehensive databases with continuously updating data and making use of the leading countries in this field. [7] used multi-source satellite imagery such as CORONA (1967, 1972), SPOT 5 (2013), LandSat TM (1986), LandSat 8 OLI (2013), to observe and analyze the interaction between changes in human activities and the spatial expansion of areas of accumulation in the regions of Wadi Fatima and Wadi Al-Shemaia in the Kingdom of Saudi Arabia, linking this to wide changes in human systems and mountainous terrain, and the transformation of agricultural lands into deserted areas, which led to the deterioration of the soil. Winds and severe arid conditions and the transfer of those soils to the accumulation areas in the study area. [8] studied the effect of sand drift on agricultural lands in Basra Governorate, using remote sensing technologies and geographic information systems for the years 2006, 2013, the results of the study indicated that 61.9% of the studied land area suffers from severe erosion with deterioration in vegetation cover. The objective of this study was to utilizing remote sensing technologies and geographic information systems to determine the locations of the distributions of sand accumulation in two regions within the Western Desert of Iraq, during the years (2000-2005-2013-2019) and to show the impact of these accumulations on pastoral lands and the loss of a significant part of the vegetation cover and to give recommendations to decision-makers in taking some measures that limit these environmental damages, and the detailed objective includes:

2-Materials and Methods

2.1: Study areas location

The study was conducted in two areas, the first is located at a distance of 20 km northwest of Al-Rutba, area 846.3 km2, within the physiographic unit Al-Hammad [9]. It is bordered from the north by the Al-Qa’ara depression, east by the Nazeraah Oud Nasir region, from south by Wadi Abilah, and the west by Shuaib Al-Awja within the Iraqi Hammad Basin, which includes part of the northern Iraq Badia this region between latitudes 33˚16’0” and 33˚4’0” North and longitudes 40˚12’0” and 40˚32’0” East, the height of the study area Between 575-646 meters above sea level, forming a plain interspersed with dry wades and a plateau. The terrain features vary within the region, sand accumulations appear and are clearly concentrated in the center of the region, which are sandy veins that appear in the low areas, while sand sheets appear in the high areas, as well as the presence of the phenomenon of nabkahs, either the second region is part of Wadi Al-Ratqah, located 56 km south of Al-Qaim
city, with 980.2 km², bordered, north by Wadi Umita and Abu Sadariah, the east, by Wadi Al-Mane‘i, south, by Wadi Azzam, west by Wadi Akash, this area is limited between 34° 12' 0”N and 33° 56' 0”N latitudes and 40° 32' 0”E and 40° 44' 0”E longitudes. The altitude of the area ranges between 394-420 meters (A.S.L), and sand sheets appear within the high areas as well as on the shoulders of Wadi Al- Ratqah, and within the unity of the upper wadi. Fig. 1, studied areas within the Iraqi Western Desert ecosystem.

![Figure 1. Study areas within the Iraqi Western Desert (Source: globalwindatlas.info [10])](image)

2.2. Study sources

To achieve the objectives of the research, this study relied mainly on fieldwork that began in 2012 in intermittent visits depending on the security situation of the study areas and stopped in 2013. We relied on:

- several maps, including: Topographic Maps 1: 100,000, Geological maps 1: 250,000, in addition to Satellite remote sensing software in combination with Geographical Information System (GIS).

a- Volumetric distribution of soil separations: they were estimated by the sorbent method described before [11].

b - Electrical conductivity using a suspension 1:1 and according to paragraph [-12 2/a].

c- Soil reaction (pH) using the measurement of the glass electrode in a 1:1 suspension and according to paragraph [12-2/b].

d- Soil content of total carbonate equivalent, estimated by weight loss method, according to paragraph [12-23c].

e- Soil content of organic matter, estimated according to Walkely and Black method of [13].

f- Soil content of gypsum, which was estimated by sedimentation method and according to the method proposed by [14].
j- The amount of prepared phosphorous in the soil according to [15 Olsen (1954)] method.
k- Soil total nitrogen content estimated by Keldahl method, described by Bremner, 1960, and mentioned in [16].
l - Potassium: Extract the available by a flame spectrometer [17].

2.3. Studying distributions of sand accumulation remote sensing techniques

To monitor the distributions sand accumulation, the data was collected using a set of satellite visuals captured by the Landsat satellite via sensors (OLI,TM) four visuals covering the study areas during the period 2000, 2005, 2013 and 2019 within path 171 and row 36 and 37. These visuals were obtained from the US Geological Survey website in the form of spectral beams, with a spatial resolution of $30 \times 30$ meters, affected areas were calculated under the Aeolian mapping index (EMI) for the observed periods as stated in [18] and as follows:

The following combination (R/NIR) was used and a matching was made for the layers according to the following combination (NIR, R & R/NIR).

Table 1 Satellite visible properties, the data was designed using the Arc View ver. program. 10.8 and Arc Info to extract the boundaries of the study areas from mosaic, and the ranges were merged for each picture of the study years separately, and to calculate their spatial changes in the two study areas.

| Name satellite | images capture date | path | row | degree discrimination |
|----------------|---------------------|------|-----|-----------------------|
| TM Landsat5    | 13-9-2000           | 171  | 37  | 30m $\times$ 30       |
| TM Landsat5    | 11-9-2005           |      |     |                       |
| Landsat8 OLI   | 17-9-2013           |      |     |                       |
| Landsat8 OLI   | 18-9-2019           |      |     |                       |
| Aster(DEM)     | -                   |      |     | 28m $\times$ 28       |

2.4. Geology

The area dates back to the sediments of the Quaternary age, consisting of valley sediments consisting of sand, silt and clay, as well as gravel and calcite rocks. Its thickness ranges between 1-2 meters where it forms different areas at the valleys' courses and depressions, in the northern Ar-Rutbah area.

Zor Horan formation (limestone, mud), Mulussa formation (mainly limestone with dolostone), Hartha formation (mainly limestone with marl), Residential soil deposits silty clayey soil, Rutba-Ms'ad formation sand stone and limestone).

As for the second study area, which is part of the valley of the Ratqah wadi, the following geological formations are located, depending on the map of the geological survey and mineral investigation (19,20), Nfayll beds (Green marl, limestone), Euphrates formation (Basal conglomerates-limestone, chalky), Zahra formation (clastics, sandy limestone), Residual soil and Valley fill deposits. Fig. 2 shows distributions geological formations in the study areas.
Figure 2. geological formations in the study areas, (A) Al-Rutba area (B) AlRatqah wadi part.

2.5. Climate condition

The study area falls within the arid desert climate as classified by [21] (BWh), Main climates (B: arid), Precipitation (W: desert), Temperature(h: hot arid),Where the climatic data for both regions for the period from 2010 to 2019 related to the Al-arRutba weather station. The results in Table 2 showed that the annual average of temperatures ranged between 12.9-27.3 °C and the minimum temperatures ranged between 7.6-16.8 °C the maximum between 23.5-46.4 °C, the relative humidity values ranged between 26.5%-71.5, the rainfall rates were between 78.5 and 133.9 mm with average 107.4 mm, annual rates of evaporation -transpiration calculated by the Torrentwaite method ranged between 2379-2778 mm, and Fig. 3 showed the relationship between the Rainfall and temperature, and Fig. 4 showed the wind rose for study area.
Table 2. Climatic elements data for Al-Rutba metrological station for the period 2010-2019

|                | January | February | March | April | May | June | July | August | September | October | November | December |
|----------------|---------|----------|-------|-------|-----|------|------|--------|-----------|---------|----------|----------|
| Avg. Temperature °C | 6.7     | 8.8      | 13.2  | 17.9  | 21.1| 27.2 | 29.7 | 29.7   | 26.1      | 20.8    | 12.8     | 8.2      |
| Min. Temperature °C | 1.8     | 3.2      | 6.4   | 10.5  | 15.2| 19.2 | 21.6 | 21.8   | 18.6      | 14.3    | 7.2      | 3.3      |
| Max. Temperature °C | 12.2    | 14.7     | 19.5  | 24.4  | 29.7| 34   | 36.5 | 36.6   | 32.7      | 27      | 18.6     | 13.8     |
| Precipitation / Rainfall mm | 18      | 20       | 16    | 10    | 6   | 0    | 0    | 0      | 0         | 8       | 14       | 14       |
| Humidity (%)       | 64      | 56       | 40    | 32    | 26  | 23   | 23   | 25     | 29        | 37      | 52       | 61       |
| Rainy days (d)     | 3       | 3        | 3     | 2     | 1   | 0    | 0    | 0      | 0         | 1       | 2        | 2        |
| avg. Sun hours (hours) | 7.5     | 8.4      | 10.2  | 11.4  | 12.4| 12.9 | 12.7 | 12.0   | 11.1      | 10.0    | 8.4      | 7.4      |

Figure 3. Precipitation and temperature in the study area

Figure 4. A wind rose showing directions and speed for study areas (Al-Rutba- 620 m ASL)
2.6. Field work

A semi-detailed survey was carried out for the study areas, two representative segments were selected. Each site was geographically modeled using the GPS device GARMIN'S GPS 72 personal navigator manufactured in Taiwan, lands of this district were chosen for scientific reasons, which was allowed by the field movement, the fre-e-lance soil survey method was adopted, in which the investigation method is used for the reflections of soil factors and processes and the associated variation in field-visible characteristics, especially the texture, topography, natural vegetation, salinity, color and nature of exploitation, in order to diagnose the soil unit for each area. As this method is the best soil survey method, which is currently presented in the field of survey work, after determining the locations of the pedons in the field at each examination point and carried out check with Auger hole to determine the location of the field pedon, after which the representative pedon was revealed and a person and a field description was based on [22] [23]. Then, soil samples were obtained from the horizons that were diagnosed in the field, and field work was required to provide the following equipment and supplies: maps - topography - geology - geomorphology - satellite images (2018 CNES/Airbus - Digital Globe) - GPS unit, compass - shovel, axe, Auger hole - hammer - pH field device - Knife - Hand lens (x 10) - Nylon bags and soil sample markers.

3. Results and Discussion

3.1. Soil characteristics of the study areas

The study areas are mainly distributed in soils of dry areas, Ardisols, and undeveloped soils, shallow to deep Entisols, and association soils. They are spread in low areas and in wadi, they are soils transported from high areas by water resources, and they are well drained with a texture, sandy loam, sandy clay loam and clay loam, soil of salinity (5.7-9.6 dSm-1), which is suitable for the cultivation and development of many grazing plants and trees. The northern Al-Rutba soils were characterized as calcareous soils with a lime content of 40%, well-developed limestones, with a depth ranging from 30-60 cm, and a low organic matter content table.3,4 morphological description Pedon representative.

Through the field study and laboratory analysis of the studied soil profile, the number of horizons in the soil of the North Ar-Rutba area was shown as containing three horizons. As for the pedon soils, part of Wadi Al-Ratqah, it was found that they are desert soils with moderate texture on the surface horizon and the second horizon, while the third horizon was textured coarse, which indicates that the original material is sandy with a very limited transfer of clay from the surface layer to the bottom due to the slope of the earth that contains a medium percentage of calcium carbonate, table.5 chemical characteristics of the soils of the study areas.

Table3. Morphological description Pedon representative north Al-Rutba region

| Horizons | Depth cm | Description |
|----------|----------|-------------|
| A        | 0-13     | Brown 7.5YR 5/4 dry, strong brown 7.5YR 4/6 moist; sandy loam; very weak medium sub angular blocky structure; soft, loose, non plastic and non sticky; few fine roots; high porosity; few medium angular shaped coarse material of lime; few Coarse rounded shaped concretions of lime; clear smooth boundary. |
| C1       | 13-39    | brown 7.5YR 5/4dry, strong brown 7.5YR 4/6 moist; sandy loam; weak medium sub angular blocky structure; soft; very friable, non-plastic and non-sticky; few fine roots; common fine pores; high porosity; few coarse angular shaped coarse material of lime; few coarse irregular shaped concretions of lime; clear smooth boundary. |
| C2       | 39-78    | Pink 7.5YR 7/4dry, reddish yellow 7.5YR 6/6 moist; sandy loam; granular structure; soft; very friable, plastic and sticky; common fine pores; medium porosity; many stones sub-rounded shaped coarse material of lime; common very |
coarse irregular shaped concretions of lime.

Table 4. morphological description Pedon representative (Wadi alRatqah part)

| Horizons | Depth (cm) | Description |
|----------|------------|-------------|
| Ap       | 0-21       | Reddish yellow 7.5YR7/8 (d), reddish yellow 7.5YR7/6 (m); sandy clay loam; moderate, medium subangular blocky; slightly hard, friable, slightly plastic and sticky; common fine horizontal vesicular pores; plentiful medium –fine roots; calcareous; clear, smooth boundary. |
| Bk       | 21-41      | Light brown7.5YR6/4(d), strong brown 7.5YR5/6; sandy clay loam; moderate, medium, subangular blocky; very hard, firm, slightly plastic and sticky; Common fine vertical tubular pores ; few medium roots; calcareous; clear, smooth boundary. |
| C        | 41-60      | Reddish yellow7.5YR7/6 (d), reddish yellow 7.5YR7/6 (m) ; clay loam; weak, medium, subangular blocky; slightly hard, firm, slightly plastic and slightly sticky; common medium horizontal interstitial pores; few, medium roots; calcareous. |

Table 5. chemical and fertility properties of the studied pedons

| pedon symbol | horizon | EC dSm⁻¹ | pH | CaCO₃ % | CaSO₄ % | N% | P Mg.g⁻¹ | K Cmol(+).g⁻¹ | O.M % | SAR |
|--------------|---------|----------|----|---------|---------|----|----------|---------------|-------|-----|
| 1            | A       | 5.7      | 7.3 | 7.6     |         | 0.14 | 1.82     | 0.5           | 1.6   | 0.15|
| 2            | C₁      | 9.6      | 7.7 | 6.9     |         | 0.09 | 1.47     | 0.3           | 1.0   | 0.08|
| 2            | C₂      | 7.5      | 7.5 | 6.9     |         | 0.09 | 1.34     | 0.4           | 0.0   | 0.17|
| 2            | Ap      | 6.5      | 7.6 | 16.4    | 0.56    | 0.04 | 3.82     | 0.6           | 0.4   | 0.85|
| 2            | C₁      | 6.3      | 7.6 | 16.6    | 0.44    | 0.05 | 4.97     | 0.5           | 0.6   | 0.73|
| 2            | C₂      | 6.8      | 7.6 | 18.5    | 0.34    | 0.09 | 2.84     | 0.5           | 0.1   | 0.24|

3.2. The status of distributions of pastoral plants in the study areas

We note that the study areas were characterized by the diversity of vegetation cover, that the climate condition and the variation in the amount of rain have a negative impact on the vegetation cover in terms of vegetation density and biomass. Table (6) explains there are 34 pastoral plant species whose palatability rates for animals vary from one species to another, they belong to 12 plant families, the Poaceae family excelled in the number of plant species, the Resedaceae, Ephedraceae, Scrophulariaceae Family occupied one plant species for everyone. It was noted that there was a decrease in the density vegetation due to the scattered geographical distribution, with the exception of the wades’ stomachs and seasonal temporary water paths, which are characterized by a better environmental condition than the neighboring areas due to the quantities of water and soil collected by surface runoff. This was consistent with (24) who studied the state of the distribution of natural vegetation within three oases in the Western Desert in Iraq and show 20 species of annual plant species representing 58.8% of the total recorded plant species, while perennial species represented 14 plant species, 41.1%.

According to the classification of [25], the growth and life cycle of Therophytes were superior, while the Phanerophytes of the apparent type took the lowest. The vegetation cover in the study area was subjected to a deterioration in some of its types, which in earlier periods formed a good pastoral cover due to droughts and human methods in the pressure on those pastoral resources, by comparing the vegetation cover in the sandy accumulation environment and the environment unaffected by sand accumulation, as well as the low density and vegetation coverage within the sandy accumulation areas and may decrease more within the deep accumulation areas, the vegetation coverage of Aizoon hispanicum in the sand accumulation area was estimated to reach the plant density values within those accumulations...
were decreasing. The annual plant Eruca vesicaria of the Brassicaceae family had the highest value of the plant density of 36 plants. m$^{-2}$, while the species *Schismus*
Table 6. Characteristics of the natural vegetation of the study area

| No. | Species                        | Local name | Family            | Duration | Life form | vegetative density (plant. m\(^{-2}\)) | vegetative coverage (cm. m\(^{-2}\)) | Total biomass gm m\(^{-2}\) |
|-----|--------------------------------|------------|-------------------|----------|-----------|----------------------------------------|--------------------------------------|-----------------------------|
| 1   | Arabica Schumpera              | جمال        | Brassicaceae      | Annual   | Therophytes | 11.2                                     | 56.6                                 |                             |
| 2   | Arctia decumbens               | جملة        | Brassicaceae      | Annual   | Therophytes | 8.0                                     | 24.6                                 |                             |
| 3   | Mathiola longipetala           | شيكورة      | Brassicaceae      | Annual   | Therophytes | 13.3                                     | 13.6                                 |                             |
| 4   | Lotus tenuissimus              | حفرية       | Papilionaceae     | Annual   | Therophytes | 10.0                                     | 44.8                                 |                             |
| 5   | Eruca vesicaria                | حافري       | Brassicaceae      | Annual   | Therophytes | 36.0                                     | 23.6                                 |                             |
| 6   | Plantago ovata                 | زعتر        | Plantaginaceae    | Annual   | Therophytes | 6.0                                     | 66.6                                 |                             |
| 7   | Atriplex leucoclada            | زرعآلة      | Chenopodiaceae    | Perennial | Chamaephytes | 7.3                                     | 33.5                                 |                             |
| 8   | Azizoon hispanicum             | دكة          | Aizoaceae         | Annual   | Therophytes | 12.0                                     | 7.6                                  |                             |
| 9   | Diploriscus hisra              | نفخ         | Brassicaceae      | Perennial | Chamaephytes | 8.0                                     | 10.9                                 |                             |
| 10  | Erodium cistarium              | بخري        | Geraniaceae       | Annual   | Therophytes | 5.8                                     | 55.3                                 |                             |
| 11  | Mellotus indicus               | غَلَب         | Brassicaceae      | Annual   | Therophytes | 7.6                                     | 34.5                                 |                             |
| 12  | Sclerocephalus arabicus        | مشرسة       | Caryophyllaceae   | Annual   | Therophytes | 9.8                                     | 33.2                                 |                             |
| 13  | Hymenaea salicornica           | رَبوْت        | Chenopodiaceae    | Perennial | Chamaephytes | 8.0                                     | 13.7                                 |                             |
| 14  | Diplochene focea               | شَعْب         | Poaceae           | Perennial | Chamaephytes | 7.5                                     | 45.5                                 |                             |
| 15  | Anvillea garcini               | نَكْت         | Aizoaceae         | Perennial | Chamaephytes | 19.2                                     | 22.7                                 |                             |
| 16  | Plantago ciliata               | ذَرْبية       | Plantaginaceae    | Annual   | Therophytes | 21.3                                     | 22.7                                 |                             |
| 17  | Poa bulbosa                    | كُبْرَاء       | Poaceae           | Perennial | Geophytes  | 4.0                                     | 12.3                                 |                             |
| 18  | Schismus arabicus              | عَلْدَة        | Poaceae           | Perennial | Geophytes  | 3.7                                     | 9.5                                  |                             |
| 19  | Medicago lacinata              | حَمَلْدَة       | Papilionaceae     | Annual   | Geophytes  | 7.0                                     | 14.8                                 |                             |
| 20  | Reseda maricata                | نَفْرَيْة      | Resedaceae        | Perennial | Chamaephytes | 9.0                                     | 33.5                                 |                             |
| 21  | Bromus tectorum                | عَمْرُ الخِلْل | Poaceae           | Annual   | Therophytes | 24.0                                     | 15.7                                 |                             |
| 22  | Astroaghias caprinis            | كَثْج          | Papilionaceae     | Perennial | Therophytes | 4.7                                     | 13.4                                 |                             |
| 23  | Artemisia herba-alba            | عَصْب          | Aizoaceae         | Perennial | Chamaephytes | 30.2                                     | 12.7                                 |                             |
| 24  | Anthems rascheyana             | رياض       | Aizoaceae         | Annual   | Therophytes | 9.0                                     | 16.5                                 |                             |
| 25  | Carooylvolkensii               | روْثة        | Chenopodiaceae    | Perennial | Chamaephytes | 14.9                                     | 22.7                                 |                             |
| 26  | Ephedra alata                  | عَلْدَة        | Ephedraceae       | Perennial | Chamaephytes | 5.8                                     | 23.7                                 |                             |
| 27  | Medicago radicata              | نَفْلُ شَرْقاً  | Papilionaceae     | Annual   | Therophytes | 9.7                                     | 19.8                                 |                             |
| 28  | Erodium lancefolium            | أَرْبَدٌ الخَيْج | Geraniaceae       | Perennial | Hemicryptophyte | 4.8                                     | 16.8                                 |                             |
| 29  | Erodium lacinatum              | كَثْج          | Geraniaceae       | Annual   | Therophytes | 22.0                                     | 22.5                                 |                             |
| 30  | Plantago albicrus              | رَبوْت         | Plantaginaceae    | Perennial | Chamaephytes | 13.6                                     | 73.8                                 |                             |
| 31  | Hordeum glaucum                | شَعْرَي          | Poaceae           | Annual   | Therophytes | 12.3                                     | 55.6                                 |                             |
| 32  | Scrophularia deserti            | عَفْنَة       | Scrophulariaceae  | Perennial | Chamaephytes | 17.8                                     | 15.9                                 |                             |
| 33  | Schismus arabisicus             | عَلْدَة        | Poaceae           | Annual   | Therophytes | 32.2                                     | 46.8                                 |                             |
| 34  | Stipa capensis                 | صَعْسَحَة      | Poaceae           | Annual   | Therophytes | 18.6                                     | 33.8                                 |                             |
arabicus of the Poaceae family got the lowest value of 3.7 plants. m⁻², the plant productivity was estimated the total areas unaffected by sand accumulation based on the dry weight of each species by cutting the plant within the square after drying it was 28.1 g. m⁻², and in the case of calculating the lost quantities of the total biomass of the areas affected by sand accumulation, the losses from the grazing plant become large, Figure 7 models of grazing vegetation in the study areas.

3.3. Variations in the distribution of sand accumulations

Table 7 shows the changing in the areas of sand accumulation during the years of observation 2000, 2005, 2013 and 2019 which reached areas 304, 443, 268 and 280 Km², respectively, for the northern Al-Rutba region, while the area of Wadi al-Ratqah which was affected with sand drift at same observation periods showed areas 289,346,191 and 113Km² respectively, through interpretations of images classification for the sand accumulation forms expanding towards the northwest, according to the direction of the prevailing winds in those areas, thus exposing them to sand erosion problems and the possibility of this situation remaining in the future if the necessary measures are not taken to correct these damages.

The table7 shows that the areas of sand accumulation areas are in an upward trend, with the exception of the area of Wadi Al-Ratqah for the year 2019, there was a decrease in the area of sand and this is attributed to topographical situation of the area, as well as the state of the climate and precipitation in that year, and the classifications of satellite images show the movement of the direction of accumulation from one place to another in the direction of wind exit, and these extensions are among the main characteristics of the movement of sand. There are many factors that control the movement of sand accumulation, the most important of which is the size of these accumulation such as their height and slope, as well as raising the state of soil moisture. These accumulations depend on the variations in rainfall negatively when sand moisture increases and its cohesion increases and impedes its movement. Terrain also plays an important role. In the case of lowlands, they impede the movement of sand to such an extent that it varies with the presence of high hills and high topographical areas, but in the case of the slope of the land surface in the direction of the wind, the transmission of those accumulations increases the rate of movement of those sand accumulations, we can conclude from the data of Landsat satellite visuals that the range of pasture areas has become threatened by the deterioration and disruption of the ecosystem. This leads to the fact that the study areas are facing desertification conditions as a result of the encroachment of these continuous accumulations at alarming rates. It was noted that they were distributed from 280 km² years 2000 to 304 km² in 2019, in area North of Al-Rutba, with an increase of 24 km², while the sandy spread in part of Wadi Al-Ratqah with an area of 113 km² in the year 2000 reached 289 km² in 2019 with an increase of 176 km², the figures 8 and 9 show the variations over the years, figure10,Statistical percentages of sand accumulation development in the study areas. Table 7 shows the changes of sand accumulation areas in the study areas during the observation period.
Figure 5. Classification of the satellite image of the distribution of sand accumulations north of the city of Al-Rutba during 2005-2019 (GIS, 10.8).
Figure 6. Classification of the satellite image of the distribution of sand accumulations in Wadi Al-Ratqah during 2005-2019 (GIS,10.8)

Table 7. Variations of the areas of sand accumulation in the study areas for the period (2019-2000) *

| Years            | 2000 | 2005 | 2013 | 2019 | Variations 2000-2019 |
|------------------|------|------|------|------|----------------------|
| North city of Ar-Rutba | 280  | 268  | 443  | 304  | 24                   |
| Part Wadi alRatqah   | 113  | 191  | 346  | 289  | 176                  |

*Source: Landsat satellite visual data 2000-2019.
Figure 7. Statistical chart of Variations of sand accumulation over the years of observation

Conclusions
The main result of the study is the increase in spatial extensions and transmission rates of sand accumulation in the study area, and that changes occurred in the ground covers of the study areas at the expense of pasture lands and shrubs, whose areas have vanished during the period of follow-up and monitoring, which threatens those areas to the risk of their deterioration and reaching degrees of extreme desertification unless development is done. These lands are to reach the state of sustainability and not to disturb the environmental balance and to improve the environment of the study areas, and from the observations that were recorded a complete absence of any interest by the competent authorities to confront this phenomenon and the absence of any obstacles that reduce wind speed.

Acknowledgment
The research team thanks Professor Abd Saleh Fayyad at University of Anbar, College of Science - Department of Applied Geology and Professor Saif Al-Din AbdulRazzaq Salem for helping to provide data and facilitate field visits. Anbar, we also thank Prof. Muhammad Othman Musa for the assistance in diagnosing plant specimens in the herbarium of the Desert Studies Center, University of Anbar.

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