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Research Article

DETERMINATION OF LANDS SUITABILITY FOR AGRICULTURAL ACTIVITY USING SOIL SURVEY AND REMOTE SENSING TECHNIQUES, AL-DABA AREA, NORTHERN STATE, SUDAN

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ABSTRACT

This study was conducted in eastern al daba localty, about 32 km South east Aldaba town, northern State, to explore and determine the suitable lands for the establishment of an agricultural project in the study area, and evaluate and determine the soil suitability for agricultural activities in the study area using remote sensing, soil survey and analysis. The study area covering (55692.1 feddans). This research was based on the data and information extracted from soil survey, remote sensed landsat 8 images dated 2021, in addition to field observation aided by GPS Garmin 62 receivers and geographic information system were used to generate soil map in the study area. Satellite image was enhanced, interpreted and analyzed using ERDAS Imagine 8.5, 18807 feddan of the project area was excluded and classified as currently unsuitable for agricultural activities because of the very high altitude, presence of mountains and rocks. By using the American soil classification system and (FAO, 1990 and 2006) the project area classified into five units, extended flat unit (7550.5 feddans), relatively flat surface unit (7550.5 feddans), completely black surface unit (7505.7 feddan), moderate – highly undulating surface (8734.6 feddan.) and highly undulating surface unit (9027.5 feddan). Using the USA classification system, the above five units were grouped and classified into three soil suitability classes which is (1) Medium soil suitability Class, S2 m (19123.0 feddan) 51.84% of the total project area, non alkaline, non saline, non sodic area, (2) Medium soil suitability Class, S2 mt (8734.6 feddan) 23.6% of the total project area, slightly alkaline, non saline, non sodic area and (3) Marginal Soil stability class S3mt (9027.5.6 feddan) 24.4% of the total project area, slightly alkaline, non saline, non sodic area. So, based on this study there was vast area is suitable for agricultural activity (28625 feddan), but provided by certain conditions.

Keywords: Land evaluations, land Suitability, soil Surface, remote sensing, soil classification.

INTRODUCTION

Northern state lies between latitudes 17˚ 45 - 19˚ 15' N and longitude 30˚ 15'-32˚ 00' E. It occupies area of about 1,734,000 km^2 (Sudan Survey, 1995). The agricultural land that could be irrigated is about 1.337.451 feddans (41.667ha) (Alzubair *et al*., 2021). The state bounded on the east by Red Sea State, in the north by Egypt, northwest by Libya and Darfur State, and in the south by the River Nile State. The state characterized as hyper-arid desert (desert), typical continental. The highest mean maximum temperature recorded is 43.1˚C in Dongolla, while the absolute maximum is 49˚C in Wadi Halfa. The mean minimum recorded temperature 8.3˚C and absolute minimum is 1^{o}C both recorded in Wadi Halfa. The relative humidity is low, the highest evaporation recorded in May and the lowest in January; the maximum duration of sunshine is 11.9 hours in June and the lowest duration is 9.8 hours in December and the highest vapor pressure occurs in August and the lowest occur in February. *In general, clouds are very low and* rain increases from north to south. Two seasons were predominant in the State, a hot summer from April to September and cold winter from October to March (Alzubair *et al*., 2021). Northern state was seriously affected by desertification processes particularly wind erosion and salinzation of soils because of the presence of conducive, condition including high temperature, low and erratic rainfall, relatively high wind speed and consequent high rates of evapotranspiration . Under such climatic conditions, wind erosion and salinzation of soils became determinative factors of biological production and agricultural suitability in the State. Attention was given to wind erosion research in Sudan by some scientists (Lamprey, 1975; UNEP, 1977; FAO/UNEP, 1984; Dregne, 1991; Salih,1996; Ayoub,1998 and Mustafa, 2008). Intensity wind erosion (IWE), research has been conducted in the State by (Abdelwahab and Mustafa, 2013; Abdelwahab *et al., 2014;* Abuzeid *et al.,* 2017). Wind and River bank erosion is the major land degradation problem facing agriculture productivity in the northern state (Ahmed, 2001). Remote sensing is more effective compared to traditional methods of field survey, with low cost and covers large areas 3,600 to 324,000 km^2 (Abdelwahab *et al., 2014*). The technique is mainly based on the physical interaction between solar radiation, atmosphere and the main features of the land surface. Remote sensing technique approved that can be used for monitoring, assessing spatiotemporal variation of degraded natural resources and wind erosion. Beside estimation biophysical soil properties such as salinity and sodicity problems, so many works conducted in Sudan (Ali *et al*., *2012;* Edris, *et al., 2013;* Biro, *et al*., *2013*; Ibrahim, *et al*., *2013*; Adam, *et al., 2014;* Abdelwahab, *et al., 2014*; Fadl, *et al., 2014*; Ibrahim, *et al., 2014*; Mohammedzain, *et al., 2015*; Elhaja, *et al., 2017;* Abuzeid, *et al., 2017;* Elhag, *et al., 2018;* Ibrahim, *et al., 2018;* Hamed*, et al., 2022)*. As matter of fact agriculture, the largest economic sector in Sudan provides the primary source of livelihood for about 80% of the population. Thus, remote sensing techniques can be used for assessment and mapping of all types of degradation of natural resources, wind erosion and estimation biophysical soil properties such as salinity and sodicity problems, were considered as

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the major factors which limit crop production in the northern state and deserve top priority in research. Moreover remote sensing is powerful in order of determine the agricultural land capabilities and enables the evaluation of conservation programs executed in targeted areas for terrestrials resources leading to setup a clear strategy for the state so as, reaches agricultural development and natural resources sustainability. The present study was undertaken to achieve the following objectives:

1. To explore and determine the suitable lands for establishment of an agricultural project in the study area.
2. To evaluate and determine the soil suitability for agricultural activities in the study area.
3. To generate quantitative data on land degradation by estimating some of biophysical soil indicators via remote sensing and GIS analysis in the study area.

MATERIALS AND METHODS

Materials

Study area

The project area is an agricultural investment located 32 Km Southeast Al-Daba Town; the total area is about 55692.1 feddans, about 18807 feddan (33.8%) out of the total area is rocky area and excluded out from the study. Thus, the remaining area 36885.1 (66.2%) considered as the real study area (Fig.1 and 2). The area is approximately bounded by longitudes and latitudes given below (table.1).

Table 1: shows X & Y bounded the project area in Projected UTM System

Corner	X in UTM	Y in UTM
1	181605.2	310925
2	181539.4	312002
3	182413.6	312051.4
4	182105.2	311008.4

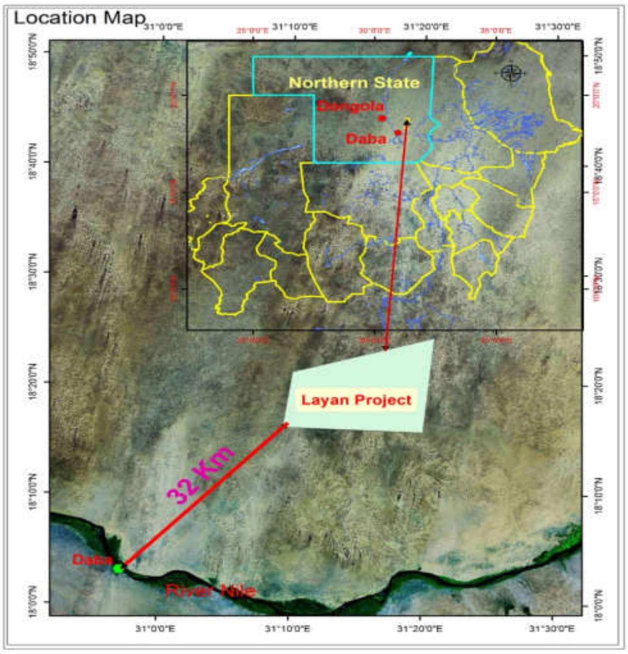


Fig.1. Location map of the study area

Remote sensing imagery

Land sat false color composite (FCC) subsets images Land sat 8 dated (2021), covering the study area (55692.1 Feddan), were used in this study. The field work was conducted during the period 05 June to 30th June 2021 aided by GPS receivers (Garmin 62C).

Methods

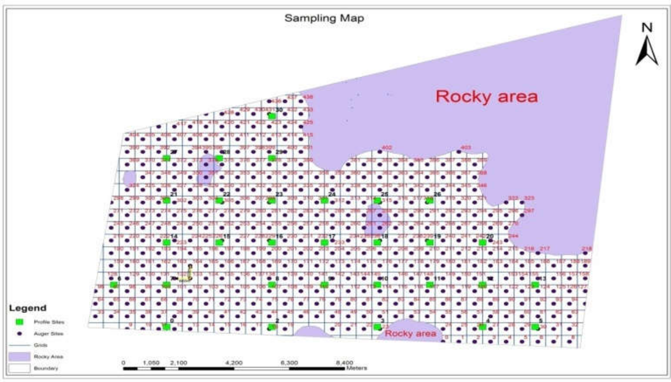
Office methods includes

i. Collection of previous studies on the study area.
ii. Preparation of location map and other topographic maps.
iii. Preparation and interpretation of satellite images.

Field work and soil sampling

Soil samples were collected from different selected locations to cover the variability that observed from satellite image analysis. Global Positioning System (GPS) and GIS were used to locate the position of soil samples. Soil grid system using Fishnet methods and observation of auger and profile sites were applied for verification and delineation of different soil unites, the intensity of observations was one auger for each 77.1 feddans gave total number of 446 auger sites for 2 depth (0-30cm, 30-60cm and, vertical and horizontal distance between the Auger sites is 600meters (Fig.2). Digging and description of soil profiles for the soil unites (indicated by the interpretation of satellite images and Sudan Land Cover maps), to have 30 profiles covering all the soil unites, (Fig.2).

Soil analysis information (Evaluation Classification & Land Suitability) based on USDA (2010) System of Soil classification.



Laboratory work

The chemical analysis carried out to investigate the following parameters;

1. Saturation Percentage (SP%). (Auger and profile site).
2. The Electrical Conductivity (EC) to investigate the soil salinity (Auger and profile site).
3. Soil reaction (pH) to investigate soil alkalinity and acidity (Auger and profile site)..
4. The Sodium Adsorption Ratio (SAR) to investigate the soil sodicity (Auger and profile site).
5. Soil texture (profile site).
6. Exchangable K (ppm) (profile site).
7. Avialable P (ppm) (profile site).
8. Total nitrogen (profile site).
9. Organic carbon(%) (profile site).
10. Organic matter (profile site).

GIS Analysis and mapping

Geographical Information System (GIS) was used for data capture, input, manipulation, transformation, visualization, combination, query, analysis, modeling and output; an intersection was performed between the classified image and the soil map of the study area in order to improve the classification results, are shown in Figures 3 to 10.

RESULTS AND DISCUSSIONS

After deducting mountains and rugged areas (excluded area), The rest of study area depending on the fieldwork, collection and analysis of the soil samples with the use of the American Soil Classification System and (FAO, 1990 and 2006) the study concluded that the soil of the study area was classified into five units, (1) **Extended flat unit** these area are characterized by a flat surface as an extended unit with different components covering the surface (small and homogeneous quartz gravel and quartz gravel in the form of regular and spaced pieces) so that these components covering the surface reflect the nature of the land. The area of this unit is 4067 feddan (2) **relatively flat surface unit** these lands are characterized by the accumulation of sand on the surface and cover non-extended areas so that the surface shows some elevations and depressions according to the density of the sand covered by the different location of the soil. In this unit the surface is free from any presence of rock pieces and gravel, the estimated area of this unit is 7550.5 feddans. (3) **Completely black surface unit**, (7505.7 feddan) this unit distinguishes the presence of loose surface soil and loamy subsoil, the depth of which does not exceed 20 cm, followed by soil affected in some places by the presence of calcium carbonate, noting that it contains rocky pieces and gravel, and this unit is devoid of any vegetation cover, (4) **moderate – highly undulating surface** , the surface is characterized by varying ripples from a semi-flat surface to areas where the sharpness of height and depression increases, as well as the presence of rocky pieces of different sizes to the degree of rocks on the surface and thus reflect shallow to medium-depth soil and its depth does not exceed 50 cm, this unit covers large areas overlapping with other units estimated at 8734.6 feddan. (5) **Highly undulating surface unit**, 9027.5 feddan this unit is distinguished by the sharpness of the elevations, which corresponds to the depth of the depressions, and covers the areas adjacent to the plateaus and mountains in the land of the project, this unit witnessed highly weathered where there are no soil no plant, only ,mountains and large rocks. the above five units were grouped and classified into three soil suitability classes which is:

Medium soil suitability class, S2m

This class covers an area about 19123.0 feddan and it represents 51.84% of the total area of the project. It is a non-saline, non-sodic and non alkaline soil (Fig. 3 to 8 and table 3 to 7), and it represents as a part of extended units from first to three units (unit 1, 2 & 3) as shown in the soil suitability map Fig.10, Light soil texture at the soil surface to medium texture at sub soil. The surface of the earth characterized by its levelness, which facilitates the movement of all agricultural operations from the preparation of the land, and this levelness also ensures the good distribution of water and fertilizers. This unit is suitable for growing all crops (vegetables, crops, grass fodder, and legumes). It is also suitable for growing fruit and forest trees with a feasible economic return as a result of the soil depth that reaches more than 100 cm.

Medium soil suitability class, S2mt

This class covers an area about 8,734.6 feddan, which represents 23.6% of the total area of the project. It is a non-saline, non-sodic and slightly alkaline soil (Fig. 3 to 8 and table 3 to 7). This class was characterized by ripples in the surface as a result of the repetition of elevations and depressions in the surface of the soil, which are represented by (unit4 in soil suitability map Fig. 10); The components covering the surface (accumulated sand and rocky pieces of different sizes) this affect the completion of agricultural operations, as the cost increases for removing it or leveling the accumulated sand, especially in land preparation operations to create extended areas.

Marginal soil suitability class, S3mt

The area was estimated at 9027.5 feddan, representing 24.4% of the total area of the project. It is a non-saline, non-sodic and slightly alkaline soil (Fig. 3 to 8 and table 3 to 7). It is represented by unit (unit5 in the soil suitability map Fig .10), the most important characteristic of these class is the sharpness of height and depression in narrow areas with which it is difficult to move to carry out any agricultural work, vegetables and crops (Fig. 9 surface map).

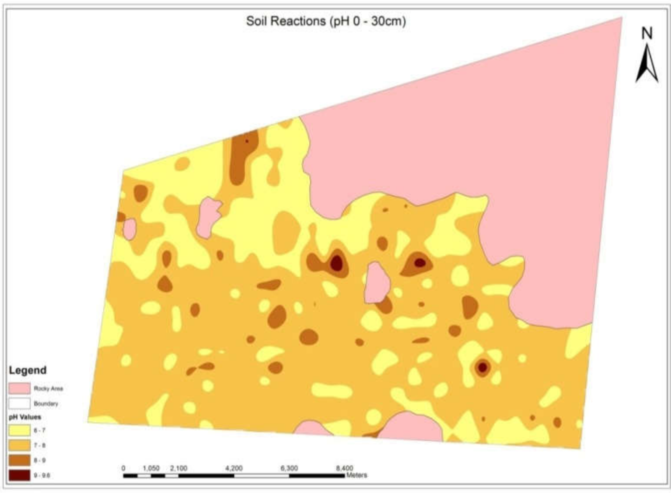


Fig.3. Soil pH in the surface soil

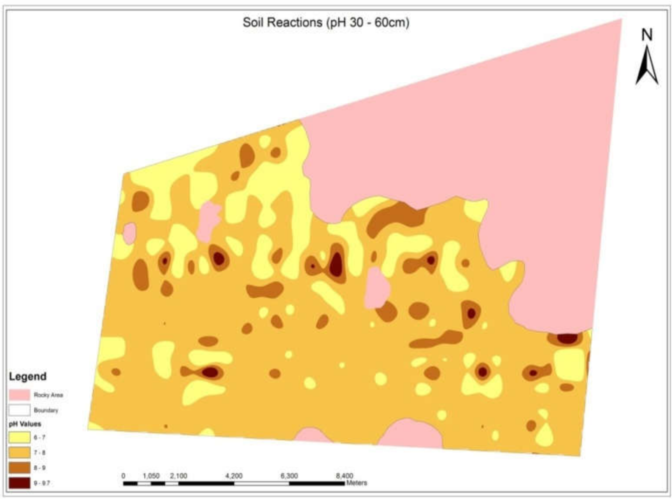


Fig.4. Soil pH in the surface soil

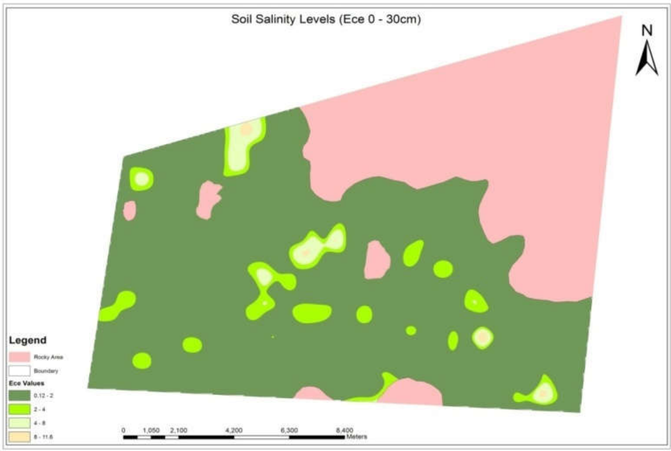


Fig.5. Salinity levels in the surface soil.

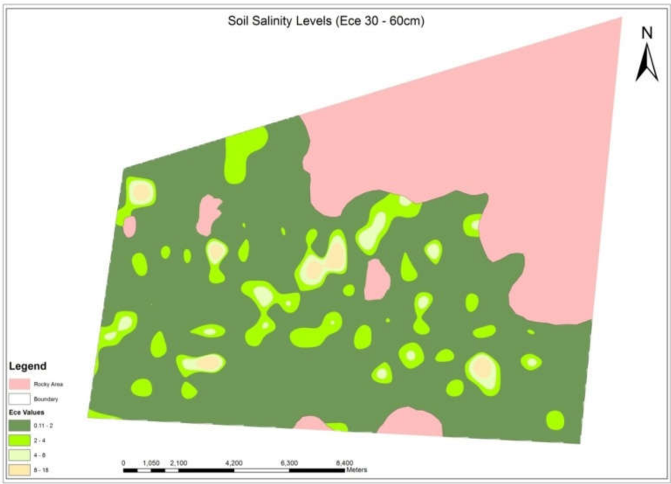


Fig.6. Salinity levels in the sub surface soil.

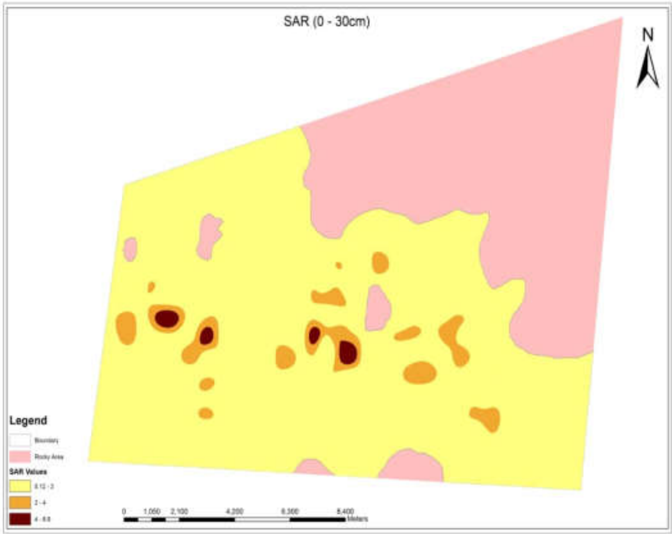


Fig.7. SAR levels in the surface soil.

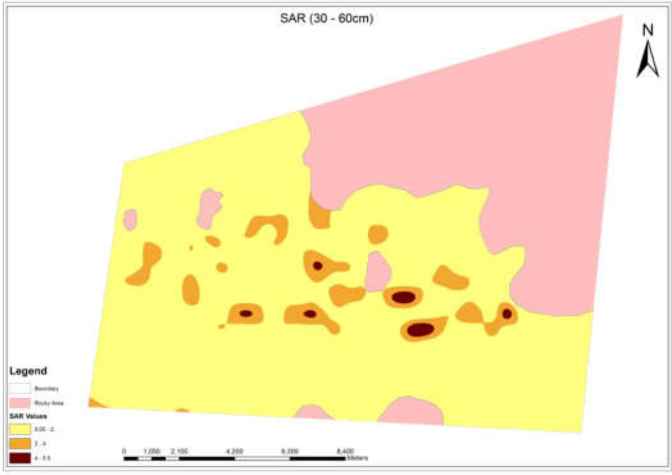


Fig.8. SAR levels in the sub surface soil.

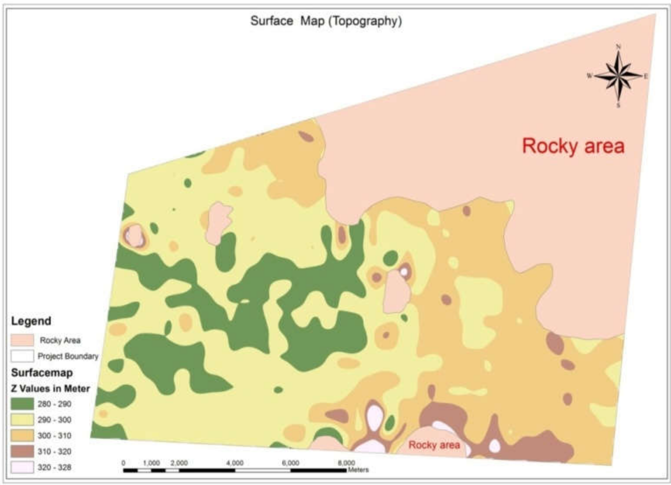


Fig.9. Surface map (Topography).

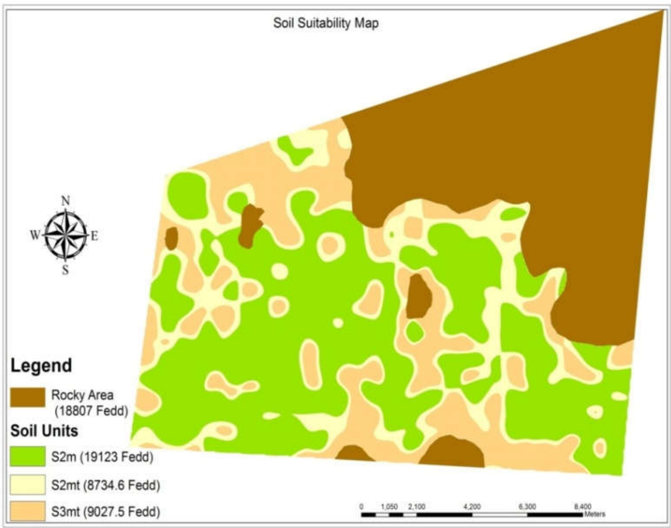


Fig.10. Soil suitability map

Table 2. The range values of soil pH in the study area.

Soil depths	Ranges	Average	Guideline	Comments
Surface soil (0 - 30 cm)	6.00 – 9.20	7.25	6.5- 7.5	Moderately alkaline
Sub – surface soil	6.00 – 9.70	7.36	6.5- 7.5	Moderately alkaline

Table 3. Salinity levels (dS/m)

Soil depths	Ranges	Average	Guideline	Salinity classes
Surface soil (0 - 30 cm)	0.12 – 7.92	0.90	<4.0ds/m	Non saline
Sub- surface soil (30-60cm)	0.11 – 18.12	1.22	<4.0ds/m	Non saline

Table 4. Sodicity levels (SAR)

Soil depths	Ranges	Average	Guideline	Comments
Surface soil (0 - 30 cm)	0.12 – 6.62	0.87	<13.0	Non sodic
Sub- surface soil (30-60cm)	0.04 – 5.16	0.97	<13.0	Non sodic

Table 5. Moisture content

Soil depths	Ranges	Average	Guideline	Comments
Surface soil (0 - 30 cm)	18.50 – 39.48	28.41	>40%	Low Moisture Content
Sub- surface soil (30-60cm)	18.97 – 42.35	30.24	>60%	Low Moisture Content, However the Moisture Increased with Depth.

CONCLUSION AND RECOMMENDATIONS

The study demonstrated the importance of using remote sensing technologies, GIS and soil survey as a basic study for selecting a suitable site and land for agricultural activities such as cultivated of Crops and Fruits. Soil analysis showed that chemical and physical properties of the soil had revealed slightly changes. The study concluded that there are large areas or lands that can be used for agricultural activity within the desert area, . Based on this study and finding, an area of **28625** feddan (Fig. 11), suitable for agricultural activity when following the following recommendation:

- Proactive studies should be conducted using remote sensing, GIS and soil survey before planning and implementing agricultural project.
- The rocky pieces of different sizes, which are present in few and scattered numbers in semi-flat areas, must be removed.
- Organic matter should be added at a rate of 1 ton per feddan, as it increases the soil's ability to retain water and nutrients, and also works to reduce the pH (reducing alkalinity).
- A windbreak must be set up.
- Chemical fertilizers that contain major and minor nutrients must be added.
- A pivot irrigation system must be adopted to maintain soil moisture, with the necessity of irrigation with good water that is free from the presence of dissolved salts in harmful proportions.
- Areas with high elevations, which are highly costly, should be excluded in case of reclamation.

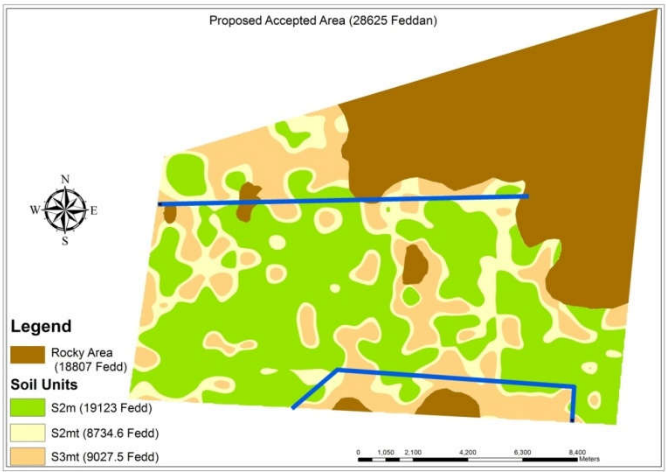


Fig.11. The proposed accepted area.

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APPENDIX

Table 7. Profile sites analytical results

Profile No & Layer cm	Ex. K ppm	Av.P ppm	T.N %	O.C %	O.M %	sand %	silt %	clay %	Tex class
P0									
(0 -8)	50	1.2	0.01	0.2	0.116	80	15	5	Sandy soil
(8 – 30)	50	1.2	0.01	0.2	0.116	55	30	15	Sandy loam
(30 – 70)	80	1.8	0.03	0.6	0.348	45	35	20	Loamy soil
P2									
(0 – 23)	55	1.3	0.01	0.2	0.116	75	20	5	Loamy sand
(23 – 63)	90	1.8	0.03	0.6	0.348	40	50	10	Loamy soil
(63 – 92)	100	2.0	0.02	0.4	0.232	20	50	30	
P3									
(0 – 20)	95	2.1	0.025	0.5	0.290	45	35	20	Loamy soil
P4									
(0 – 9)	60	1.7	0.015	0.3	0.174	65	25	10	Sandy loam
(9 – 30)	55	1.4	0.02	0.4	0.232	55	35	10	Sandy loam
(30 – 70)	95	1.8	0.03	0.6	0.348	20	40	40	Maude or Sand stone
P5									
(0 – 9)	65	1.2	0.01	0.2	0.116	70	20	10	Loamy sand
(9 – 37)	70	1.5	0.015	0.3	0.174	55	30	15	Sandy loam
(37 – 83)	60	1.0	0.01	0.2	0.116	80	15	5	Sandy soil
P6									
(0 – 12)	65	1.2	0.015	0.3	0.174	50	35	15	Sandy loam
(12 – 23)	60	1.2	0..01	0.2	0.116	55	30	15	Sandy loam
(23 – 49)	55	1.0	0.01	0.2	0.116	65	25	10	Sandy loam
(49 – 66)	60	1.2	0.01	0.2	0.116	55	35	10	Sandy loam
(66 – 80)	80	1.8	0.03	0.6	0.348	45	40	15	Loamy soil

Profile No & Layer cm	Ex. K ppm	Av.P ppm	T.N %	O.C %	O.M %	sand %	silt %	clay %	Tex class
P7									
(0 – 8)	70	1.6	0.02	0.4	0.232	60	30	10	Sandy loam
(8 – 26)	75	1.7	0.02	0.4	0.232	40	45	15	Loamy soil
(26 - 72	100	2.0	0.03	0.6	0.348	45	35	20	Loamy soil
P8									
(0 – 9)	65	1.2	0.01	0.2	0.116	65	25	10	Sandy loam
(9 – 29)	75	1.3	0.015	0.3	0.174	55	30	15	Sandy loam
(29 – 57)	77	1.4	0.015	0.3	0.174	50	35	15	Sandy loam
(57 – 80)	60	1.2	0.01	0.2	0.116	70	20	10	Sandy loam
P9									
(0 – 9)	75	1.4	0.01	0.2	0.116	50	35	15	Sandy loam
(9 – 36)	68	1.5	0.015	0.3	0.174	50	35	15	Sandy loam
(36 – 69)	120	2.2	0.03	0.6	0.348	45	40	15	Loamy soil
(69 – 100)	110	2.1	0.035	0.7	0.406	20	40	40	Mudstone
P10									
(0 – 10)	95	1.8	0.02	0.4	0.232	55	35	20	Sandy loam
(10 – 40)	100	2.2	0.03	0.6	0.348	45	40	15	Loamy soil
(40 – 58)	65	1.2	0.015	0.3	0.174	65	25	10	Sandy loam
(58 – 92)	110	1.8	0.035	0.7	0.406	40	40	20	Loamy soil
P11									
(0 -5)	75	1.2	0.01	0.2	0.116	55	35	10	Sandy loam
(5 – 22)	65	1.5	0.025	0.5	0.290	40	45	15	Loamy soil
(22 – 31)	70	1.2	0.01	0.2	0.116	60	30	10	sandstone
(31 – 70)	75	1.4	0.015	0.3	0.174	50	20	30	Mudstone
P12									
(0 -15)	110	2.1	0.025	0.5	0.290	40	45	15	Loamy soil
(15 – 51)	120	2.1	0.04	0.8	0.465	30	50	20	Loamy soil
(51 – 87)	125	2.0	0.04	0.8	0.465	30	50	20	Loamy soil
P13									
(0 – 6)	75	1.2	0.02	0.4	0.232	55	35	10	Sandy loam
(6 – 29)	120	2.2	0.04	0.8	0.465	45	40	15	Loamy soil
(29 – 73)	125	2.4	0.04	0.8	0.465	40	45	15	Sandy loam
(+73)	95	1.4	0.02	0.4	0.232	65	25	10	Sandy loam
P14									
(0 – 8)	68	1.0	0..01	0.2	0.116	70	20	10	Sandy loam
(8 – 44)	77	1.0	0.15	3	1.744	65	25	10	Sandy loam
(44 – 72)	65	1.2	0.01	0.2	0.116	65	25	10	Mud Or Sandstone
P15									
(0 – 20)	70	1.0	0.015	0.3	0.174	70	20	10	Sandy loam
(20 – 50)	110	1.8	0.03	0.6	0.348	30	45	25	Loamy soil
(50 – 100)	120	2.1	0.04	0.8	0.465	30	45	25	Loamy soil
P16									
(0 – 10)	80	1.4	0.015	0.3	0.174	50	40	10	Sandy loam
(10 -105)	110	2.2	0.03	0.6	0.348	40	40	20	Loamy soil
P17									
(0 – 11)	120	2.3	0.35	7	4.069	45	40	15	Loamy soil
(11 – 38)	120	2.5	0.04	0.8	0.465	35	50	15	Loamy soil
(38 – 90)	125	2.4	0.04	0.8	0.465	35	40	25	Loamy soil
P18									
(0 – 5)	70	1.2	0.01	0.2	0.116	75	20	5	Sandy loam
(5 – 84)	65	1.0	0.015	0.3	0.174	55	30	15	Sandy loam
(84 – 93)	70	1.0	0.01	0.2	0.116	65	25	10	Sandy loam
P19									
(0 – 12)	76	1.2	0.015	0.3	0.174	55	30	15	Sandy loam
(12 – 31)	110	2.6	0.03	0.6	0.348	40	45	15	Loamy soil
(31 – 70)	120	2.8	0.035	0.7	0.406	45	35	20	Loamy soil
P20									
(0 – 9)	125	2.7	0.04	0.8	0.465	45	35	20	Loamy soil
(9 – 23)	122	2.6	0.04	0.8	0.465	45	35	20	Loamy soil
(23 – 56)	125	2.7	0.045	0.9	0.523	45	35	20	Loamy soil
(56 – 84)	75	1.2	0.01	0.2	0.116	50	35	15	Sandy loam

Profile No & Layer cm	Ex. K ppm	Av.P ppm	T.N %	O.C %	O.M %	sand %	silt %	clay %	Tex class
P21									
(0 – 10)	82	1.4	0.15	3	1.744	55	35	10	Sandy loam
(10 – 37)	100	2.8	0.04	0.8	0.465	40	45	15	Loamy soil
(37 – 80)	120	2.7	0.04	0.8	0.465	40	45	15	Loamy soil
P22									
(0 – 12)	95	1.4	0.015	0.3	0.174	55	30	15	Sandy loam
(12 – 56)	98	1.3	0.015	0.3	0.174	55	30	15	Sandy loam
(56 – 80)	110	1.8	0.04	0.8	0.465	45	40	15	Loamy soil
P23									
(0 – 6)	76	1.3	0.01	0.2	0.116	70	25	5	Sandy loam
(6 – 91)	65	1.2	0.015	0.3	0.174	60	30	10	Sandy loam
P24									
(0 – 5)	98	1.4	0.02	0.4	0.232	55	35	10	Sandy loam
(5 – 36)	90	1.6	0.02	0.4	0.232	50	35	15	Sandy loam
(36 – 63)	75	1.3	0.015	0.3	0.174	70	20	10	Sandy loam
(63 – 81)	105	1.5	0.02	0.4	0.232	65	25	10	Sandy loam
P25									
(0 – 9)	65	1.0	0.01	0.2	0.116	75	20	5	Sandy loam
(9 – 71)	78	1.4	0.015	0.3	0.174	55	30	15	Sandy loam
P26									
(0 – 13)	65	1.2	0.01	0.2	0.116	75	20	5	Sandy loam
(13 – 35)	68	1.6	0.01	0.2	0.116	75	20	5	Sandy loam
(35 – 64)	72	1.2	0.01	0.2	0.116	75	20	5	Sandy loam
(64 – 90)	85	1.4	0.015	0.3	0.174	50	35	15	Sandy loam
P27									
(0 -10)	76	1.2	0.01	0.2	0.116	75	20	5	Sandy loam
(10 – 70)	75	1.2	0.015	0.3	0.174	55	35	10	Sandy loam
P28									
(0 – 5)	65	1.0	0.01	0.2	0.116	75	20	5	Sandy loam
(5 – 32)	66	1.0	0.01	0.2	0.116	72	20	8	Sandy loam
(32 – 43)	70	1.2	0.01	0.2	0.116	70	20	10	Sandy loam
P29									
(0 – 4)	85	1.4	0.015	0.3	0.174	65	30	5	Sandy loam
(4 – 19)	95	1.5	0.02	0.4	0.232	55	30	15	Sandy loam
(19 – 50)	90	1.4	0.015	0.3	0.174	60	30	10	Sandy loam
(50 -74)	95	1.6	0.015	0.3	0.174	65	25	10	Sandy loam
p30									
(0 -13)	88	1.4	0.01	0.2	0.116	60	30	10	Sandy loam
(13 – 70)	92	1.2	0.015	0.3	0.174	50	35	15	Sandy loam

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