Scientific Journal of Agricultural Sciences

Print (ISSN 2535-1796) / Online (ISSN 2535-180X)

Land Evaluation of Different Land Cover Classes for Agricultural Use in South East of Egypt using Remote Sensing Data

Ayman A. Abdel Khalek[1], Afify A. Afify[2], Heitham M. S. Salem[3], Mohamed. M. Elsharkawy[4] and Wesam R. Zahra[3]

[1] Egyptian Survey Authority, Giza, Egypt.
[2] Soil, Water and Environment Research Institute; Agricultural Research Center; Giza; Egypt.
[3] Faculty of Agriculture Banha University, Egypt
[4] Soils and water Sciences Department, Faculty of Agriculture, Beni-Suef University, Beni Suef, Egypt.

Citation: Ayman A. Abdel Khalek, Afify A. Afify, Heitham M. S. Salem, Mohamed. M. Elsharkawy and Wesam R. Zahra. (2023). Land Evaluation of Different Land Cover Classes for Agricultural Use in South East of Egypt using Remote Sensing Data. Scientific Journal of Agricultural Sciences, 5 (3): 117-130. https://doi.org/10.21608/sjas.2023.218124.1314.

Publisher :
Beni-Suef University, Faculty of Agriculture

Received: 16 / 6 / 2023
Accepted: 23 / 8 / 2023

Corresponding author:
Mohamed. M. Elsharkawy

Email:
elsharkawy25518@agr.bsu.edu.eg

ABSTRACT

This study carried out in an area south Egypt covering 386,171.04 hectares (ha). Remote sensed data were manipulated for defining the land cover features. Setting up Digital Elevation Model (DEM) configures the network of natural drainage flows via the descending slopes. It was a guide for allocating micro dams as water harvesting sites as well as minimizing the runoff hazards and managing the priority of land use suitability versus flood hazards. Land cover units were defined as terrestrial irrigated areas of sequentially herbaceous crops and permanent trees covering 1387.83 ha in levees; 1608.82 ha in point bar; 718.89 ha in bow bar and 23938.29 ha in alluvial plain. Terrestrial natural vegetation is dominated by xerophytes herbaceous in wadis (123533.56 ha). Terrestrial non- vegetated areas includes bare areas of rock land (98102.59 ha) and 67201.57 in bajada. Artificial non-linear surfaces include buildings (5403.59 ha) and linear features include roads and railways (875.78 ha). Aquatic areas include artificial irrigation and drainage canals (1062.15 ha) and natural water body of River Nile course (2785.92 ha). Current land suitability for specific Land Utilization Types (LUTs) was assessed by matching soil attributes with the growth requirement of each LUT. Current land suitability can be improved by decreasing of salinity and sodicity practices. Accordingly, the land units can be potentially more profitable for increasing the ability of extra crops to be more productive. Old cultivated areas are the most profitable land cover/use units highly suitable (S1) for all LUTs comparing with other land cover categories.

KEYWORDS: land evaluation, South East Egypt and remote sensed data.

1. INTRODUCTION

The FAO-Land Cover Classification System (LCCS) was used for mapping many desert areas in Egypt (Afify, 2009; Afify et al., 2022; Arafat et al., 2014b; Sheta et al., 2016). Remote sensing imagery (RS) have been used widely for mapping crops (Elsharkawy et al., 2016a, 2016b; Farg et al., 2020). Satellite sensors produce imageries of high spatial features in a fast, precise and low-cost data over large areas for mapping soil and water quality, compared with classic techniques. It's a perfect tool to assess land use/cover (Arafat et al., 2014a; Elsharkawy et al., 2022a; Nabil et al., 2022). It can be used to realize an integration of maximizing the use of water and land resources based on a complementary view (AbdelRahman et al., 2022; Elsharkawy et al., 2022b; Saleh et al., 2021). Satellite imageries also are widely used for mapping the Egyptian water resources (Elsharkawy, 2023). South east of Egypt area and its outskirts receive a seasonal amount of surface runoff during the rainy season over the mountains in the, eastern side of the study area (Peel et al., 2007). Furthermore, the available types of renewable energy can realize a successful management of this region for the agricultural land use. These natural elements can maximize the use of proposed Land Utilization Types (LUTs). In addition to trace promising areas to be under development the study realizes a specific value of the old cultivated land. This inherited rural area should to be as a protectorate. According to Afify et al 2022, this old cultivated land with Nile sedimentation should be secure as a cultural terrain with inheritable farming biodiversity (Afify et al., 2022). Setting up Digital Elevation Model (DEM) was a beneficial base that generates landscape configuration to be a guide for delineating physiographic and land cover features and for tracing the runoff directions. (Evans, 2012), considered the DEM as a basic of geomorphometric analysis that reflect the existence of a relationship between landforms and some numerical parameters. The study area and its outskirts are seasonally receive a rainy precipitations over the catchment areas in the high lands that flow as surface runoff over the drainage channels capacity via descending slopes. The status can be managed to utilize these surface water at the basin outlets for increasing ground water recharge as well as avoiding the flush flooding hazards. According to (El Bastawesy et al., 2010) the Kom-Ombo area and its outskirts includes fracture system, which is particularly promising for bringing groundwater from the Nubian aquifer. Also, directions of deep seated fractures seem to control much of the Kom-Ombo graben structure east of the Nile. Afify, 2009 stated that Egypt is located in the zone of aridic moisture regime with limited water resources. Performing a firm policy of building up assets and integrating experience for tracing extra water resources should be a profound part of our interests (Afify, 2009). Accordingly, the current study considered all these natural elements within a region includes suitable land for agricultural land use. This suitable land includes a network of available solar energy for generating electrical power. Also aligning the old cultivated River Nile sediments with easy excess for marketing and dealing beneficial activities. The processed and displayed data by Geographic Information Systems (GIS) resulting in interpreted spectral signatures of landscape features associated with specific soil taxa (Saleh et al., 2021). They can be used as a geo-data base to serve the extrapolation process when other area in the same region will be investigated (Elsharkawy et al., 2022b). The aim of the current study is to update the spatial database of land-cover categories and their level of suitability for farming use, and to trace promising areas for agrarian development. The main objective was to delineate land cover features and associated soils to trace the promising areas for agricultural land use in this unique region of promising natural elements.

2. MATERIALS AND METHODS

2.1.Study area

The study was situated in the south east Egypt, which includes part of River Nile alluvium with its eastern desert outskirts covering 386171.04 hectares. The coordinates of this area are latitude of 24°16'44 "N and longitude of 32°53'24"E in the lower-left corner, while in the upper-left corner are latitude of 24°38'12"N and longitude of 32°55'27"E. In the upper-right corner, the latitude is 24°44'13"N and the longitude is 33°43'14. "E, while in the lower-right corner, the latitude is 24°16'43"N and the longitude is 33°43'06"E (figure 1).

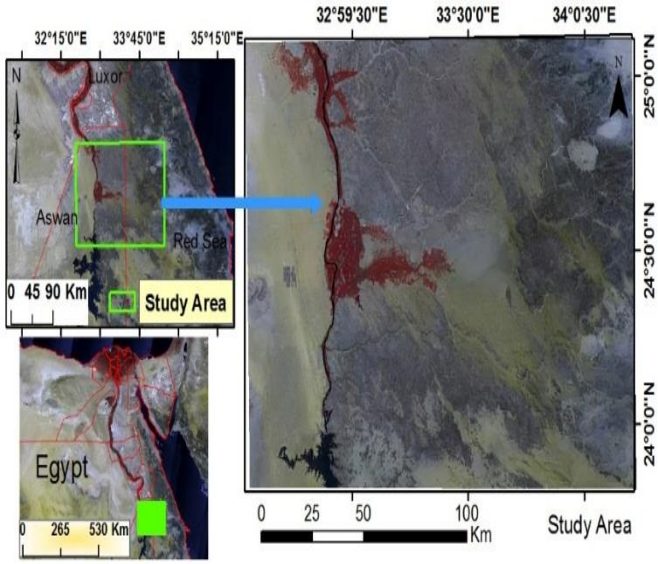

Figure 1. Location of the surveyed study site

2.2.Digital Elevation Model (DEM)

DEM was manipulated as raster layer of pixel values that are corresponding to their associated elevations. This DEM was obtained from the active sensor database Advanced Space borne Thermal Emission and Reflection Radiometer (ASTER) of resolution 30 m. These data of ASTER GDEM v2 (version 2 of Global Digital Elevation Model) are available for the globe from the United States Geological Survey (USGS). The data were manipulated in conjunction with OLI Data to provide a better visualization of the landscape configuration in the region of the study area.

2.3.Remote sensing data

Landsat 8 satellite imagery of Operational Land Image (OLI) acquired in 2022 were manipulated for land cover classification. The multispectral bands have spatial resolution of 30 meters with spectral resolutions of Green (530-590 nm), Red (640 -670 nm), and Near-Infrared (850-880 nm). These data were merged with panchromatic band of 15 meters spatial resolution with spectral resolution of 500- 680 nm.

2.4.Imagery geometric-corrections and data sub-setting of remote sensing imagery

Remotely sensed data were geometrically rectified utilizing Universal Transverse Mercator (UTM) projection, zone 36, spheroid and the stetted datum was WGS 84. Subscenes were segmented to fit the local study area utilizing cartographic software from ERDAS (2010) to demote data space and processing time.

2.5.Automated and visual land cover classification

Land-cover components categorized regarding to landscape attributes, utilizing unsupervised automatic classification. This process is based on the natural divisions of pixels by the clustering technique of the ISODATA (Iterative Self-Organizing Data Analysis Technique) of (ERDAS, 2010). Major roads, railroads and waterways were visually defined in the GIS shapefile as linear features and buffered as polygons measured as areas. Land-cover categories were determined as stated by the LCCS (Di Gregorio, 2005) and regarding to the physiographic units as mentioned by (Zinck and Valenzuela, 1990).

2.6.Identifying Geographic Features

Pinpointing geographical characteristics of the location site utilizing topographic of scale 1: 50000, which were issued by the Egyptian Land Survey Authority (1990).

2.7.Data collection and fieldwork

Fieldwork was initiated to validate the primary characterization maps through various ground truth observations and to confirm or correct boundaries between land-cover divisions and land-cover categories. For soil morphological survey and data sampling, 17 soil profiles representing land-cover units were selected using the Global Positioning System 'GPS'. Soil layers are listed according to the terminologies of the soil survey manual (Soil Science Division, 2017).

2.8.Laboratory analyses

To identify different texture classes in the studied site, particle size distribution was measured as mentioned by Sparks *et al.* (2020) using the pipette after eliminating salts and organic materials. Hexametaphosphate Sodium was added as a scattering agent. According to Nelson (1982), the Calcimeter utilized to take the measurements of calcium carbonate percentage, while gypsum percentage was measured by precipitation technique with acetone**.** Soil salinity were determined in soil paste extract and expressed as Electric-Conductivity (EC) according to (Carter and Gregorich, 2007). Soil pH in soil paste and Exchangeable Sodium Percentage (ESP) were estimated as referred by Richard (1954).

2.9. Evaluation of land suitability for agrarian land-use

For the irrigated cultivation, the land assessment was performed utilizing the tabulated criteria as referred by Sys *et al*. (1993) for arid and semi-arid regions for evaluating each land utilization type versus certain land cover class.

3. RESULTS AND DISCUSSION

3.1. Setting up Digital Elevation Model (DEM)

Digital Elevation Model (DEM) was produced as a guide for defining corresponding elevations as 3-dimentional visualization in projections. The elevation intervals in this produced DEM are highly correlated with the defined physiographic units and their associated land cover fractures and soil attributes. Within the descending slopes landscape features are highly affected by their relative positions, which face variations of flush flooding action. The case reflects variability of erosion and sedimentation processes within the land configuration and via specific drainage pattern. These patterns link the catchment area in the high lands with the drainage basin in the low lands. Accordingly, DEM serves as a satisfactory overall view to be basis for understanding the best way for managing the land and water resources.

Rabah et al., (2017) stated that DEM is crucial to a wide range of surveying and civil engineering applications worldwide. Furthermore, it can be utilized as a data source for mathematical analysis of the topography and landscape (Martinez and Muñoz, 2016). Munar and Martínez, 2014 considered this DEM as a base for enhancing soil information as well as enhancing land evaluation. The study area and its outskirts are graphed by elevations range from 75 to 792 meters above sea level.

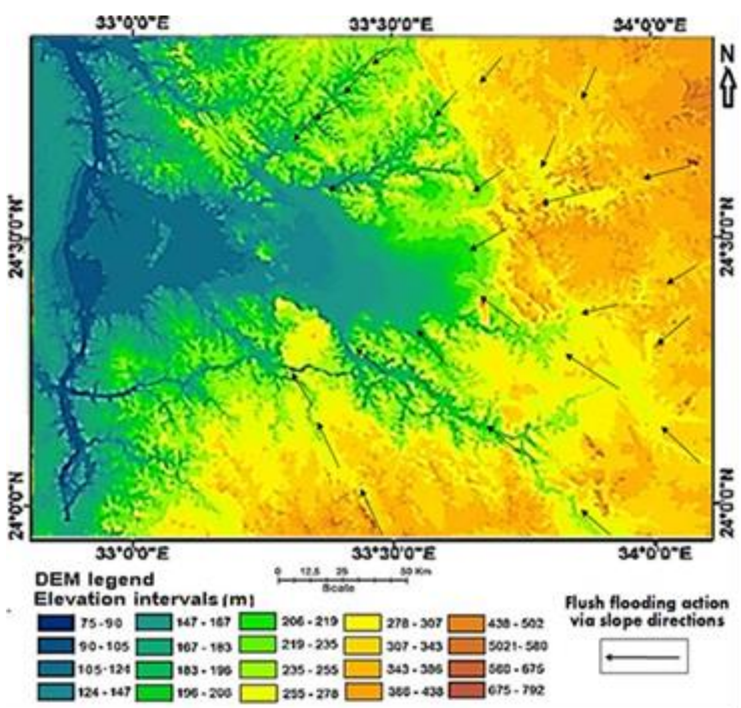

Figure 2. DEM and slope directions in the study area and its outskirts

Table 1. Land cover classes and their spatial distribution in the study area

Land cover classes	Area per hectares	Percent (%)
Irrigated agriculture in Nile Levee	1387.83	0.36
Irrigated agriculture in Nile point bar	1608.82	0.42
Irrigated agriculture in Nile bow bar	718.89	0.19
Irrigated agriculture in Nile alluvial plain	23938.29	6.20
Natural vegetation in wadis partly cultivated	123533.56	31.99
Bare area in rock land	98102.59	25.4
Bare area in pediplain	59552.04	15.42
Bare area in bajada	67201.57	17.4
Non linear surfaces (setllements)	5403.59	1.40
Linear surfaces (roads and railways)	875.78	0.23
Artificial waterbodies (irrigation and drainage canals)	1062.15	0.27
Natural water body (River Nile)	2785.92	0.72
Total area	386171.04	100

This overall view configures the network of natural drainage flows westwards having impacts on the low laying cultivated lands. Accordingly, DEM (figure 2) can be used as a guide for allocating micro dams as water harvesting sites and minimizing the runoff hazard .

Moreover, can help for managing the priority of land use allocations versus these flood hazards considering the relationship between certain land unit and the required land utilization types.

3.2.Defining land cover units and their spatial distributions

The defined land cover features were delineated as terrestrial vegetated area of irrigated cultivation-and natural vegetation. Non-vegetated areas iclude terrestrial artificial surfaces or aquatic ones as artificial or natural water bodies. They are listed in Table 1and, mapped in figure 3 and described as follows :

3.2.1. Terrestrial vegetated area

3.2.1.1.Cultivated lands

These cultivated lands include irrigated cultivation, which are mostly managed under surface irrigation of sequentially herbacous crops and permanently managed trees. This land-cover category is covering 1387.83 hectares (ha) in Nile levees as 0.36%; 1608.82 ha in Nile point bar as 0.42 %; 718.89 ha in bow bar as 0.19 % and 23938.29 ha in Nile alluvial plain as 6.20 percent (%) of the total site area

3.2.1.2.Natural-vegetation

Natural-vegetation includes xerophytes sparse herbaceous and shrubs in wadis covering 123533.56 ha as 31.99 %

3.2.2.Terrestrial non-vegetated area

3.2.2.1.Consolidated bare-areas of rock land

This land-cover class is covering 98102.59 ha (15.42 %). It is attributed by consolidated surfaces of hard rock .

3.2.2.2.Unconsolidated bare-areas

This land cover class (67201.57 ha) in bajada as17.4 %. It is dominated by bare areas of gravelly soils with very local scattered herbaceous in riled landscape.

3.2.2.3.Artificial non linear surfaces

These non-linear surfaces represent the buildings of settlements or administrative affairs, which cover 5403.59 ha (1.40 %).

3.2.2.4.Linear surfaces

These linear surfaces were traced as lines that represen a nework of infrastructure including the main asphated roads and railways. They were bufferd considering each of their width to be calculated as areas in polygons that cover 875.78 ha as 0.23%

3.2.3. Aquatic non-vegetated area

3.2.3.1.Artificial water bodies

These artificial water bodies are a nework of flowing water in the satudy area as irrigation and drainage canals. They were traced and buffered as polygons covering 1062.15 as 27% .

3.2.3.2.Natural water bodies

This natural water body represents a locall allocated part of River Nile course in the study area that covers 2785.92 ha as 0.72 %

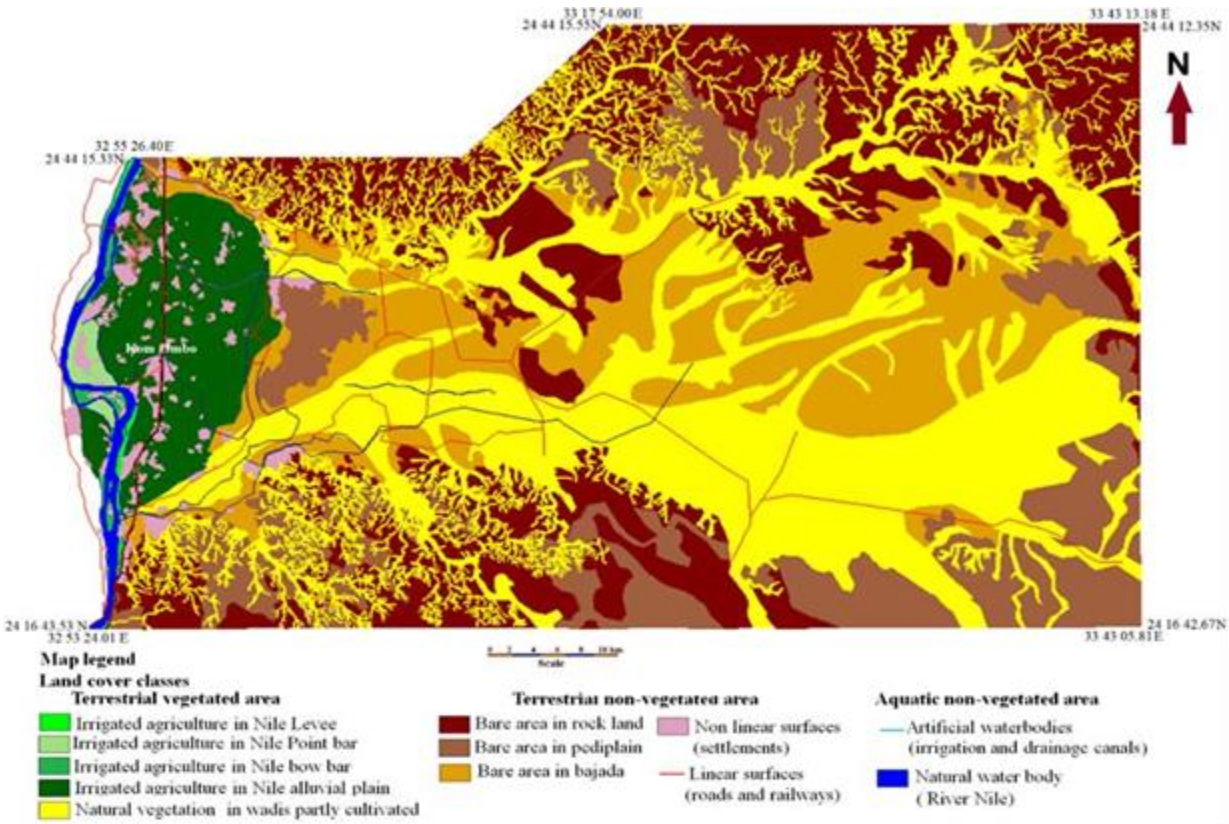

Figure 3. The spatial distribution of land cover units in the study area.

3.3. Land evaluation for agricultural use

In this study, land evaluation defines specific levels of soil managements for land use as land units rather than evaluating each individual soil profile. Suitability assessment based on evaluating each land-cover unit for defined LUT to identify the most productive LUT in certain land cover unit. The purpose was to maximize the productivity in all the land units in the study area. The proses of performing land suitability legend based on managing irrigated agriculture in arid and semi-arid regions. Suitability classification was processed to define orders as suitable (S) or not suitable area (N). These orders were classified as highly suitable area (S1), moderately suitable area (S2), marginally suitable area (S3), currently not suitable area (N1) and potentially not suitable area (N2). This Land evaluation was assessed by matching the calculated ratings that based on soil attributes (Table 2) with the crop requirements as proposed by (Sys et al., 1993). The calculated ratings are soil depth, drainage, texture, calcium carbonate, gypsum, pH, salinity and alkalinity. The land was evaluated for the LUTs that are traditionally cropped as terrestrial cultivation and mainly managed under surface irrigation. These collective LUTs were considered to satisfy the requirements in Egypt for edible and fodder crops as well as oil seed crops.

Table 2. Soil chemical and physical analyses in land cover units

phyhsiographic units	Profile No.	Depth (cm)	Gravel %(vv)	Particle size distribution			Modified Texture class	$CaCO_3$ g/kg.	$CaSO_4$ g/kg.	pH	EC	ESP
				Sand (%)	Silt (%)	Clay (%)						
Irrigated agriculture in Nile levee	8	0 - 20	-	39.2	20.7	40.1	C	13.2	8.4	7	0.9	2.9
		20 - 65	-	42	31.2	26.8	L	14.2	9.4	8	1	4.8
		65 - 120	-	46.7	30.1	23.2	L	17.5	8.8	8	0.8	3.9
		120 - 150	-	28.7	35.2	36.1	CL	11.6	7.9	8	1	5.1
	17	0 - 25	-	30.7	34.2	35.1	CL	12.2	8.9	8	0.7	3.9
		25 - 65	-	47.9	29.5	22.6	L	14.3	7.4	8	0.8	2.8
		65 - 85	-	63.9	20.3	15.8	SL	19.5	8.3	8	0.9	2.9
		85 - 150	-	33.9	31.1	35	L	17.6	5.9	8	1	4.7
Irrigated agriculture in Nile point bar	6	0 - 30	-	50.8	27.6	21.6	L	19.4	3.4	8	1.1	4.9
		30 – 75	-	31.1	33.4	35.5	CL	17.5	9.4	8	1	3.4
		75- 100	-	84.3	7.3	8.4	LS	16.7	4.8	8	0.8	3.8
		100- 150	-	82.1	8.2	9.7	LS	18.6	5.9	8	0.9	2.9
	7	0 - 30	-	74.9	9.9	15.2	SL	21.2	8.4	8	0.8	4.1
		30 - 85	-	49.9	26.7	23.4	L	26.1	9.8	8	0.9	4.1
		85 - 150	-	86.7	6.2	7.1	LS	12.5	8.1	8	0.7	4.2
Irrigated agriculture in Nile bow bar	4	0 - 30	-	38.3	19.8	41.9	C	18.8	5.9	8	1	3.8
		30 – 60	-	45.1	30.5	24.4	L	17.4	6.8	8	1.1	4.3
		60 - 100	-	69.9	14.7	15.4	SL	20.4	7.3	8	0.8	3.1
		100- 150	-	65.8	16.5	17.7	SL	21.5	8.5	8	1	6. 2
	5	0 - 30	-	36.9	31.1	32	CL	14.9	9. 4	8	0.8	6.8
		30 – 80	-	39.8	29.9	30.3	CL	16.8	6.4	8	0.9	6.7
		80 - 100	-	74.9	11.3	13.8	SL	30.8	7.3	8	0.8	5.9
		100- 150	-	37.9	30.6	31.5	CL	24.2	4.7	8	1	5.8

Table 2

Irrigated agriculture in Nile alluvial plain	6	0 - 25	-	38.3	20.8	40.9	C	11.8	3.8	7	1.1	3.8
		25 - 50	-	30.2	20.2	49.6	C	19.4	10.3	7	1.3	3.9
		50 - 70	-	16.2	40.9	42.9	C	30.8	7.2	8	0.8	6.1
		70-150	-	40.2	19.6	40.2	C	22.2	9. 3	8	1.4	5.6
	7	0 - 20	-	36.7	18.2	45.1	C	18.8	6.8	7	1	6.9
		20 - 50	-	29.5	19.4	51.1	C	19.9	7.6	8	0.9	8.6
		50 - 80	-	33.2	18.3	48.5	C	32.8	6.5	8	0.8	7.9
		80 - 150	-	34.8	17.8	47.4	C	20.2	8. 7	8	1.1	5.8
	8	0 - 20	-	39.5	16.3	44.2	C	28.8	8. 7	7	7.1	1.5
		25 – 70	-	36.2	19.7	44.1	C	29.9	9.8	8	7.9	1.1
		70 - 85	-	28.1	34.5	37.4	CL	12.8	8.5	7	7.2	0.9
		85 - 150	-	39.5	16.3	44.2	C	21.7	6.9	8	7.1	0.9
Natural vegetation in wadis partly cultivated	9	0-25	5	77.1	10.8	12.1	SG, SL	12.3	33.8	7	1.1	2.9
		25-80	5	63.9	14.2	21.9	SG, CL	15.4	49.3	8	2.3	4.1
		80-100	10	82.7	9.6	7.7	SG, LS	13.2	37.8	7	2.6	2.4
		100-150	5	73.1	12.4	14.5	SG, SL	14	54.2	8	1.9	12
	10	0-20	10	70	14.3	15.7	SG, SL	13.4	30.7	7	1.8	5.4
		20-75	10	47.1	28.9	24	SG, SCL	14.6	45.1	8	2.5	5.2
		75-120	15	81.8	9.5	8.7	G, LS	12.5	36.9	7	2.3	6.1
	11	0-30	10	72.2	14.3	13.5	SG, SL	15.7	40.7	7	1.9	5.3
		30-85	5	48.1	27.6	24.3	SG, SCL	16.2	42.5	8	3.1	4.3
		85-100	10	57.2	21.2	21.6	SG, SCL	13.7	55.9	8	2.1	5.1
	12	0-25	10	43.1	32.4	24.5	SG, L	12.6	43.8	7	2.2	4.7
		25-75	5	44.9	26.1	29	SG, SCL	10	44.3	8	1.8	9.7
		80-100	10	42.1	27.1	30.8	SG, SCL	11	47.8	7	3.7	3.9
		100-150	5	71.1	13.1	15.8	SG, SL	13.1	39.8	8	1.1	4.5

Table 2

Bare area in pediplain	15	0-15	15	82.8	9	8.2	GLS	99	104.1	8	11	11
		15-45	15	76.8	12.3	10.9	GSL	40.2	106.3	8	14	16
		> 45	Bed rock of sandstone									
	16	0-20	10	84.3	8.5	7.2	SGLS	117.8	99.1	8	15	9.1
		20-45	25	82.9	7.6	9.5	GLS	64.2	42.1	8	16	16
		> 45	Bed rock of sandstone									
Bare area in bjada	13	0-20	15	58.2	21.3	20.5	GS, CL	42	45.8	8	3.3	5.4
		20-45	25	67.9	17.7	14.4	GSL	59.4	98.5	8	4.7	6.7
		45-85	20	71.9	11.7	16.4	GSL	18.1	48.6	8	3.9	12
		85-150	30	81.6	9.6	8.8	GLS	15	80	8	5.1	6.9
	14	0-25	15	70.3	13.4	16.3	GSL	39.4	45.1	7	2.7	5.1
		25-50	10	67.2	17.3	15.5	SG, SL	22	102.4	8	2.4	3.5
		50-85	10	46.1	29.6	24.3	SG, SCL	50.5	43.5	7	3.6	3.9
		85-120	15	69.5	13.8	16.7	GSL	10.2	73.5	8	4.1	4.8

Where: C = clay; CL = clay loam; SL = sandy loam; LS = loamy sand; SG = slightly gravely; SCL = sand clay loam; SL = sandy loam; LS = loamy sand and vv = volume of void-space

3.4. Current suitability of definite land-cover categorize for specific LUTs

The current suitability for those LUTs are shown in Table 3. Land-cover divisions were rated for various LUTs. The suitability categorizes for irrigated farming in levees and bow bars are highly suitable area (S1) for all LUTs, while irrigated cultivation in point bars are S1.for most of LUTs but moderately suitable area (S2) for soya beans and wheat crop. Irrigated cultivation in alluvial plain is S1 for most LUTs but is S2 for beans, potato, sesame, soya beans, citrus trees, mango, while is marginally suitable area (S3) for carrot. Areas of natural vegetation in wadis are S1 for alfalfa and barley, sesame, S2 for cabbage, beans, cowpea, maize, onion pea, potato, sorghum, sunflower, wheat, guava, mango, green pepper, tomato, carrot crop and citrus trees, while are N1 for beans crop and soya beans. Bare area in bajada is S2 for alfalfa, cowpea, maize, sesame, sorghum, sunflower, wheat, date palm; while is S3 for barley, cabbage, green pepper, onion, potato, tomato, guava, citrus and mango but are currently not suitable area (N1) for beans, carrot, and soya. Bare areas in pediplain are S3 for barley, and N1 for other crops. Bare areas in rock land are potentially not suitable area (N2) for all crops.

Table 3 Current soil suitability of definite land-cover categorize for specific LUTs

Land-cover class	Suitable Crops	Land suitability
Irrigated griculture in Nile levees and bow bars	Alfalfa, beans, cabbage, carrot, cowpea. green pepper, maize, onion, pea, potato, sesame, soya tomato, sorghum, sweet potato, wheat, sunflower, tomato, date palm, citrus, guava and mango	Highly suitable area(S1)
Irrigated griculture in Nile point bar	Alfalfa, barley, cabbage, carrot, cowpea, green pepper, maize, onion, pea, potato, sesame, sorghum, sunflower, sweet potato, tomato, date palm, citrus, guava and mango	Highly suitable area (S1)
	Beans, soya and wheat	Moderately suitable area (S2)
Irrigated griculture in Nile alluvial plain	Alfalfa, barley, cabbage, cowpea, green pepper, maize, onion, pea, sorghum, sunflower, sweet potato, tomato, wheat, date palm and guava	Highly suitable area (S1)
	Beans, potato, sesame, soya, citrus, and mango	Moderately suitable area (S2)
	Carrot	Marginally suitable area (S3)
Natural vegetation in wadis partly cultivated	Alfalfa, Barley crop and sesame	Highly suitable area (S1)
	Cabbage, beans, cowpea, maize, onion, pea, potato, sorghum, sunflower, sweet potato, wheat, date palm, guava and mango	Moderately suitable area (S2)
	Green pepper, tomato, carrot and citrus	Marginally suitable area (S3)
	beans and soya	N1
Bare area in bajada	Alfalfa, cowpea, maize, sesame, sorghum, sunflower, wheat and date palm	Moderately suitable area (S2)
	Barley, cabbage, green pepper, onion, pea, potato, sweet potato, tomato guava, citrus and mango	Marginally suitable area (S3)
	Beans, carrot and soya	N1
Bare area in pediplain	Barley	Marginally suitable (S3)
	Other crops	N1
Bare area in rock land.	All crops	N2

3.5. Potential land suitability

Current suitability of the virgin land can be improved by correcting the levels of Limitations, are mainly concerning the limitations of salinity and sodicity. Accordingly, the Land units can be potentially more profitable for most of increasing the ability of extra crops to be more productive. Potential land suitability classes for Irrigated griculture in Nile levees and bow bars are S1.for all LUTs. Irrigated griculture in Nile point bars are S1.for most of LUTs but S2 for, beans soya and wheat. Irrigated griculture in Nile Alluvial plain is S1 for most LUTs but is S2 for beans potato, sesame, soya citrus and mango, while is (S3) for carrot. Areas of natural vegetation in wadis (partly cultivated) are S1 for alfalfa, barley, cabbage, sesame, onion and sesame, while are S2 for beans, cowpea maize, pea, potato, sorghum, sunflower, sweet potato, wheat, date palm guava and mango. They are S3 for tomato carrot, green pepper and citrus but are N1 for soya. Bare area in bajada is S2 for Alfalfa, beans, cowpea, maize, onion, pea, potato, sesame, sorghum, sunflower, wheat, date palm; mango and citrus, while is S3 for barley, cabbage, carrot green pepper, sweet potato, tomato, guava, but are currently not suitable area (N1) for soya. Bare areas in pediplain are S3 for barley, cabbage, cowpea, maize, potato and wheat, while are N1 for other crops. Bare areas in rock land are potentially not suitable area (N2) for all crops. Potential land suitability classes for LUTs are shown in Table 4.

4. RECOMMENDATIONS

1-The study area was situated in a unique region with natural element including relief of seasonal flush flooding and available renewable energy. These natural resources can be managed for maximizing the agricultural development in such region.

2- DEM reflect an overall view that can help as a base for earthwork concerning the network of natural drainage flows eastwards with erosional and depositional processes. These processes have impacts on the low laying lands. Accordingly, DEM can be used as a guide for allocating micro dams as water harvesting sites and minimize the runoff hazard. The case can help managing the priority of land use allocations versus the flood hazards.

3-LUTs were proposed as edible and fodder crops as well oil seed crops to fit the need of food security and as economic importance in industry.

4-The current land suitability can be improved as potential land suitability one by correcting salinity and sodicity limitations. By cultivating specific LUT in certain more suitable land unit, all land units will be more profitable.

5. REFERENCES

Abdel Rahman MAE, Saleh AM, Elsharkawy MM, Farg E, Moustafa M, Abutaleb K and Arafat SM (2022). Geomatics-Based Mapping of Hydraulic Soil Properties for Agricultural Management. Ann. Agric. Sci. Moshtohor 60, 225–238. https://doi.org/10.21608/assjm.2022.227887

AbdelRahman MAE, Farg E, Saleh AM, Sayed M, Abutaleb K, Arafat SM, Elsharkawy MM (2022). Mapping of soils and land-related environmental attributes in modern agriculture systems using geomatics. Sustain. Water Resour. Manag. 8, 116.

Afify AA (2009). Land resources evaluation of the paleodarainage delta in western desert of egypt using remote sensing data. Egypt. J. Remote Sens. Sp. Sci. 12, 3–26.

Afify AA, El Tabey H, Abdel Moneim AET, Al-Gammal I and Afify NM (2022). Monitoring and evaluating the attributes of retreated cultivated land under urban encroachment in South Giza Governorate, Egypt. Sci. J. Agric. Sci. 4, 11–23.

Arafat SM, Afify AA, Nagwan MA and Elsharkawy MM (2014). Change detection of land use/land cover categories in the Nile Delta region using remote sensing and GIS, in: SPIE Remote Sensing. in Proceedings of the SPIE Remote Sensing and SPIE Security, Amsterdam, Netherland, p. vol. 9239.

Table 4. potential land suitability of certain land-cover class for specific LUTs

Land-cover class	Crops	Land suitability
Irrigated agriculture in Nile levees and bow bars	Alfalfa, barley, beans, cabbage, carrot, cowpea, green pepper, maize, onion, pea, potato, soya tomato, sweet potato, sesame, sorghum, sunflower, tomato, wheat, date palm, citrus, guava and, mango	Highly suitable area (S1)
Irrigated agriculture in Nile point bars	Alfalfa, barley, cabbage, carrot, cowpea, green pepper, maize, onion, pea, potato, sesame, sorghum, sunflower, sweet potato, tomato, date palm, citrus, guava and mango	Highly suitable area (S1)
	Beans, soya and wheat	Moderately suitable area (S2)
Irrigated agriculture in Nile alluvial plain	Alfalfa, barley, cabbage, cowpea, green pepper, maize, onion, pea, potato, sesame, sorghum, sunflower, soya, sweet potato, tomato, wheat, date palm and guava.	Highly suitable area (S1)
	Beans, potato, soya, citrus and mango	Moderately suitable area (S2)
	Carrot	Marginally suitable area (S3)
Natural vegetation in wadis partly cultivated	Alfalfa, Barley, cabbage, sesame, onion and sesame	Highly suitable area (S1)
	Beans, cowpea, maize, pea, potato, sorghum, sunflower, sweet, potato, wheat, date palm, guava and mango	Moderately suitable area (S2)
	Tomato, carrot, green pepper and citrus,	Marginally suitable area (S3)
	Soya	N1
Bare area in bajada	Alfalfa, beans, cowpea, maize, onion, pea, potato, sesame, sorghum, sunflower, wheat, citrus date palm, mango and citrus	Moderately suitable area (S2)
	Barley, cabbage, carrot, green pepper, sweet potato, tomato and guava.	Marginally suitable area (S3)
	Soya	N1
Bare area in pediplain	Barley, cabbage, cowpea, maize, potato and wheat.	Marginally suitable area (S3)
	Other crops	N1
Bare area in rock land	All crops	N2

Arafat Sayed M, Saleh NS, Aboelghar M, Elshrkawy M (2014). Mapping of North Sinai land cover according to FAO-LCCS. Egypt. J. Remote Sens. Sp. Sci. 17, 29–39. https://doi.org/https://doi.org/10.1016/j.ejrs.2014.03.002

Carter MR and Gregorich EG (2007). Soil sampling and methods of analysis (eds). Canadian Society of Soil Science, Lewis Publisher, CRC Press. CRC press.

Di Gregorio A (2005). Land cover classification system: classification concepts and user manual: LCCS. Food & Agriculture Org.

El Bastawesy M, Faid A and Gammal ESEl (2010). The Quaternary development of tributary channels to the Nile River at Kom-Ombo area, Eastern Desert of Egypt, and their implication for groundwater resources. Hydrol. Process. 24, 1856–1865.

Elsharkawy MM, Nabil M, Farg E and Arafat SM (2022a). Impacts of land-use changes and landholding fragmentation on crop water demand and drought in Wadi El-

Farigh, New Delta project, Egypt. Egypt. J. Remote Sens. Sp. Sci. 25, 873–885.

Elsharkawy MM, Sheta AEAS, Abd El-Wahed MS, Arafat SM, El Behiery OM (2016a). Precision agriculture using remote sensing and GIS for peanut crop production in arid land. Int. J. Plant Soil Sci. 10, 1–9.

Elsharkawy MM, Sheta AEAS, D'Antonio P, Abdelwahed MS and Scopa A (2022b). Tool for the Establishment of Agro-Management Zones Using GIS Techniques for Precision Farming in Egypt. Sustainability 14. https://doi.org/10.3390/su14095437

Elsharkawy MM, Sheta AS, Arafat SM and Abd El-Wahed MS (2016b). Precision agriculture using advanced remote sensing techniques for peanut crop in Arid Land. J. Hyperspectral Remote Sens. 6, 72–81.

ERDAS I (2010). Earth resources data analysis system. ERDAS Inc. Atlanta, Georg. 628.

Evans IS (2012). Geomorphometry and landform mapping: What is a landform? Geomorphology 137, 94–106.

Farg E, Abutaleb K, Arafat S, Elsharkawy MM and Nabil M (2020). Assessment of Sentinel-2 data capabilities for vegetation physiological parameters retrieving in the Nile Delta. Biosci. Res. 17, 467–478.

Martinez LJ and Muñoz NAC (2016). Digital elevation models to improve soil mapping in mountainous areas: case study in Colombia. Geopedology An Integr. Geomorphol. Pedol. soil Landsc. Stud. 377–388.

Munar-Vivas OJ and Martínez MLJ (2014). Relief parameters and fuzzy logic for land evaluations of mango crops (Mangifera indica L.) in Colombia. Agron. Colomb. 32, 238–245.

Nabil M, Farg E, Arafat SM, Aboelghar M, Afify NM and Elsharkawy MM (2022). Tree-fruits crop type mapping from Sentinel-1 and Sentinel-2 data integration in Egypt's New Delta project. Remote Sens. Appl. Soc. Environ. 27, 100776. https://doi.org/10.1016/J.RSASE.2022.100776

Peel MC, Finlayson BL and McMahon TA (2007). Updated world map of the Köppen-Geiger climate classification. Hydrol. Earth Syst. Sci. 11, 1633–1644. https://doi.org/10.5194/hess-11-1633-2007

Rabah M, El-Hattab A and Abdallah M (2017). Assessment of the most recent satellite based digital elevation models of Egypt. NRIAG J. Astron. Geophys. 6, 326–335.

Richard LA (1954). Diagnosis and Improvement of Saline and Alkaline Soils. Agricultural Handbook No. 60. US Dep. Agric. https//www. ars. usda. gov/pacificwest-area/riverside-ca/us-salinity-laboratory/docs/handbook-no-60/(accessed 26.27. 2017).

Saleh AM, Elsharkawy MM, AbdelRahman MAE and Arafat SM (2021). Evaluation of Soil Quality in Arid Western Fringes of the Nile Delta for Sustainable Agriculture. Appl. Environ. Soil Sci. 2021, 1434692. https://doi.org/10.1155/2021/1434692

Sheta AEAS, Afify AA, Abd-Elwahed M S, Mohammed AA and Arafat SM (2016). Impacts of land reclamation and urbanization on agriculture land use in Egypt, in: ElBeltagy, A. (Ed.), Twelfth International Dryland Development Conference "Sustainable Development of Drylands in the Post 2015 World." Twelfth International Dryland Development Conference, Alexandria, Egypt.

Soil Science Division, U., 2017. Soil survey manual. USDA Handb. 18.

Sys C, Van Ranst E, Debaveye J and Beernaert F (1993). Land Evaluation. Part III: crop requirements. Agricultural Publications n° 7, GADC, Brussels, Belgium, 1993, 191 p.

Zinck JA and Valenzuela CR (1990). Soil geographic database: structure and application examples. ITC J. 270–294.

الملخص العربي

تقييم اقسام الغطاء الارضى المختلفة من اجل الاستغلال الزراعى فى جنوب شرق مصر باستخدام بيانات الاستشعار من البعد

ايمن احمد عبد الخالق[١]، عفيفى عباس عفيفى[٢]، هيثم محمد شحاتة سالم[٣]، محمد مرتضى الشرقاوى[٤] ووسام رشاد احمد زهرة[٣]

[١]هيئة المساحة المصرية – مصر

[٢]معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

[٣]كلية الزراعة – جامعة بنها – مصر

[٤]قسم علوم الأراضى والمياه – كلية الزراعة – جامعة بنى سويف – مصر

اختيرت منطقة الدراسة فى جنوب شرق مصر ممتدة فى مساحة ٣٨٦,١٧١ الف هكتار وقد استخدمت بيانات الاستشعار عن البعد للقمر الاصطناعى (Landsat 8 (OLI لعام ٢٠٢٢ لتعريف ملامح الغطاء الارضى باستخدام نموذج االارتفاعات الرقمى امكن التعرف على شبكة تدفق الصرف الطبيعى خلال انحدارات الميول ليكون دليلا لاحقا لتحديد مواقع السدود الصغيرة لتجميع المياه وايضا للحد من مخاطر السيول بالاضافة الى تحديد بدائل لمواقع استخدامات الاراضى فى مواجهة مخاطر السيول وقد تم تحديد وحدات الغطاء الارضى كمساحات مزروعة بنباتات المناطق الجافة الحولية والمتناوبة والتى تشمل مساحات للاشجار ويمتد هذا القسم من الغطاء الارضى الى ١٣٨٧,٨٣ هكتار فى اكتاف النهر والى ١٦٠٨,٨٢ هكتار وفى العوارض المحدبة داخل النهر تمتد الى ٧١٨,٨٩ هكتار بينما تمتد الى ٢٣٩٣٨,٢٩ فى السهل الرسوبى، وغطاء نباتى طبيعى فى الوديان يسوده نباتات موسمية محبة للجفاف مساحته ١٢٨٥٣٣,٥٦ هكتار، مساحات غير منزرعة فى المنطقة الصخرية مساحتها ٩٨١٠٢ وتمتد فى الباجادا الى ٦٧٢٠١,٥٧ هكتار بينما فى سهل التجوية تغطى٥٩٥٥٢,٠٤ هكتار سطوح اصطناعية تشتمل على البنايات بمساحة ٥٤٠٣,٥٩ هكتار بينما تغطى الطرق الاسفلتية والسكك الحديدية ٨٧٥,٧٨. هكتار وتغطى القنوات الاصطناعية للرى والصرف١٠٦٢,١٥ هكتار اما جزء نهر النيل المتاخم لمنطقة الدراسة مساحته ٢٧٨٥,٩٢ هكتار. تم تحديد صلاحية الاراضى الحالية لاستخدامات انماط معينة عن طريق مقابلة خصائص التربة لاحتياجات نمو كل نمط لمحصول معين ويمكن تحسين هذه الصلاحية الحالية عند تعديل مستوى المحددات الخاصة بالملوحة والقلوية مما يجعل الصلاحية الكامنة اكثر ربحية مع محاصيل اخرى لتكون اكثر انتاجية. اتضح ان وحدات الغطاء للاراضى المستزرعة القديمة هى الافضل صلاحية لكونها عالية الصلاحية لكل المحاصيل مقارنة لباقى وحدات الغطاء الارضى.