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Agro-Ecological Assessment Soil Suitability for some Crops in the Newly Reclaimed Areas in the Western Desert, Giza Governorate, Egypt

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THE AREA under investigation bounded by longtitudes 31° 00¯ west and 31° 15¯ east and latitudes 29° 15¯ south and 30° 00¯ north and the total area is about 1813.34 Km^2, in the Western Desert Giza Governorate Egypt. Thirteen soil profiles were chosen to representative the soils of the area and discripted in the field and collected the disturbed samples to analyses. Based on the morphological discreption and analytical data classified the soils as Torripsamments and Torrifluvents. To make suitability using the Micro LEISIP (Integrated Pakage), which including the assessment of land suitability in the studied area indicate that the barren areas which observed in the mapping units of WP1, WP2, WP31, and WV with total area about 1545.51 km^2 have marginal suitable areas (S4 and S5) for all selected crops and fruit trees due to the high content of coarse gravels, the excessively drainage condition, high content of $CaCO_3$ and salts, except olive has moderate suitable (S3) in these areas. On the other hand the mapping units of WP32, WP33, AW11, AW12, AW21, and AW22 are cultivated areas and total area is about 31267.831.14 km^2 the suitable ranges between high suitable (S2) and moderate suitable (53) to cultivate all selected crops and fruit trees. Moreover, the mapping units of AW11 and AW12 have optimum suitable (S1) to cultivate cotton. The cultivated areas of the study area showed healthier soil quality than the barren one. These results manifested the impact of human activity on the ecosystem and its power to convert unsuitable areas to be come suitable. There is need to improve irrigation and drainage system to increase land suitability for crops and fruit trees in the study area. Human impact on the ecosystem and incorporating indigenous knowledge must be considered if any sustainable development have to be successful.

Keywords: Analytical data, Almagra model, Description, Soil suitability, Mapping units, Improve, Sustainable.

Land suitability assessment for agriculture is meant to evaluate the ability of a piece of land to provide the optimal ecological requirement of a certain crop variety. In other words, assessing the capability of land is enabling optimum crop development and maximum productivity. Without respect to economic conditions a physical suitability evaluation indicates the degree of suitability for a land use (Rossiter *et al.*, 1997). The application of information and communication technology has exerted an impact on sustainable land use decision support system, as the assessment of land performance when used for specified purposes, provides a rational basis for land use planning (De la Rosa *et al.*, 2002). DSS are computerized technology that can be used to support complex decision-making and problem solving. Many people consider geographic information system (GIS) as very useful decision support system. Thus the use of (GIS) conceptual based methodologies for this kind of under taking is advantageous (Booty *et al.*, 2001).

Since 1990, Micro LEIS (Mediterranean Land Evaluation Information System) has evolved towards an agro-ecological DSS. Today Micro LEIS DSS is a set of useful tools for decision-making which in a wide range of agro-ecological schemes. ALMAGRA agricultural soil suitability model is one of the Micro LEIS micro-computer DSS models. It fits the types of biophysical evaluation that use as diagnostic criteria those soil characteristics or conditions favorable for crop development in function of productivity affecting (Dela Rosa *et al.*, 2002). It is based on an analysis if the edophic characteristics most directly affecting productive development under different agricultural uses. It's confection follows the general scheme proposed by Beek & Bennema (1972), in the Expert consultation land Evaluation for Rural Purposes, adapted to the conditions and needs of a typical reference zone (Fig. 1) .

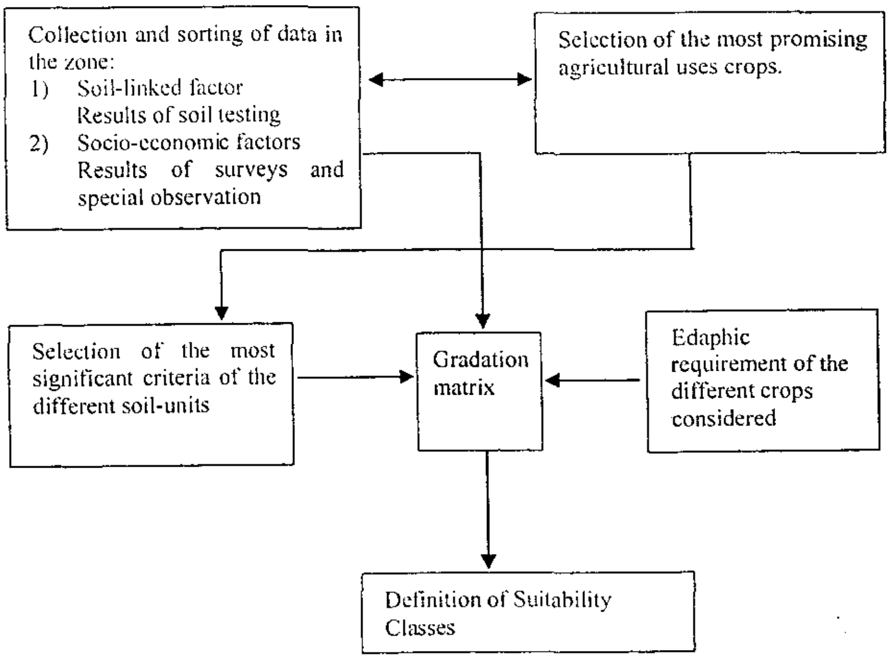


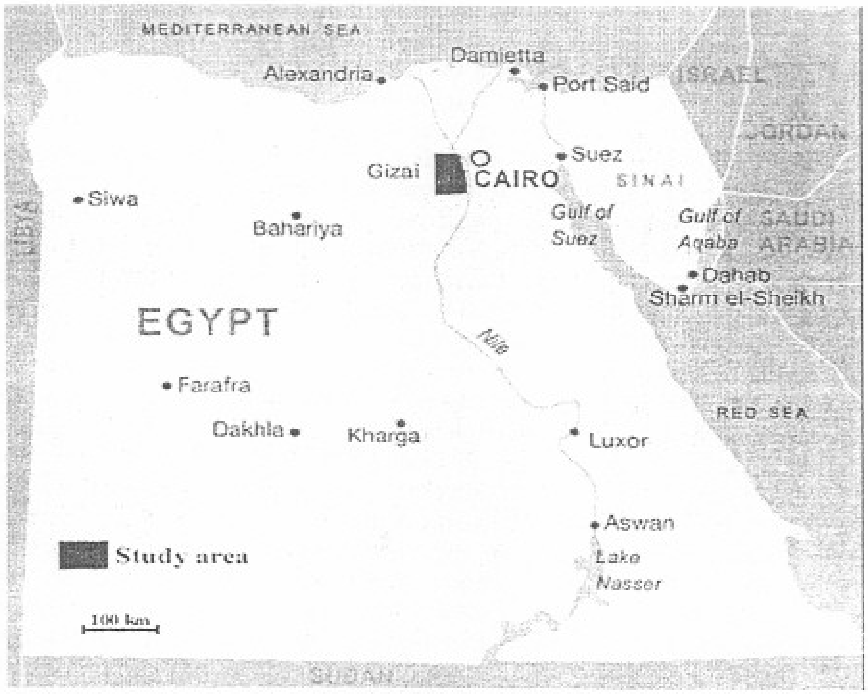
Fig. 1. Methodological diagram followed in Almagra model .

The main considered soil characteristics are useful:- depth, texture, drainage condition, carbonates content, salinity, sodium saturation and degree of development of the profile. The Micro LEIS software has been used before by Yehia (1998) to evaluate the soil Banager El-Sokkar area (Egypt). He found that the dominant capability subclasses are S2I, S2II and S3I with soil properties and topographic conditions as main limitation factors. Bahnassy *et al.* (2001) applied and suitability using Micro LEIS program in integration with SALTMOD to predict the effect of water table and salinity on the productivity of wheat in sugar beet area, West Nubaria, Egypt. They found that the productivity of wheat in sugar beet area, West Nubaria, Egypt will be decrease due to increasing salinity and water table depth, as a result of mismanagement practices. Darwish (2004) found that the wheat, potato and sunflower have high suitable in the Typic Haplogypsids, and the rest of group has low suitable. Calcic Haplosalids and Gypsic Haplosalids are moderately suitable. Typic Haplocalcids, Lithic Haplcalcids and Calcic Haplosalids horizon are ranges between low and non suitable.

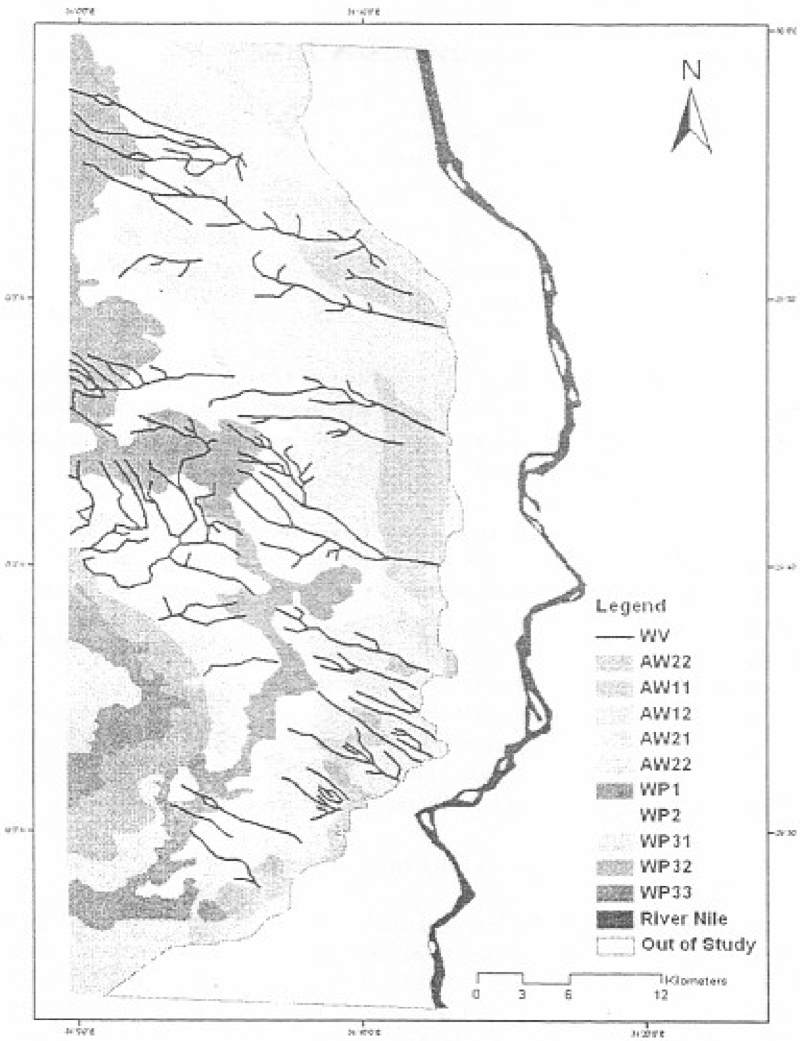
The area under investigation is one of the suggested areas for the horizontal expansion in the Western Desert specially a dejected to the Nile Valley in the Giza Governorate which has high store of artesian water from multi layers of Nubian sandstone aquifer system and seepage of the Nile River and near from the Urbanization areas. The study area is considered as semi-arid zone. The average climatic parameters over thirty year's period after the Egyptian Meteorological Authority (1996) shows that the main annual temperature obtained from Badrashien is 21.8°C and the difference between summer and winter are more than 5°C. The precipitation is nil and evapo-transpiration reach 195 mm/month. According to the USDA (2006) the soil temperature regime is thermic and the moisture regime is Torric. According to Abuo Al-Ezz (2000) the geological constriction of the area formed from massive yellow limestone, chalky limestone, marl and shale of lower middle Eocene. Said (2000) added the western side of the Nile Valley covered by Cretaceous, Eocene (limestone, clay and sands), Pliocene (gravels and sands) and Pleistocene (river silts, sands, gravels). According to Abuo Al-Ezz (2000) geomorphology of the area the Western Desert is one of the most arid regions in the world; it is surface composed of bar rocky plateau and high-lying stony and sand plains, but few distinct drainage lines, and even from these drainage channels extended for a short distance and consequently do not reach the Nile Valley. Said (2000) mentioned the Western Desert plateau surface is marked by various erosional features on varied lithologic units within the Eocene bedrock that give variable colour tones and drainage is poorly developed on the surface of the plateau. Abuo El-Enain (1981) mentioned that the texture of the soils is sandy classified as Torrifluvents, Torripsamments, and salorthids. El-Hamedy (1982) mentioned that the desertic deposits texture is sandy gravel. The total soluble salts ranges between 15.90 and 19.10 dS/m. Calcium Carbonate content ranges between 1.58 and 7.94 %. Organic matter content is very low and less than 0.53 %. pH values ranges between 7.6 and 7.8. The soils classified as Torrifluvents, Torripsamments, Salorthids and Calciorthids. The main objective of this research is to identify the optimum land use for each defined land map unit taking into account the soil properties as well as the sustainability of soil resources of the selected the study area in Western Desert, in El-Giza Governorate. In addition, this study focuses on the development of a GIS linked with some adapted modules of evaluation and decision system using the required data based experts knowledge.

Material and Methods

The study are is bounded by longtitudes 31° 00˝ and 31° 15˝ east and latitudes 29° 15˝ and 30° 00˝ north and it's total area is about 1618.68 km^2, in the Western Desert Giza Governorate, Egypt (Map 1). Thirteen soil profiles were chosen to representative the soils of the investigated area. The exact locations of the soil profiles and auger observation points were precisely defined in the field using the GPS (System Cooperation MAGEILAN) GPSNAVDLX-10TM and plotted in Map 2. The soil profiles were dig and brief description in the field then, the samples were collected according to the different in morphological features of soil profile layers or horizons to complete the laboratory analyses. The morphological description of these profiles was carried out according to the guidelines edited by FAO (2006). Representative disturbed soil samples have been collected and analyzed using the soil survey laboratory methods manual (USDA, 2004). The American Soil Taxonomy, (USDA, 2006) was used to classify the different soils of the investigated area to the sub great group level. Then the correlation between the physiographic and taxonomic units, were designed, after Elberson & Catalon (1987).



Map 1. Location map of the study area .



Map 2. Physiographic map of the investigated area.

Soil suitability methods:- The ALMAGRA Soil suitability method as described by (Dela Rosa *et al.*, 2000) was based on an analysis of soil characteristics which influence the productive growth of twelve traditional Mediterranean crops. The ALMAGRA micro computer program is an automaized application of this soil suitability method, which maches soil characteristics of the soil-units with growth requirement of each particular crop; and results in the crop growth limitations being provided by the computer. The five suitability classes for each crop are presented in Table 1.

TABLE 1. Qualitative land suitability classes for a particular land use .

Suitability classes	Land characteristics			
	Soil depth (cm)	Texture	Salinity (dS/m)	Slope (%)
S1	> 120	Loam, Silty loam, silt	0-2	0-3
S2	60 – 120	Silt loam to clay	2-4	3-8
S3	30 – 60	Silty loam to sand	4-8	8-15
S4	15 – 30	Sand	8-10	15-30
S5	< 15	Clay	>10	>30

In this study, twelve traditional crops are considered as fellow:- wheat, maize, water melon, potato, soybean, cotton, sunflower, suger beat, alfalfa, peach, Citrus and olive. These crops were selected to be evaluated on the available soil condition of the study area under investigation.

Combining Micro LEIS with GIS:- Integrating Micro LEISDSS with GIS system for mapping and analysis allows the use of spatial techniques to expand land evaluation results from point to geographic areas used a simple map subsystem (*e.g.*, Arc view GIS) to show basic data and model results on a map. It helps to extract information from the evaluation models (Micro LEIS) to be used and displayed as thematic geo-referenced maps. The core objects can be used for retrieving features from the attribute databases (*e.g.*, Almagra model), projecting layers and displaying maps, creation/editing/deletion of spatial objects. querying, operations, mapping the projected layers, etc. However, this level of assessment is where policy decisions are usually made (Davidson *et al.*, 1994).

Results and Discussion

The detailed morphological descriptions recorded using the FAO guidelines (2006) in Table 3. The physiographic map and legend are shown in Map 2 and Table 2. The physical (texture) and chemical analyses (cations exchange capacity and cation exchange) are shown in Table 4. The chemical analyses (pH, $CaCO_3$, O.M, gypsum, EC, soluble cations, and soluble anions) are shown in Table 5. The physiographic map of the area included the units WP_1, WP_2, WP_{31}, WP_{32}, WP_{33}, WV, AW_{11}, AW_{12}, AW_{21}, and AW_{22} .These areas of units are 278.31, 326.98, 816.39, 24.20, 26.58, 123.83, 49.50, 39.56, 81.87 and 46.12 km^2, respectively, some units are barren and the others are cultivated. The barren units are WP_1, WP_2, WP_{31}, WV. The elevation of these areas ranges between 70 and 90m ASL. Theses areas have gently undulating to moderately steep slope and its drainage condition is excessive. Soil colour in dry is very pale brown (10YR7/4); and yellow brown (10YR5/6) in the moist condition. The dominant texture is sand in the upper; sandy granules and sandy gravels in the middle and deep layers. Calcium carbonate content ranges between 13.56 and 18.80 % in the upper layers and 10.13 and 19.77% in the lower layers. Organic matter content is low than 0.50 in the different layers. Soils salinity values ranges between 6.37 and 8.31 dS/m in the upper layers and 5.27 and 7.95 dS/m in the middle and lower layers. pH values ranges between 7.48 and 7.56. cation exchange capacity (CEC) ranges between 5.15 and 7.41 mq/100g soil in the upper; and 4.45 and 7.25 mq/100g soil in the lower layers. The exchangeable sodium percentage (ESP) values ranges between 12.04 and 14.19 % in the upper layers; and 11.02 and 14.20 % in the lower layers. Based on the American Soil Taxonomy (USDA, 2006) these soils classified as Torripsmments.

The cultivated units are WP_{32}, WP_{33}, AW_{11}, AW_{12}, AW_{21}, and AW_{22}. The elevation of these areas ranges between 60 to 75m ASL. These areas have nearly level to gently undulating slope and its drainage condition is well to moderately well. Soil colour in dry is brownish yellow (10 YR6/8); and yellowish brown (10 YR5/8) in the moist condition. The dominant texture is sandy and sandy clay loam in the upper layers, and sandy clay loam, loamy sand, sandy loam in the middle and lower layers. Calcium Carbonate content ranges between 3.16 and 9.18% in the upper layers and 4.42 and 13.51% in the lower layers. Organic matter content is less than 1.62% in the upper layers and decrease with depth to reaches 0.26 % in the lower layers. Soil salinity reveled that the electrical conductivity ranges between 1.15 and 2.37 dS/m in the upper layers and 1.37 and 9.45 dS/m in the middle and lower layers. PH values ranges between 7.22 and 7.94. Cation exchange capacity (CEC) ranges between 10.37 and 35.8 mq/100g soil in the upper layers and 4.14 and 30.52 mq/100g soil in the lower layers. The exchangeable sodium percentage (ESP) values ranges between 3.61 and 6.09% in the upper layers and 6.40 and 14.49% in the lower layers. Based on the American Soil Taxonomy (USDA, 2006) these soil classified as Torrifluvents and Torripsamments.

Agriculture land capability

The Micro LEIS model provides prediction for general land use capability for abroad series of possible uses. According to the model production as shown in Table 6 and Map 3, most of the studied area are classified as (S3lrb) in the mapping units WP_1, WP_2, WP_{31}, and WV, while (S3lb) in WP_{32} and WP_{33}, and (S_{31}) in AW_{21}, the total area are 1497.97 Km^2. The degree of capability is moderate could be refered to the moderate severe limitations that restrict the range of crops or require special conservation practices, and these limitations are erosion risk for barren areas, excessively drained and bioclimatic deficit. These lands are low productive for a range of crops, and improvement practices are recommendable. Two mapping units (AW_{11} and AW_{22}) have good capability (S_{21}) and the total area 85.39 Km^2. These soils have some limiting factors as coarse texture in some parts and moderately salinity in the other parts, which some what reduce the productivity of certain crops. One mapping unite (AW_{12}) has excellent capability (S_1) and area 35.332 Km^2, which referred to in significant limitations in using for traditional agricultural crops.

TABLE 2. Physiographic map legend .

Landscape	Relief	Land form	Phase	Mapping unit	Main and associated soils	Area Km2
Western Plateau	Summit	Flat	Barren	WP1	Torripsamments	278.31
		Summit	Barren	WP2	Torripsamments	326.98
	Steep	Steep	Barren	WP31	Torripsamments	816.39
	Slope	Slope	Cultivated with crops	WP32	Torripsamments	24.20
			Cultivated with crops and Orchards	WP33	Torripsamments	26.83
Dry valleys	Concave slope	undulating	Barren	WV	Torripsamments	123.83
Sand sheet	Gently undulating	Relatively high Parts	Cultivated with crops	AW11	Torrifluvents	49.50
			Cultivated with crops and Orchards	AW12	Torrifluvents	39.56
		Relatively low Parts	Cultivated with crops	AW21	Torrifluvents	81.87
			Cultivated with crops and Orchards	AW22	Torrifluvents	46.12

TABLE 3. Some physical and chemical analyses of the investigated area.

Profile No.	map unit	Depth in cm	Gravels %	Corse sand %	Fine sand %	Silt %	Clay %	Texture class	CEC Cmol/kg	Exchangeable cations mq/100g				ESP %
										Ca^{++}	Mg^{++}	Na^{+}	K^{+}	
1	AW11	0-20	0.00	38.24	17.38	10.61	33.77	Sandy clay loam	33.21	23.51	6.21	1.96	1.32	5.90
		20-40	0.00	40.37	20.94	8.76	29.93	Sandy clay loam	29.43	20.22	5.26	2.58	1.08	8.77
		40-55	0.00	56.48	17.31	6.73	19.48	sandy loam	19.16	15.75	2.71	1.89	0.73	9.87
		55-85	0.00	81.62	10.47	2.66	5.25	sandy	5.16	2.54	1.39	0.54	0.61	10.46
		85-120	0.00	88.03	8.12	0.34	3.51	sandy	3.45	1.43	1.01	0.44	0.52	12.75
2	AW12	0-20	0.00	58.16	6.27	13.15	22.42	Sandy clay loam	22.05	15.36	4.42	0.80	1.34	3.63
		20-50	0.00	65.71	11.71	9.92	12.66	Sandy loam	12.45	8.56	2.63	0.81	0.28	6.51
		50-70	0.00	81.42	6.35	7.13	5.10	loamy sand	5.02	3.28	0.65	0.49	0.54	9.77
		70-110	0.00	88.25	5.64	3.37	2.74	sand	3.22	2.01	0.61	0.37	0.21	11.49
3	AW12	0-20	0.00	33.71	17.94	13.52	34.83	Sandy clay loam	34.25	23.81	7.26	1.60	1.03	4.67
		20-70	0.00	48.23	12.37	10.24	29.16	Sandy clay loam	28.67	19.73	5.84	2.05	0.67	7.15
		70-90	0.00	62.74	12.94	8.24	16.08	Sandy loam	15.81	9.46	3.53	1.78	0.81	11.26
		90-130	0.00	85.51	6.88	2.46	5.15	sandy	5.06	2.41	1.72	0.59	0.32	11.65
4	AW21	0-20	0.00	22.66	33.11	14.18	30.05	Sandy clay loam	29.55	20.78	5.24	2.10	1.05	7.11
		20-50	0.00	29.24	20.39	16.15	34.22	Sandy clay loam	33.65	21.96	6.88	3.61	0.82	10.73
		50-75	0.00	37.54	17.21	18.67	26.58	Sandy clay loam	26.14	18.46	3.32	3.72	0.41	14.23
5	AW21	0-25	0.00	35.44	24.65	8.82	31.09	Sandy clay loam	30.57	20.49	5.75	2.06	1.79	6.74
		25-45	0.00	38.65	15.07	10.24	36.04	Sandy clay loam	35.44	21.71	7.68	3.51	1.91	9.90
		45-75	0.00	45.03	12.12	15.60	27.25	Sandy clay loam	26.80	17.18	4.16	3.68	1.44	13.73
6	AW22	0-30	0.00	10.65	51.88	14.16	33.31	Sandy clay loam	27.45	14.62	5.26	1.58	1.14	6.89
		30-60	0.00	17.58	38.52	15.98	27.92	Sandy clay loam	22.92	18.66	4.65	2.85	1.04	10.38
		60-100	0.00	21.91	46.13	10.64	21.32	Sandy clay loam	20.96	13.58	3.44	3.06	0.66	14.60
7	WP1	0-45	10.78	39.47	33.68	15.08	0.99	Sandy	1.95	1.14	4.54	0.25	0.10	12.82
		45-140	31.17	52.63	10.52	4.85	0.83	Sandy gravel	2.65	1.80	3.86	0.24	0.11	9.06
8	WP2	0-70	17.82	40.56	28.86	11.46	1.30	Sandy	2.72	1.63	2.76	0.26	0.12	9.56
		70-130	29.88	48.54	14.06	6.94	0.58	Sandy gravel	2.12	1.36	1.98	0.26	0.12	12.26

TABLE 3. Contd.

Profile No.	map unit	Depth in cm	Gravels %	Corse sand %	Fine sand %	Silt %	Clay %	Texture class	CEC Cmol/kg	Exchangeable cations mq/100g				ESP %
										Ca^{++}	Mg^{++}	Na^{+}	K^{+}	
9	WP31	0-25	13.67	44.46	27.61	12.48	1.78	Sand	2.41	1.40	0.64	0.24	0.13	9.96
		25-60	17.08	58.46	15.60	8.31	0.55	Sand	1.25	0.52	0.49	0.12	0.12	9.60
		60-75	24.31	56.81	12.26	6.24	0.38	Sand	1.15	0.60	0.32	0.13	0.10	11.30
		75-120	41.49	43.98	9.27	5.02	0.24	Sandy gravel	1.45	0.85	0.32	0.15	0.13	10.34
10	WP32	0-20	3.76	40.13	28.36	16.11	11.64	Sand loam	10.20	4.88	2.52	1.45	1.35	14.22
		20-40	14.17	42.16	25.25	11.14	7.28	Loamy sand	5.75	2.25	1.75	0.63	1.12	10.96
		40-70	26.79	45.44	16.68	7.87	3.22	Sandy gravel	2.25	1.25	0.62	0.26	0.12	11.56
		70-120	35.76	47.18	13.23	3.25	0.58	Sandy gravel	1.20	0.52	0.42	0.14	0.12	11.67
11	WP32	0-20	1.86	38.74	24.32	21.62	13.46	Sandy loam	11.10	5.67	2.10	1.55	1.78	13.96
		20-55	12.76	52.14	20.18	8.89	6.03	Loamy sand	4.50	2.21	0.95	0.52	0.82	11.55
		55-80	16.07	58.89	14.08	8.19	2.77	Sand	1.60	0.65	0.37	0.20	0.38	12.50
		80-180	24.09	60.75	11.45	2.78	0.93	Sand gravel	0.85	0.38	0.30	0.10	0.07	11.76
12	WP33	0-20	2.33	39.26	24.84	18.72	14.85	Sand loam	12.50	6.15	2.78	1.77	1.80	14.16
		20-50	15.23	49.82	14.65	11.86	8.44	Loamy sand	6.20	3.02	1.23	0.75	1.20	12.10
		50-75	22.96	53.33	11.51	7.98	4.22	sand	2.65	1.38	0.14	0.28	0.85	10.57
		75-110	37.67	48.23	8.04	4.61	1.45	Sand gravel	1.11	0.50	0.24	0.14	0.23	12.61
13	WV	0-40	20.20	45.73	23.24	9.75	1.08	Sand	1.02	0.56	0.21	0.13	0.12	12.75
		40-110	42.84	44.13	9.36	2.86	0.81	Sand gravel	0.56	0.25	0.20	0.06	0.05	10.71

TABLE 4. Chemical analyses (pH, CaCO3, O.M, gypsum, EC, Soluble cations and anions) of the investigated area .

Profile No.	mapping unit	Depth in cm	pH (sp)	$CaCO_3$ %	O.M %	gypsum %	EC dS/m	Soluble cations mq/L				Soluble anions mq/L			
								Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
1	AW11	0-20	7.23	4.72	1.84	0.22	1.25	2.26	1.76	6.25	2.23	0.00	2.13	7.28	3.09
		20-40	7.44	6.18	0.90	0.61	1.37	2.36	1.82	7.10	2.42	0.00	1.55	8.89	3.26
		40-55	7.63	3.75	0.61	0.24	1.51	3.45	2.06	7.23	2.36	0.00	1.98	8.32	4.80
		55-85	7.71	4.26	0.30	0.32	2.52	5.66	2.34	12.98	4.22	0.00	2.99	15.65	6.56
		85-120	7.78	4.67	0.27	0.80	2.67	5.98	2.32	13.78	4.62	0.00	2.88	16.89	17.10
2	AW12	0-20	7.33	3.87	1.67	0.34	1.21	3.10	1.32	6.12	1.56	0.00	0.67	7.22	4.21
		20-50	7.38	5.56	0.72	0.41	2.48	5.32	2.77	12.56	4.15	0.00	2.56	14.99	7.25
		50-70	7.51	8.53	0.35	0.62	2.61	5.11	3.78	13.10	4.10	0.00	2.87	15.85	7.38
		70-110	7.57	8.82	0.26	0.66	3.15	6.20	3.64	15.56	6.10	0.00	3.67	17.78	10.05
3	AW12	0-20	7.35	2.16	1.61	0.20	1.33	3.10	1.89	6.31	2.00	0.00	1.99	7.85	3.46
		20-70	7.42	3.42	0.55	0.27	1.46	3.20	2.20	7.10	2.10	0.00	1.88	9.50	3.22
		70-90	7.48	6.18	0.36	0.45	1.86	4.12	2.77	9.15	2.56	0.00	1.95	11.26	5.39
		90-130	7.57	6.29	0.27	0.56	3.18	8.20	4.13	15.36	4.11	0.00	2.76	17.45	11.59
4	AW21	0-20	7.31	2.63	1.62	0.38	4.81	10.12	3.74	24.12	10.12	0.00	6.33	26.78	14.99
		20-50	7.77	4.81	0.83	0.52	8.18	20.25	11.52	40.22	9.81	0.00	3.98	42.35	35.47
		50-75	7.83	5.44	0.55	0.61	11.64	30.35	17.15	58.12	10.78	0.00	6.25	60.12	50.03
5	AW21	0-25	7.36	3.38	1.43	0.21	4.28	11.35	6.77	20.13	4.55	0.00	2.89	22.89	17.02
		25-45	7.94	4.66	0.63	0.49	7.58	20.98	18.01	30.89	6.89	0.00	6.12	35.99	33.69
		45-75	7.93	4.23	0.32	0.63	10.16	25.21	14.73	50.83	10.83	0.00	10.39	60.23	30.98
6	AW22	0-30	7.28	3.81	1.87	0.24	2.96	9.12	3.81	13.89	2.78	0.00	3.15	15.56	10.89
		30-60	7.55	6.96	0.90	0.32	5.37	12.98	9.05	25.89	5.78	0.00	2.99	30.78	19.93
		60-100	7.81	8.28	0.31	0.61	8.13	18.25	12.48	40.35	10.21	0.00	6.36	45.95	28.99
7	WP1	0-45	7.70	13.36	0.12	3.55	8.35	20.78	12.47	40.68	9.57	0.00	6.20	42.88	34.42
		45-140	7.65	11.62	0.16	3.68	9.67	23.98	16.39	45.12	11.21	0.00	10.25	50.68	35.77
8	WP2	0-70	7.64	14.62	0.04	2.81	10.63	27.36	11.04	52.78	15.12	0.00	10.99	60.79	39.52
		70-130	7.61	18.86	0.19	3.64	9.05	22.36	15.82	45.05	7.22	0.00	10.87	50.95	28.68

TABLE 4. Contd.

Profile No.	mapping unit	Depth in cm	pH (sp)	$CaCO_3$ %	O.M %	gypsum %	EC dS/m	Soluble cations mq/L Ca^{++}	Mg^{++}	Na^+	K^+	Soluble anions mq/L CO_3^-	HCO_3^-	Cl^-	SO_4^-
9	WP31	0-25	7.52	16.52	0.13	2.20	9.15	23.75	15.65	46.89	5.21	0.00	10.25	50.78	30.47
		25-60	7.44	18.44	0.12	2.91	9.46	25.76	15.53	47.99	5.32	0.00	9.85	52.23	32.52
		60-75	7.58	15.32	0.14	3.77	9.84	25.85	20.97	45.96	5.62	0.00	9.92	50.67	37.81
		75-120	7.66	13.81	0.12	2.38	10.35	26.21	18.20	54.20	4.89	0.00	10.02	57.23	36.25
10	WP32	0-20	7.19	6.56	1.13	1.67	1.37	3.15	2.20	7.10	1.25	0.00	2.56	9.20	1.94
		20-40	7.25	10.28	0.59	1.81	2.50	5.21	3.76	13.50	2.53	0.00	3.78	15.60	8.72
		40-70	7.32	13.13	0.22	2.36	2.81	5.98	3.86	15.61	2.65	0.00	3.85	17.89	6.36
		70-120	7.51	15.24	0.08	2.80	5.63	15.51	8.15	29.62	3.02	0.00	4.98	32.65	18.67
11	WP32	0-20	7.22	5.18	1.25	1.76	1.37	2.53	1.33	7.85	1.99	0.00	2.73	8.67	2.30
		20-55	7.58	8.77	0.81	1.94	3.52	7.22	5.22	18.98	3.78	0.00	3.89	20.99	10.32
		55-80	7.61	13.26	0.52	2.50	4.41	10.20	6.20	23.68	4.02	0.00	3.99	25.89	14.22
		80-120	7.69	18.51	0.26	2.67	6.65	17.62	8.61	35.49	5.78	0.00	5.01	39.20	22.29
12	WP33	0-20	7.23	5.87	1.03	1.84	1.28	2.15	1.82	6.98	1.85	0.00	2.35	8.20	2.25
		20-50	7.27	7.55	0.62	2.53	3.41	7.95	4.38	18.22	3.55	0.00	3.99	20.98	9.13
		50-75	7.31	12.28	0.33	2.66	5.11	10.65	9.20	27.23	4.02	0.00	4.62	30.67	15.81
		75-110	7.34	16.12	0.14	2.67	6.15	13.35	9.08	33.22	5.85	0.00	4.99	36.35	20.16
13	WV	0-40	7.60	21.90	0.22	3.46	9.61	25.76	12.81	50.25	7.28	0.00	11.56	55.76	28.79
		40-110	7.50	20.97	0.12	5.37	7.60	18.51	10.53	40.21	6.75	0.00	9.62	45.65	20.72

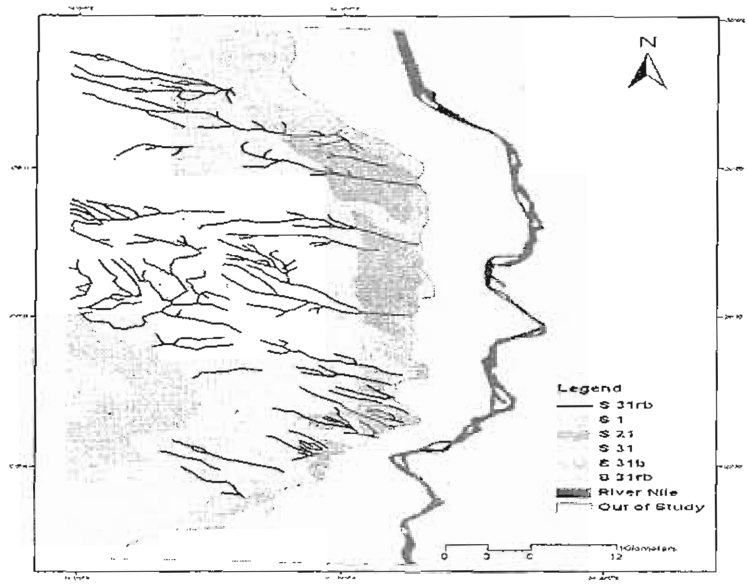
TABLE 5. Land capability classes of the different mapping units .

Factor	AW11	AW12	AW21	AW22	WP1	WP2	WP31	WP32	WP33	WV.
Slope factor (t)										
Slope	1	1	1	1	2	1	1	1	1	1
Soil factor (l)										
depth	1	1	2	1	1	1	1	1	1	1
Texture class	2	1	1	1	2	2	2	2	2	2
Stoniness	1	1	1	1	1	2	1	1	1	1
Drainage class	1	1	2	1	3	3	3	3	3	3
Salinity	1	1	3	2	2	2	2	1	2	2
Erosion risks factors ®										
Slope gradient	1	1	1	1	2	1	1	1	1	1
Vegetation density	1	1	1	1	3	3	3	1	1	3
Rainf all erosivity	1	1	1	1	1	1	1	1	1	1
Bioclimatic deficit factor (b)										
Aridity degree (Hi= P/Erp)	1	1	1	1	3	3	3	2	2	3
Frost risks										
(n#months T< 6c)	1	1	1	1	1	1	1	1	1	1
Limiting factor	I		I	1	I,r,b	I,r,b	I,r,b	I,b	I,b	I,r,b
Capability class	S21	S1	S31	S21	S31rb	S31rb	S31rb	S31rb	S31rb	S31rb

Where: S1 = Excellent, S2 = good, S3 = Moderate .
Limiting factor: t = slope, I = soil, r = erosion risk, b = bioclimatic deficit .

TABLE 6. Current land suitability for different selected crops in the different mapping units.

Mapping unit	Wheat	maize	Cotton	alfa alfa	Potato	Sun flower	Peach	Soybean	Water melon	Sugar beet	Olive	Citrus
AW11	S2tca	S2tca	S1	S2tca	S2a	S2tca	S2a	S2tca	S2a	S2tc	S2ca	S2a
AW12	S2tca	S2tca	S1	S2tca	S2a	S2tca	S2a	S2tca	S2a	S2tc	S2ca	S2a
AW21	S3tsa	S3tsa	S2s	S3tcsa	S3sa	S3tcsa	[illegible]	S3tcsa	S3sa	S3tcs	S3dcsa	S4dsa
AW22	S3tcsa	S3tsa	S2s	S3tcsa	S3sa	S3tcsa	S4sa	S3tcsa	S3sa	S2tcs	S3csa	S4sa
WP1	S5tdcsa	S5tdsa	S5td	S5tdcsa	S5tdsa	S5tdcsa	S4tdsa	S5tdcsa	S5tdsa	S5tdc	S3tdcsa	S4tdsa
WP2	S5tdcsa	S5tdsa	S5td	S5tdcsa	S5tdsa	S5tdcsa	S4tdsa	S5tdcsa	S5tdsa	S5tdc	S3tdcsa	S4tdsa
WP31	S3tcsa	S3tsa	S3t	S3tcsa	S3tsa	S3tcsa	S3tsa	S3tcsa	S3tsa	S3tc	S3tcsa	S3tsa
WP32	S3ts	S3tcs	S3tc	S3ts	S3tcs	S3ts	S2tcs	S3ts	S3tcs	S3t	S2ts	S2tcs
WP33	S3tcsa	S3tsa	S3t	S3tcsa	S3tsa	S3tcsa	S3tsa	S3tcsa	S3tsa	S3tc	S3tcsa	S3tsa
WV.	S4tsa	S4tsa	S4ts	S4tsa	S4tcsa	S3tsa	S4tcsa	S4tsa	S4tcsa	S4ts	S3tsa	S4tcsa



Map 3. Capability map of the investigated area.

Agriculture land suitability

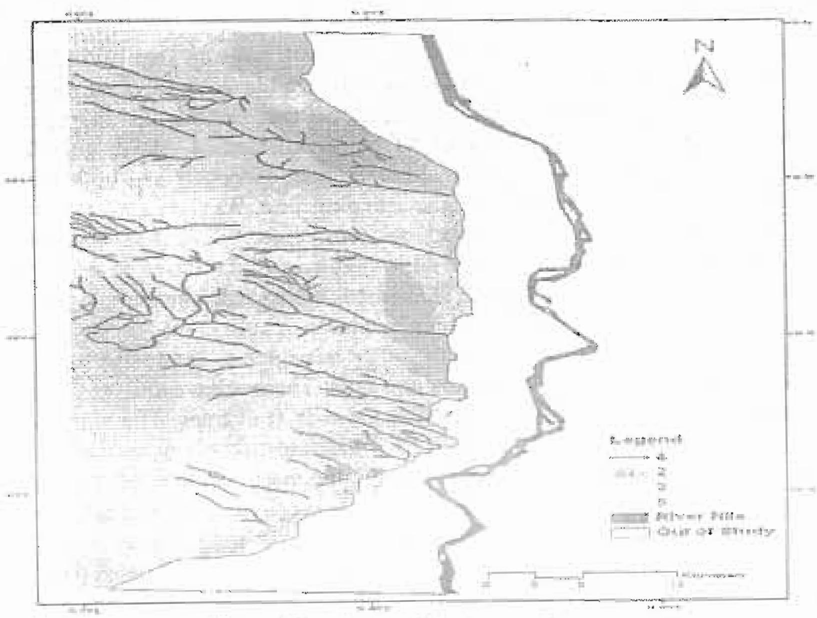
The Pro & Eco Model was used to product land suitability for some common crops cultivated in the studied area including: wheat, maize, melon, potato, soybean, cotton, sun flower, sugar beat, alfalfa, peach, citrus and olive. The obtained results as shown in Table 6 reval the following:-

The barren soils of mapping units of WP_1, and WP_2 have an area of 248.49, 291.95 Km^2, respectively. They have moderate suitable to cultivated olive, marginal suitable to cultivated peach and citrus and non suitable for the other crops. They are non suitable because of its higher content of coarse gravels, excessively drainage condition, high content of calcium carbonate and high salts content. Also, these areas are barren. The mapping unit WP_{31} has an area of 728.92 Km^2. It has moderate suitable to cultivate olive, while it is marginal suitable to cultivate the other crops and fruits which could be referred to the high content of Calcium Carbonate and salts. These areas are barren. The mapping unit of WP_{32} has an area of 21.61 Km^2. It has high suitable to cultivated peach, Citrus and Olive; moderate suitable to cultivate the other crops due to the coarse texture and the high content of calcium carbonate and salts. These areas cultivated with crops but after this study we prefer to cultivate it with fruit trees. The mapping unit of WP_{33} has an area of 23.72 Km^2. It has moderate suitable to cultivate all crops and fruits due to of the coarse texture, the high content of calcium carbonate and salts. These areas cultivated with crops and fruit trees. The mapping unit of WV has an area of 110.54 Km^2. It has moderate suitable to cultivate olive and marginal suitable to cultivate the other crops and fruits due to of the high content of coarse gravels, high content of calcium carbonate and salts. These areas are barren. The mapping units of AW_{11} and AW_{12} have an areas of

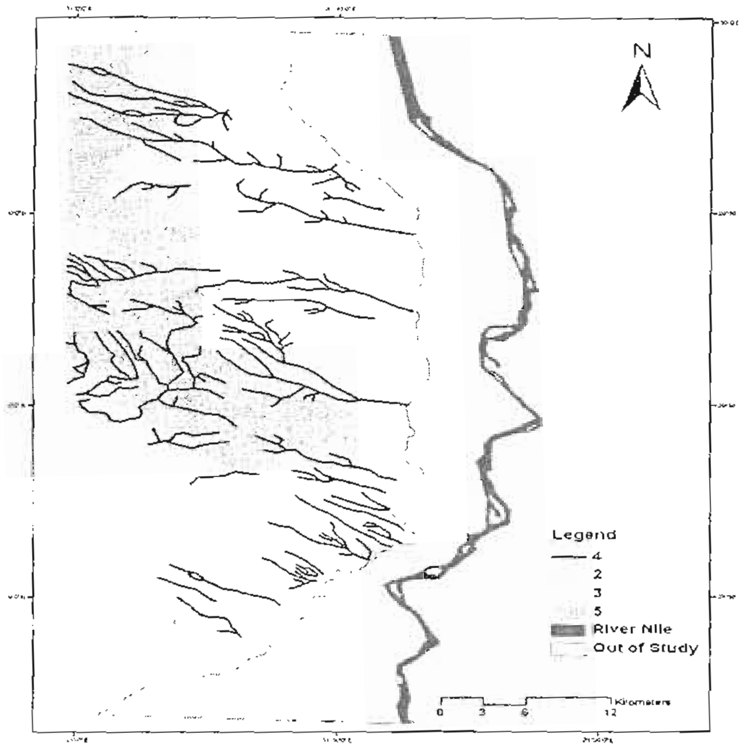
44.20, 35.32 Km^2, respectively, and totally 79.52 Km^2. They have the optimum suitable to cultivate with cotton and high suitable to cultivate with the other crops and fruits which could be referd to high soil quality. The mapping units of AW_{21} and AW_{22} have an area of 73.10, 41.19 Km^2, respectively and the total area about 114.29 Km^2. They have high suitable to cultivate with cotton, while moderate cultivate with olive and other crops, and marginal to cultivate with peach and citrus trees because the rising of the water table and increase in salts in these parts, moreover, the moderately high content of calcium carbonate.

Conclusion

The barren areas have marginal suitable areas (S4 and S5) for all the selected crops and fruit trees due to its high content of coarse gravels, excessively drainage condition, high content of calcium carbonate and salts; except olive moderate suitable (S3) in these areas. On the other hand, the mapping units of WP_{32}, WP_{33}, AW_{11}, AW_{12}, AW_{21}, and AW_{22} are cultivated areas with total area about 391.66 km^2 and ranges between high (S2) to moderate suitable (S3) to cultivate all selected crops and fruit treas. Moreover, the mapping units of AW_{11} and AW_{12} have optimum suitable (S1) to cultivate cotton. The cultivated areas showed healthier soil quality than the barren one. These results manifested the impact of human activity on the ecosystem and its power to convert unsuitable areas to suitable. There is a great need to improve irrigation and drainage systems to increase land suitability for crops and fruit trees in the study area. Human impact on the ecosystem and incorporating indigenous knowledge must be considered if any sustainable development have be successful (Map 4-15).



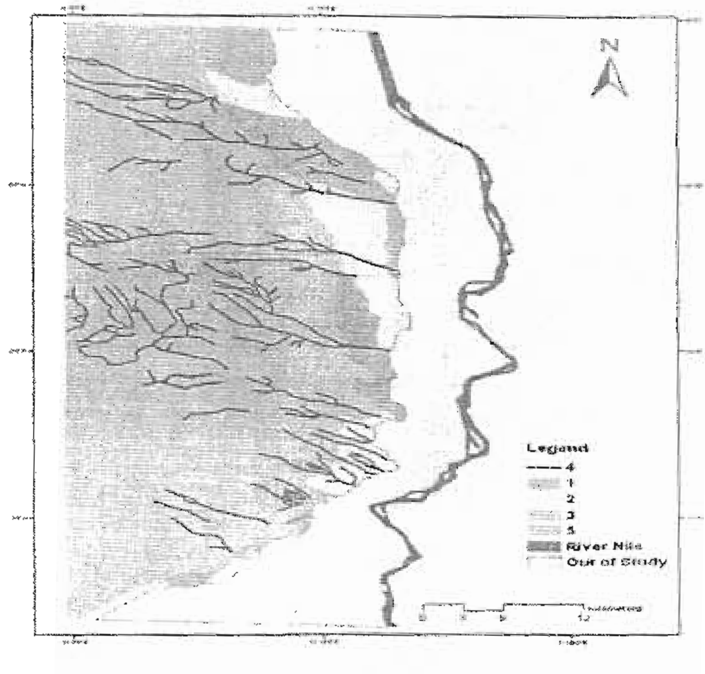
Map 4. Land suitability for sun flower.



Map 5. Land suitability for wheat.

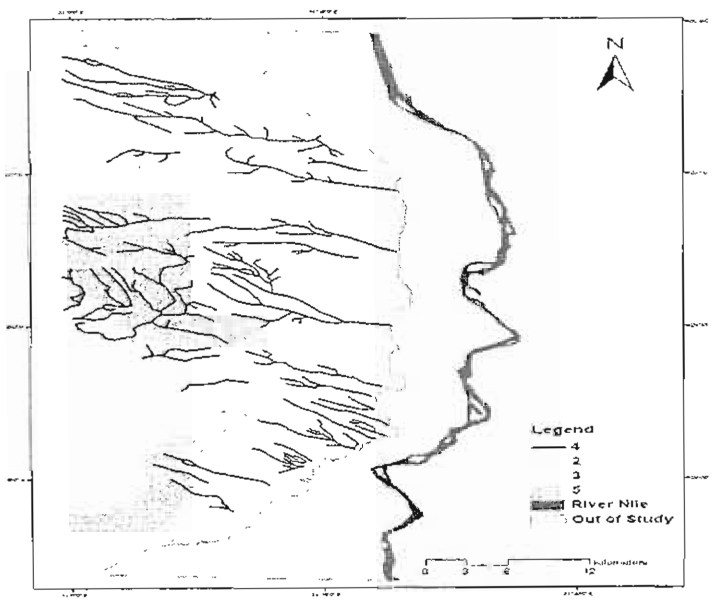
Map 6.Land suitability for alfa alfa.

Map 7. Land suitability for citrus.

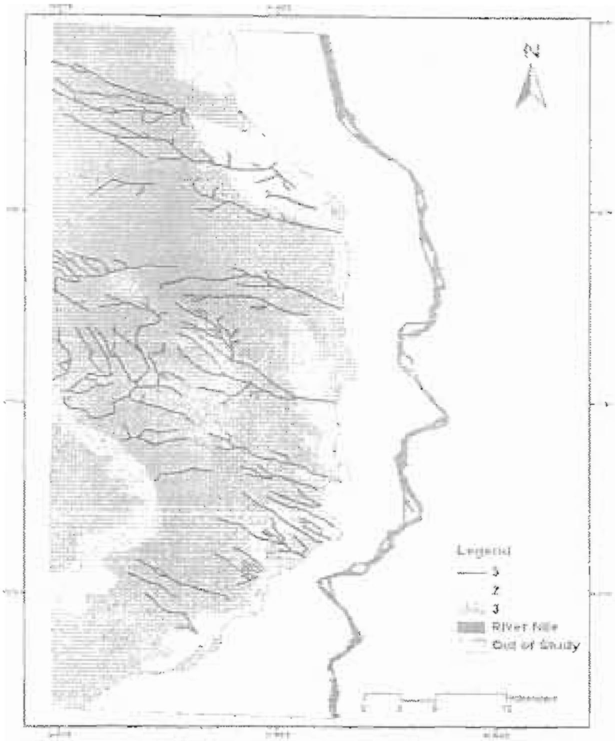


Map 8. Land suitability for cotton.

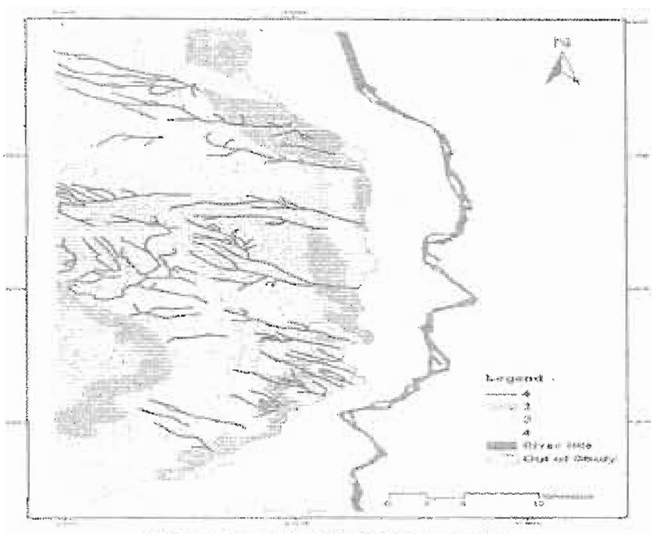
Map .9. Land suitability for maize.



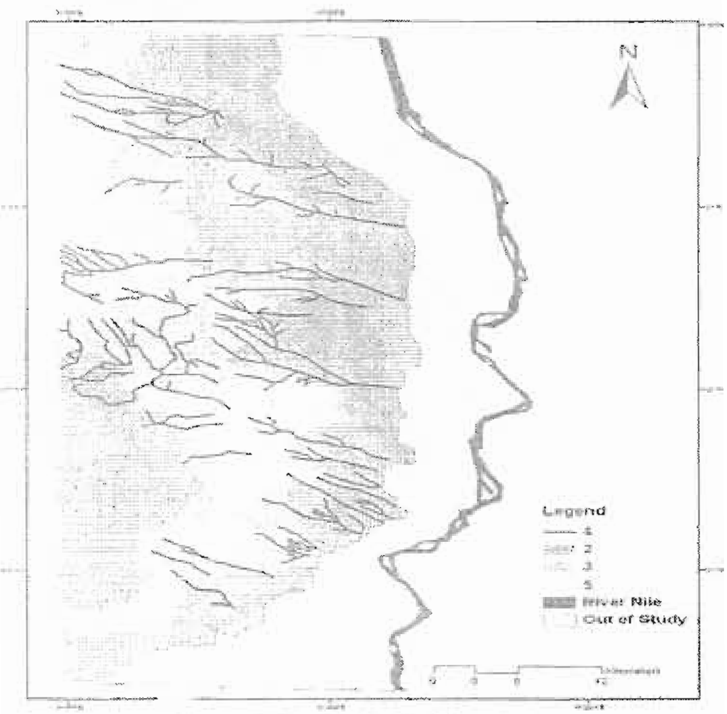
Map 10. Land suitability for water melon.



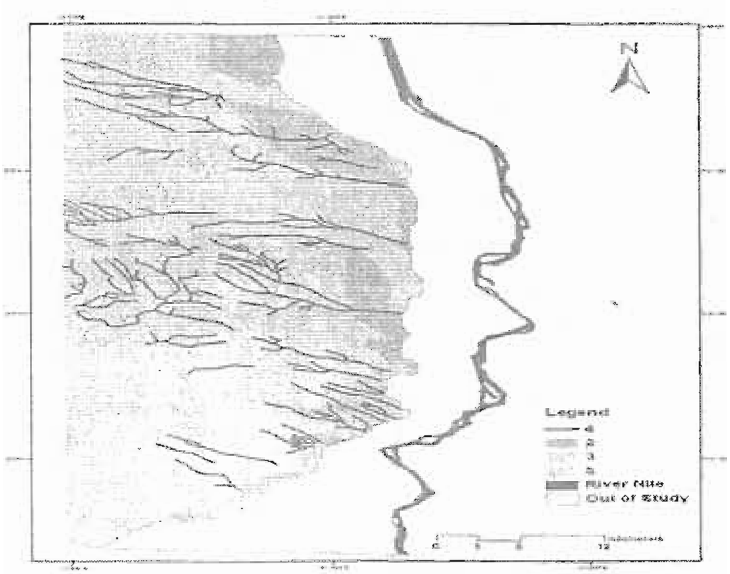
Map 11. Land suitability for olive.



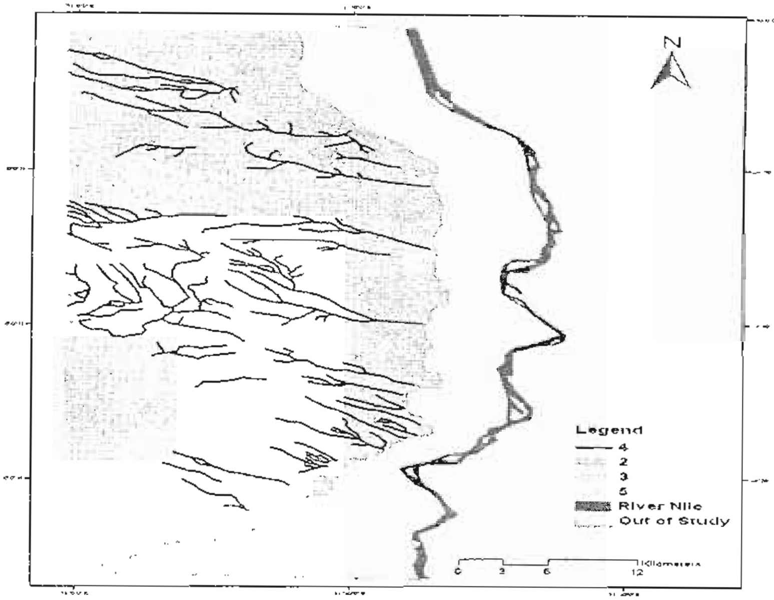
Map 12. Land suitability for peach.



Map 13. Land suitability for potato.



Map 14. Land suitability for soy bean.



Map . 15. Land suitability for sugar beat.

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تقييم صلاحية الأراضى من الوجه الزراعية والبيئية لبعض المحاصيل فى مناطق الاستصلاح الجديدة فى الصحراء الغربية فى محافظة الجيزة – مصر

على عبد الحميد عبد الهادى
قسم الأراضى والمياة – كلية الزراعة – جامعة القاهرة – الجيزة – مصر .

المنطقة محل الدراسة تقع بين خطى طول ٠٠َ ٣١ْ و ١٥َ ٣١ْ غرباً وخطى عرض ١٥َ ٢٩ْ و ٠٠َ ٣٠ْ شمالاً ومساحة المنطقة الكلية ١٨١٣,٣٤ كم٢ فى الصحراء الغربية محافظة الجيزة مصر تم أخذ ثلاثة عشر قطاع أرضى تمثل أراضى المنطقة وتم وصفها فى الحقل وأيضاً تـم تجميع عينات أرضيـة مثارة لإجـراء التحليلات المعمليـة على أساس الوصف المورفولوجى وعلى أساس نتائج التحليل والوصف المورفولوجى تم تقسيم الأراضى تبعاً للتقسيم الأمريكى (٢٠٠٦) إلى المجاميع الأرضية Torripsamments and Torrifuvents وعمل دراسة لصلاحية أراضى المنطقة تم إستخدام برنامج Micro LEISIP تبعاً للعالم Dela Rosa, D. (2000) والمتخصص فى تقييم صلاحية أراضى حوض البحر الأبيض المتوسط وأوضحت الدراسة أن المناطق الغير مزروعة والتى تمثلت فى الوحدات الأرضية WP1, WP2, WP31,WV والتى مساحتها ١٥٤٥,٥١ كم٢ ذات صلاحية حرجة تتراوح بين S5, S4 بالنسبة للمحاصيل الحقلية المختارة وأشجار الفاكهة ويرجع ذلك إلى إرتفاع محتواها من الحصى الخشن وسرعة الصرف والمحتوى العالى من كربونات الكالسيوم والملوحة ما عـدا الزيتون فهـو متوسـط الصلاحية (S3) وعلى الجانب الأخر فإن الأراضى المزروعة المتمثلة فى الوحدات الأرضية WP32, WP33, AW11, AW12, AW21,AW22 ومساحتها تمثل ٢٦٧,٨٣ كم٢ صلاحيتها للمحاصيل تتراوح بين عالية (S2) ومتوسط الصلاحية (S3) وكذلك أشجار الفاكهة بالإضافة إلى أراضى الوحدتان AW11, AW12 فهما ذات صلاحية ممتازة لمحصول القطن.

المناطق المزروعة أوضحت أنها أعلى خصوبة إنتاجية من الأراضى التى لم يتم زراعتها وهذا يظهر أثر الإنسان أو العامل البشرى على النظام البيئى المحيط به حيث أنه حول أراضى المناطق الغير صالحة إلى أراضى صالحة للزراعة. كما أن المناطق المزروعة تحتاج إلى استمرار نشاط الإنسان فى تحديث نظم الرى وإيجاد نظم صرف لإدخال أشجار الفاكهة فى المناطق المزروعة بالإضافة إلى المحاصيل الحقلية والخضر. ومحاولات الإنسان فى التأثير على النظام البيئى فى مجال الزراعة وذلك بإدخال الدورات الزراعية المناسبة والتركيب المحصولى كل ذلك يدعم ويزيد نجاح تطور الأرض وتحولها الى أراضى صالحة لكل المحاصيل .