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Developing a Master Urban Plan for the west Bitter Lakes Region, Ismailia, Egypt, using geology considerations and the analytic hierarchy process (AHP)

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ABSTRACT

The goal of this study was to identify potential sites in the Bitter Lakes region for urban and agricultural development. Residential, institutional, commercial, and industrial lands are the four categories of urban land. Agrarian, parks, and green zones are examples of cultivated lands. Economic, social, and environmental factors are the key dimensions of Egypt's 2030 Sustainable Development Strategy. Economic development is the most significant and highest priority dimension, which comprises developing agricultural areas, supporting agro-industry (national industry), and constructing new urban settlements in order to accomplish integrated development. The suitable lands for future development were selected according to geomorphological, hydrological, environmental, social, and geological parameters. These parameters were used to create geospatial database for the study area. To avoid any future problems might be resulting from mis-planning, accurate and modern land use planning principals, field work, laboratory tests and analyses, remote sensing, and GIS techniques were integrated. To get the final highly suitable lands for development; analytical hierarchy process (AHP) steps were applied. AHP used to identify the best suitable lands from a set of alternatives with respect to several criteria and their weights. Finally, the research area was separated into three major zones to design the urban master plan: core urban zone, outer urban zone, and outskirts zone.
Keywords: Urban lands, cultivated lands, AHP, GIS, Remote sensing, geology.

INTRODUCTION

The 2030`s Egyptian Sustainable Development Strategy (SDS, 2030) is considered the sustainable development principle as a general framework for improving the quality of lives and welfare. The tenth pillar in Egypt vision 2030 is balanced spatial development management of land and resources to accommodate population and improve the quality of their lives. One of the giant national projects "locomotive of development" is the Suez Canal corridor development project. It includes a series of integrated projects including industrial, agricultural, infrastructure and urban development projects.

The current study aimed at identifying the suitable lands for urban and cultivation sites within the study area. An innovate and futuristic vision for integrated community living was introduced, to attract the top investors and developers within the area located between latitude 30° 00′ N to 30° 30′ N and longitude 31° 45′ E to 32° 25′ E (Figure1) and covers an area of about 1901 km^2. It is bordered by Cairo-Ismailia desert road to the north, by Cairo-Suez Road to the south, Hurghada-Ismailia Road and Bitter lakes to the east and 10th of Ramadan city and the regional ring road to the west.

The area has a competitive edge; as it nestled between new cities such as Al-Amal district and new Ismailia to the north, new administrative capital, and new Suez to the south. It is surrounded by many ports as east Port-Said port to the north, Suez, Ain Sukhna and Adabiya ports to the south and new dry ports as Ismailia dry port and 10th of Ramadan dry port. According to the national road network plan, new roads are being established as a new road connecting Suez Road with the regional ring road and another road which will be an extension of Ahmed Hamdy Tunnel Road. Additionally, new railway road connects Suez with Cairo and 10th of Ramadan (SDS, 2030).

MATERIALS AND METHODS

Urban and cultivated lands are among the mainland-use kinds that are expected to be included in the study area's Master Urban Plan. Suitability requirements must be established in order to assess the research area's application in various land uses. These standards were developed after reviewing a large quantity of previously published literature and consulting with a number of specialists. (Rojas *et al*, 2013, and Girmay *et al*., 2018).

Factors influencing site suitability for urban development

Geomorphological and hydrological factors

a.Elevation

At higher elevations, land collapse is more likely, reducing urban suitability. Elevation data were gathered at 30 m spatial resolution from the ASTER Global DEM data source. The elevation of the area ranges from 5m to 528m. In Figure (2), multiple appropriateness grades for new development are presented in relation to elevation.

b.Slope

Soil texture, depth, moisture, and nutrient availability all vary with slope (Datye and Gupte, 1984). The number of earthworks is determined by the land slope. Earthworks include the excavation of earth cuts and fills for highway and railway lines, roads and airfields, canals and stream diversion, building construction, and any other project in which soil serves as both the

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foundation and the building materials. Constructing on steep slopes means that an incredible amount of site grading is necessary for adequate drainage and sewage systems. Sites that have steep slopes reduces the cost of site grading, increases the erosion level, and may cause lateral seepage and surfacing of effluent in the down slope areas. For all these reasons, ASTER Global Digital Elevation Model (GDEM) was used to calculate the percent slope. In meantime, the slope suitability classes were determined based on the work of Ranatunga (2001), and Gizachew and Ndao (2008).

C. Water logging

Due to the underwater scenario of low-lying regions, waterlogged environments are one of the most serious environmental hazards. Waterlogging is influenced by local geology, topography, drainage, and the amount of water delivered to the site (Holden et al., 2009). The normalizing differential moisture index (NDMI) developed by Wilson and Sader (2002) and the Tasseled Cap Wetness Index (TCWI) developed by Baig *et al*. (2014) were calculated using a 2020 Landsat 8 picture (earthexplorer.usgs.gov/) as shown in Figure (3). Wetlands were defined, identified, and classified using these two land-wetness indices, yielding four suitability classes (Figure 4).

Soil characteristics for construction (geotechnical properties)

Numerous criteria are considered when examining soil suitability for urban land use, the most important of which are soil geotechnical qualities. To do this, the

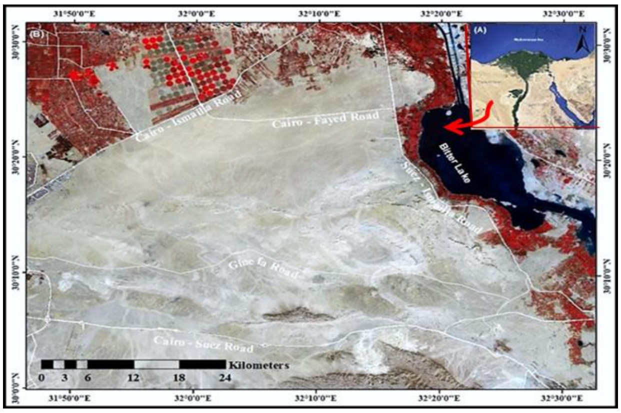

Figure (1): Location map of the study area (RapidEye image, bands 5, 3 and 2).

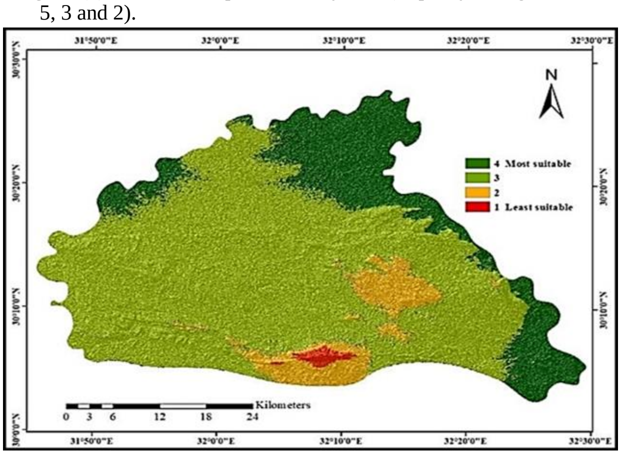

Figure (2): Surface elevation suitability for new development.

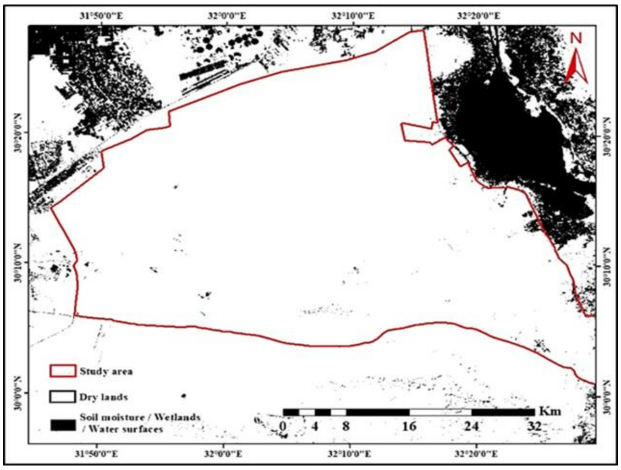

Figure (3): TCWI classes of the study area showing dry land, wetlands and surface water (Baig *et al*., 2014).

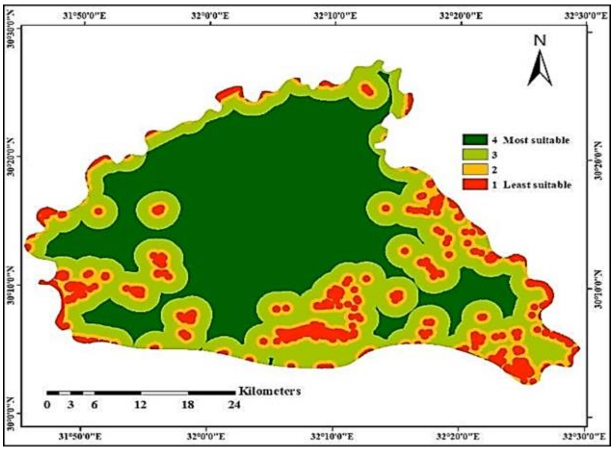

Figure (4): Soil suitability classes related to waterlogged areas and soil moisture.

current study included extensive testing, for both *in situ* and laboratory tests.

Soil sampling and borehole network were designed based on previously published research and soil maps, 1:500,000 and 1:250,000 scale geologic maps (Geological Survey of Egypt, 1984 & 1992) using Global Positioning System (GPS) receiver, Magellan GPS NAV 5000 Pro to easily identify the geology of the study area and selecting the collected samples. To study soil properties and profile depth, eight soil profiles (Figure 5) representing randomly selected open pits were excavated. The tests were carried out according to the American Society for Testing Materials (ASTM) and American Association of State Highway and Transportation Officials (AASHTO) standards. The geotechnical tests include the following: Grain Size Distribution Analysis ASTM D 422 (ASTM, 2007a), Bulk Density (γ) (Cresswell and Hamilton, 2002), Natural moisture content (w) (ASTM 2007b), Direct shear test ASTM D1557 (ASTM, 2012), Proctor Compaction characteristics ASTM: D1557 (ASTM, 2012), California Bearing Ratio (CBR) ASTM D1883 (ASTM, 2016), Atterberg limits, Consistency indices ASTM D 4318 (ASTM, 2000), and Swelling potential IS: 1977.

Based on the geological and physiographic nature of the terrane, the current study area is subdivided into three zones; these are the northern plain, the costal plain of the Bitter Lakes, and the southern plain (Cairo-Suez Road). The general subsurface soil sequence at the northern plain includes intercalation of poorly graded sand to silty sand and sandy fat clay. The sandy soil (SP) and silty sand (SM) (types A-1-a, A-1-b & A-2) are considered excellent to good subgrades. The friction angle (f: 34.32° - 41.4°) and shear strength (6.93-7.6 psi) which are high value, comparable to dense sand. The fat clay (kaolinite) soils have no expandability high plasticity. The friction angle (f: 16.32^{o}) and shear strength (2.492 psi) which is considered low value and has the risk of collapsing. For pavement and construction purposes, this clay layer has bad geotechnical behavior, so it must be removed or fixed using Boring piles to depth enough to penetrate this layer. The basic subsurface soil succe-ssion at Bitter Lakes' coastal plain includes interc-alation of poorly graded sand (SP) and sandy fat clay (CH). Poorly graded sand soil (SP) (class A-3) with excellent to good subgrades. The clay layer (CH) is classified as (type A-7-6) comparable to that of montmorillonite clay mineral (LL:141%and PL27%). It has very high plasticity and very high swelling potential. The general subsurface soil sequence at the southern plain includes intercalation of poorly graded silty sand (SM), sandy silt, sandy fat clay, silty sand, and well graded sand. The sandy silt layer has a slight to medium plasticity, and high compressive shear strength (6.575psi -8.42psi) which is non-collapsible soil. The clay layer (CL & CH) (kaolinite) is low to high plasticity clays and of type A-7-6 & A-6 has very high swelling potential which considered poor to moderate subgrade.

Based on the attained geotechnical results soil texture analysis, interpretation of Rapideye satellite, and Soil Map of Alexandria-Suez area (FAO, 1964), the soil suitability classes for urbanization are illustrated in Figure (6). It is clear that the most suitable zones for urbanization area situated at the northern plain, as well as sporadic areas which are scattered in the central part (18.20 Km^2), whereas the least suitable zones area situated at the central part of the study area (48.08 Km^2).

Geological hazards

Identification of environmentally sensitive or hazardous areas include natural hazards and unsuitable lands and require great efforts to avoid mis-planning and / or mitigate damages and impacts of hazards or expected disasters.

Fault zones

The Alpian orogeny uplifted the area causing a set of faults, fractures, and joints that represent the main structural features within the study area (Said, 1962). In addition to these set of faults interpreted by field survey; structural lineaments were identified by visual interpretation out of composite RapidEye image (acquired on 2015). This image was enhanced by several image processing and techniques including contrast stretching, directional and edge detection filtering (Laplacian and Sobel directional filters edges, 3x3, 5x5 and 7x7 Low and high Pass filters in different directions N-S, E-W, NE-SW and NW-SE).

The extracted lineament map (Figure7) and lineament density per square kilometer was determined (Figure 8). Based on lineament intensity it is found that most of the area is suitable for urbanization.

Seismic activity

Although Egypt is considered as an area of relatively low to moderate seismicity, it has experienced different damaging earthquake effects throughout its history. Sawires et al., (2014) recorded the seismological database for Egypt, and they mentioned the same magnitudes in the study area (< 6). The locations of earthquakes epicenters, magnitude, focal depth, and origin time collected from the USGS website form 1950-2018, then the Euclidean distances from the different epicenter’s points were calculated. Based on that distance the study area was classified to different land suitability classes for urbanization (Figure 9).

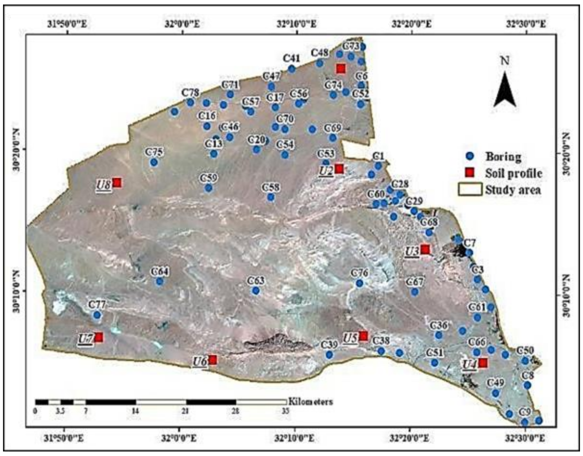

Figure (5): Location map of the profile pits and soil borings.

Factors controlling the suitability of land for agriculture

Soil Physical Properties

a.Soil depth

Soil depth influences soil characteristics such as moisture content, soil nutrient content, infiltration rate, and plant root growth. In shallow soils with lithic contact, root growth may be restricted. The crops suffer from inadequate conditions as a result of the reduced soil volume, delaying plant growth and crop prod-uction. According to the soil drilling network, the soil depth in the research region is mostly appropriate for agriculture (>100 cm depth).

b.Particle Size

For particle-size analyses, gravel and coarser grains were separated from clay and silt using a sieve larger than 75 µm. Dry sieving was used to fractionate the sand. The soil hydrometer test was performed on fine-textured soil (clay and silt fractions) from the sieve set's bottom pan. The USDA categorization of particle size distribution (1993) was used to classify the soil type. Soil components defined as loam (L), loamy sand

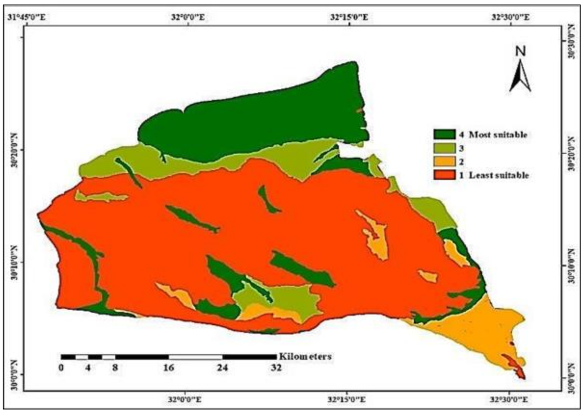

Figure (6): Soil suitability classes according to its geotechnical properties.

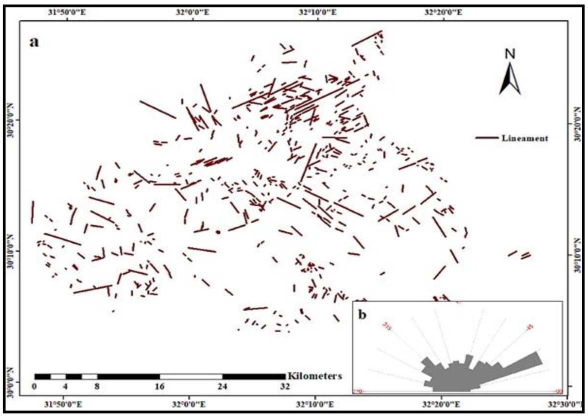

Figure (7): The extracted lineament map of the study area, .a: Manual extracted lineament features; b, rose diagram for the manual extracted lineament showing their major trend.

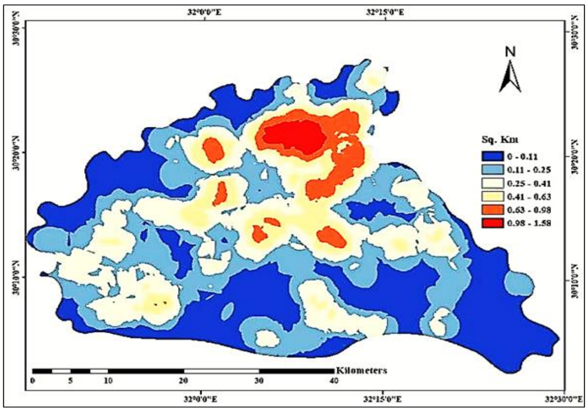

Figure (8): Lineament distribution showing lineament density per square kilometre (per Km^2).

(LS), and sandy loam (SL) is designated for class 4. However, silt (Si), sandy clay loam (SCL), silty clay loam (SiCL), silty loam (SiL), silty clay (SiC), sandy clay (SC), and clay loam (CL) is for class 3. For class 2, silty clay (SiC) is the main component. Rock-lands is designated for class 1. Figure (10) represents the agricultural suitability groups based on soil particle size distribution.

Soil chemical properties

Soil pH

Soil pH shows the soil's acidity, neutrality, or alkalinity, as well as its availability for key nutrients and toxicity to other elements (McLean, 1982; Thomas, 1996). Soil paste was prepared in a ratio of 1:5 (soil: dH_2O) to measure soil pH following the method of USDA (1954). According to Burt (2014), pH values were divided into three appropriate classes (Fig. 11). Class 1, soils have pH values between 5 and 8.5, indicating that they are very acidic or alkaline. Fairly acidic and alkaline soils (pH 5.6-6.0 and 7.9-8.4) are designated as class 3 or moderately appropriate soil for agriculture. Furthermore, class 4 soil has pH values ranging from 6.1 to 7.8 and is the best soil for agriculture.

b.Electric conductivity **(***Ec)*

Soil salinity is measured using electric conductivity based on the method given by Jackson et al. (1973). Figure (12) shows the suitability for agriculture based on soil salinity.

c.Exchangeable Bases

Ca and Mg in soils were directly determined by EDTA procedure (Tucker and Kurtz, 1961). Potassium (K^+) and Sodium (Na^+) were determined by flame photometry (Jackson, 1962). Cation Exchange Capacity is the summation of the exchangeable bases.

d.Sodium adsorption ratio (SAR)/Sodicity/Alkalinity

Increasing salinity levels in the soil profiles had led to an increase in SAR values. SAR is a better indicator to evaluate sodicity and alkalinity hazards to the cultivated crops in the soil. Therefore, most soil profiles that show low ESP and SAR values indicate a low sodicity hazard (FAO, 2006). Sodium adsorption ratio

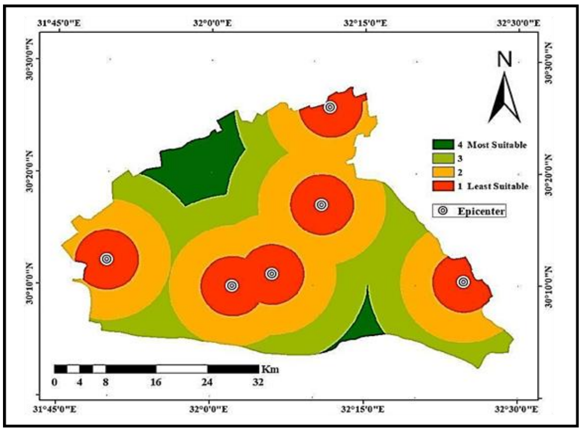

Figure (9): Land Suitability for urban land use category based on euclidian distance away from active epicenters.

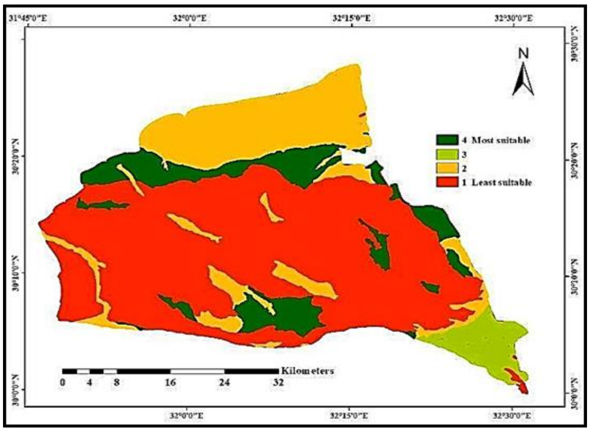

Figure (10): Soil suitability for agriculture based on soil particle size distribution.

(SAR) and exchangeable sodium percentage (ESP) were calculated, according to Ayers and Westcot (1994), using the following formulas.

$$ESP = \frac{[Na^{+}]}{CEC} X100$$

Where ESP is exchangeable sodium percentage and CEC is Cation exchange capacity.

$$SAR = \frac{[Na^{+}]}{\sqrt{Ca^{2+} + Mg^{2+}}}$$

Where SAR is sodium adsorption ratio.

The research area classified soil suitability for agriculture into four groups, most suitable, moderate, less and the lowest appropriate, based on SAR (Richards 1954 and Todd 1959), as shown in Figure (13).

Soil fertility index (SFI)

SFI was estimated using the equation developed by lu *et al*. (2002) and categorised according to Sağlam and Dengiz (2014).

$$SFI = pH + OM\ \% + P + K + Ca + Mg - Al$$

Where OM is the organic matter (%) of dry soil basis; P is available Phosphorous (mg kg^{-1} dry soil); K, Ca, Mg and Aluminium are exchangeable metals (ceq kg^{-1} dry soil). Moreover, soil classes. according to soil fertility index (SFI), is represented in Figure (14).

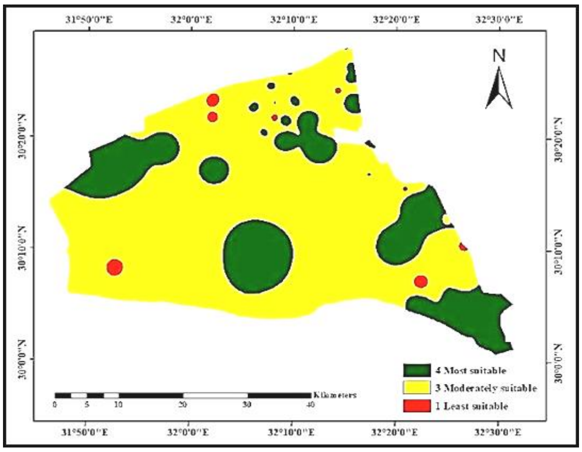

Figure (11): Soil suitability classes for agriculture according to pH values.

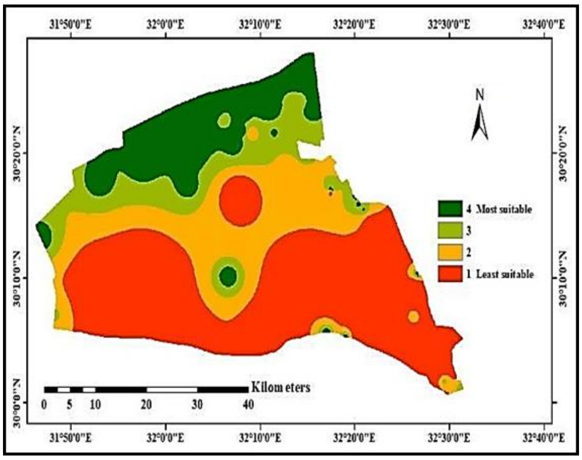

Figure (12): Soil salinity grads showing the suitability soil groups for agriculture based on soil salinity (EC) readings.

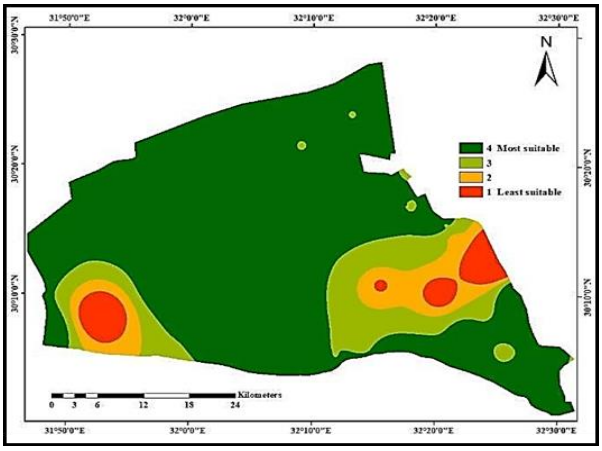

Figure 13: Land suitability for agriculture according to SAR.

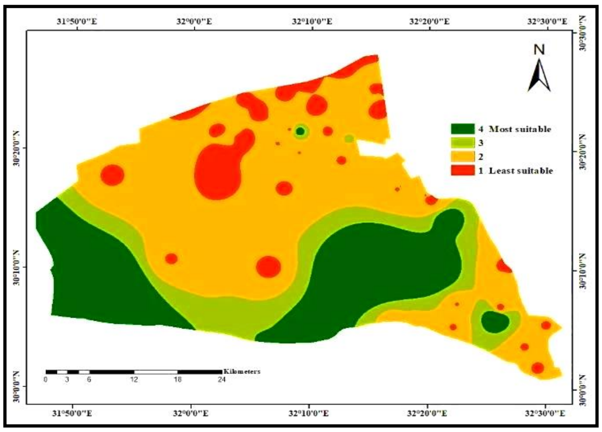

Figure (14): Soil fertility index (SFI) of the study area and its suitability for agriculture.

Land proximity

Proximity to transportation

Main road

The road network connects and offers access to rural places. The research area's road networks were updated using Open Street Maps (https://www.openstreetmap.org/#map=6/26.805/30.246). Main corridors, paved highways, and desert paths were all taken into account. As more settlement develops near the road networks because of the transportation facilities and easy access to the nearby places and city centers. In this study, the main roads 200m buffer was used to identify the road corridor where no construction is allowed. Then, distances from the corridor zone are calculated. Based on these distances from road network corridor four different groups of proximity have been developed: 200m-2Km, 2-5Km, 5-10Km and >10Km. Suitability map according to main road proximity is illustrated in Figure (15).

Railway

Most industries like to be near railway lines so that their products may be imported and exported easily. Residents near these railways, on the other hand, can easily travel from and to their residential area, and railway transport modes are the most commonly used daily by residents because they are economically efficient and effective in terms of time, but these sites are uncomfortable for them due to continuous locomotive noise.

A barrier of 500m is proposed to protect the workers and residents from any potential dangers as well as the loud noise. The Euclidean distance is then calculated to determine how far or close the development is. The Euclidean raster was divided into four classes, with the shortest (50m-2.5Km) ranked as best and the longest (>7.5Km) ranked as worst (Fig. 16).

Airport

Cairo International Airport is around 90 kilometres from the study area's centre. This is a moderate distance, making the research center area suitable for residential, commercial, and industrial urbanization. The distance map was developed and categorized, with areas closer to the airport performing better in terms of urban development (60Km).

Industrial zones to cultivated land

Industrialization is detrimental to agricultural land. Industries could cause agricultural land shrinking and loss. Proximity to agricultural areas should take into account the potential impact of production-related pollution on crop yields and local income. They have an adverse effect on soil fertility, agricultural productivity, and irrigation infrastructure. As a result, agricultural lands should not be allotted to industrial usage in close proximity in order to limit the damage to vegetation and the detrimental impact on agriculture connected with industrial sector pollution, which decreases with distance. The suitability of property for industrial zone development was established based on its closeness to existing and future agricultural zones (Fig. 17).

Wind direction

Wind data from 1907 to 2019 were used to construct a wind map and wind rose. They demonstrated that the major wind direction of the research region was southwest (Fig. 18). As a result, the industrial zone should be located near the southwest corner of the study area.

The Analytic Hierarchy Process (AHP)

The AHP was first introducing by Saaty, 1980, it is used in this study to rank the different land use suitability criteria. Hierarchy models for the demarcation of the suitable land for urban and cultivation are shown in Figures (19 A and B). The relative importance of the selected criteria is determined based on an examination of the data gathered during the interviews with experts from local and international academic institutes, urban planning engineers from nearby governorates, ministry of agriculture experts, the Egyptian geological survey and data obtained from published literatures. The pairwise comparison matrix of the main criteria for selecting land suitable for urban and cultivation land use were performed. The weight of each criterion was calculated, then the final weight of each criterion was determined (Ullah and Hafiz, 2014).

RESULTS

A development master plan assists municipal officials in making decisions on budgets, ordinances, capital projects, zoning and subdivision issues, and other

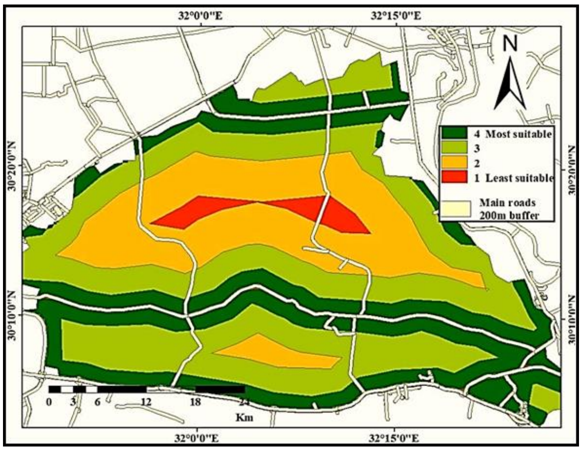

Figure (15): Suitability map for urban growth predicated on a 200m buffer around key roadways

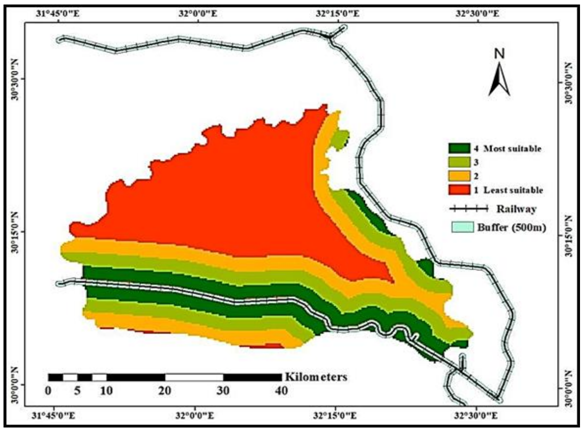

Figure (16): Suitability map for urban growth based on railway of 500 m buffer proximity.

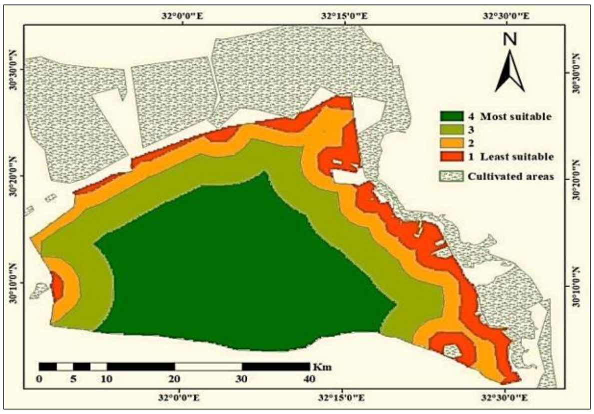

Figure (17): Suitability map for urban growth away from existing agriculture land.

growth-related issues. To determine the land's suitability for both agricultural and urban land use, the weighted linear combination (WLC) technique was utilized.

Based on a hierarchy model and pairwise comparison, the priority considerations for determining land suitability for urbanization and cultivation were geomorphological hazards, followed by soil characterization (Table 1). However, soil characterization is the most important component in determining land suitability for agriculture (Table 2).

The Weighted Linear Combination (WLC) was used to integrate the GIS layers that specify the geographical distribution values of the suitability criteria for agriculture and urban land use. WLC was applied using" Weighted Overlay" function of the spatial module. Weighted Overlay function in ArcGIS 10.8 software (Law & Collins, 2015) combined to determine the composite map layer which is the output. The demarcation of the land suitable for agriculture (Fig.20 A) was done first, and then the land suitable for urbanization was defined (Fig. 20 B). In case there is an area suitable for both agriculture and urbanization, this area was assigned to the agriculture category. The research area was separated into three major zones to design the urban master plan: core urban zone, outer urban zone, and outskirts zone (Fig. 21).

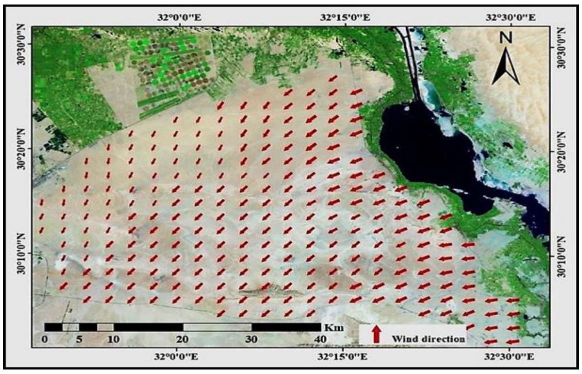

Figure (18): Main wind direction along the study area (Landsat 8, 753).

Outer urban zone

Land suitable for agriculture has three parts, one in the north with an area of around 250 km^2 (60,000 feddan) and the other two parts in the south with areas of 54 and 46 Km^2, respectively (12857 and 10952 feddan). The areas positioned over the region's primary faults are unsteady and unsuitable for urbanization. It is suggested that these sites be turned into public parks (Fig. 21). These lands could serve as a green belt around the city. Green belts give fresh food supplies to the neighbourhood, create employment opportunities, and are a great investment opportunity.

Middle urban zone

It is planned to include residential, institutional, and industrial land use categories. These are lands having populated urban areas, a mix of land uses, and a wide range of residential land use densities.

Residential lands

Residential lands represented by 495 Km^2 can be classified into three categories, as high density (multi-family), medium density, or low density. For developpment to occur, high density residential zones must be located near an arterial route and must be equipped with full urban facilities. For the designation of land appropriate for this land use category, the following criteria were employed. This category's suitable land had been chosen from two major regions (Fig. 21).

The Medium Density category intends to provide two or three-story homes for farmer or worker families (Fig. 22). The worker housing candidate area is located in the eastern half of the study area, just north of the industrial candidate region, and provides workers with a cost-effective route to commute to their workplaces away from congested neighbourhoods. Schools, hospitals, commercial complexes, and government offices are all nearby.

Low Density Residential aims to create single-family homes. It is compatible with transit, local commercial uses, and services. Recreational, commercial, and public facilities and services may be allowed in the region, but only within one or two stair dwellings as a maximum because the area chosen for Low Density Residential is surrounded by areas disse- cted by major structure faults (Fig. 22). The area lacks a solid road network, and it should be linked to nearby routes like the Ismailia-Suez Road to the east and the 30th of July road to the west.

Institutional land

The area allocated for this category is approximately 92 Km^2, which is sufficient for current and future demands. It is centrally located among worker housing, farmer housing, and residential districts, allowing easy access to the majority of the area's inhabitants (Fig. 22).

Industrial lands

Industrial lands chosen is 195 Km^2 which refers to the use of land for the primary purpose of conducting

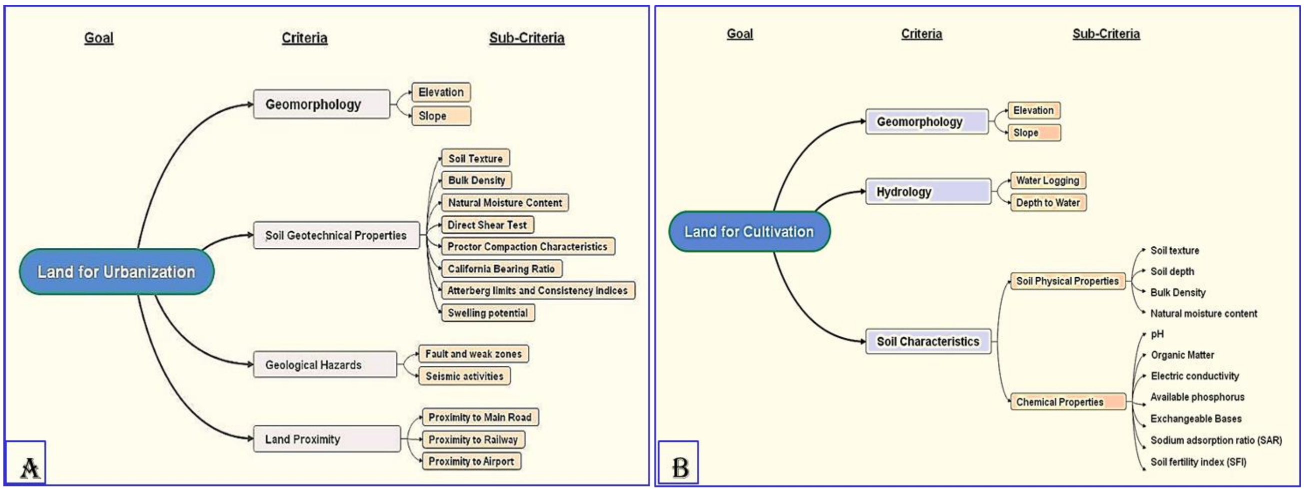

Figure 19: Hierarchy model for the demarcation of the land suitability. A, suitable land for urbanization; B, suitable land for cultivation.

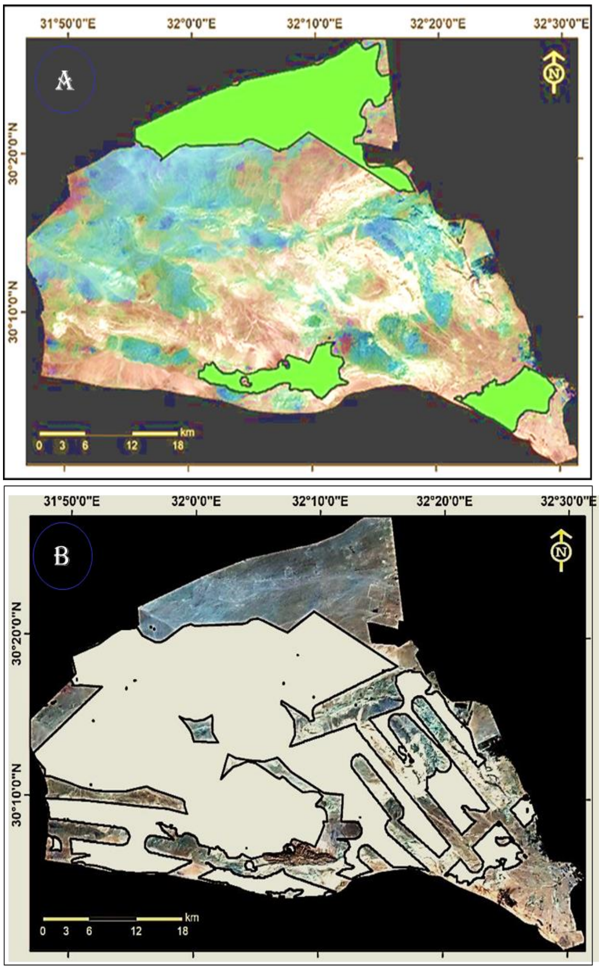

Figure (20): The suitability map of the land use. A, suitable land for agriculture (in green), B, Land suitable for urbanization.

industrial manufacturing and assembly processes. Our, results illustrated that a suitable buffer should be built between industrial areas and sensitive areas to industry, traffic, glare, odour, and other issues, particularly residential and institutional areas (Fig. 22).

For supplementary uses, such as factories, metal foundries, wood treatment facilities, mines, refineries, and others, two different zones might be established, one for light industry and the other for heavy industries. The buffer zone is suggested to be formed between industrial zones and sensitive areas since the wind direction is primarily south-west, the smoke from the factories will travel away from the residential area. (Fig. 22).

Core urban zone

This zone (80 Km^2) is supposed to offer governm-ental offices, commercial services, and retails centers. This land use type selected where a range of commercial purposes that are compatible can be concentrated, major transit routes are nearby or nearby, but not in lengthy, continuous strips or isolated areas, close to residential areas, where parking and other upgrades might be possible and near job centers.

A comprehensive master plan for the research area has been established and is depicted in Figure (22). This master plan serves as a roadmap for the study area's potential development. It's comprehensive enough to assist decision-makers in predicting out-comes with adequate wiggle room. This flexibility allows other developers and urban designers to make any necessary improvements, whether to improve the quality of life in the area, increase its productivity, or comply with government regulations.

CONCLUSION

This study discussed a master urban plan design based on several characteristics. The current study identifies the most ideal locations for future urban and agricultural growth using geological, economic, environmental, and social parameters and the analytical hierarchy process (AHP). Since a master plan serves as the official policy guide for a municipality, any regulat-

Table (1): The pairwise comparison matrix includes the primary criteria for selecting suitable land for urbanization.

Main criteria	Geomor-phology	Soil Characteristics	Geological Hazards	Land Proximity	Priorities†
Geomorphology	1.00	0.25	0.20	2	0.1
Soil characteristics	4.00*	1.00	0.80	8	0.38*
Geological Hazards	5.00**	1.25*	1.00	10	0.48**
Land Proximity	0.50	0.13	0.10	1	0.05

†Criteria with asterisks have higher influence for selecting suitable land for urbanization.

Table (2): The pairwise comparison matrix includes the primary criteria for selecting suitable land for agriculture.

Main criteria	Geomor-pholy	Hydrology	Soil characteristics	Priorities†
Geomorphology	1.0	2.0	0.2	0.15
Hydrology	0.5	1.0	0.1	0.08
Soil characteristics	5.0**	10	1	0.77*

†Criteria with asterisks have higher influence for selecting suitable land for urbanisation.

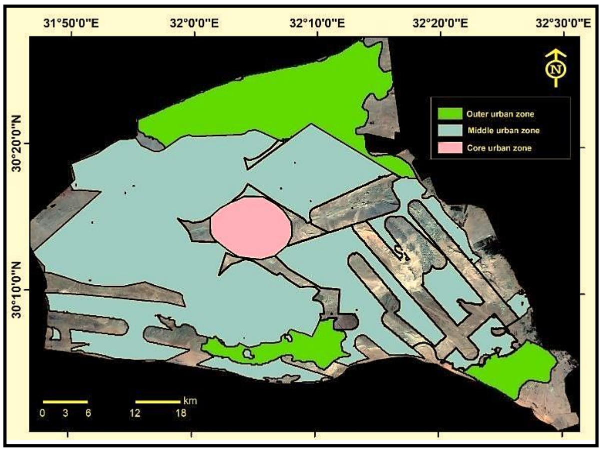

Figure (22): Urban master plan major zones.

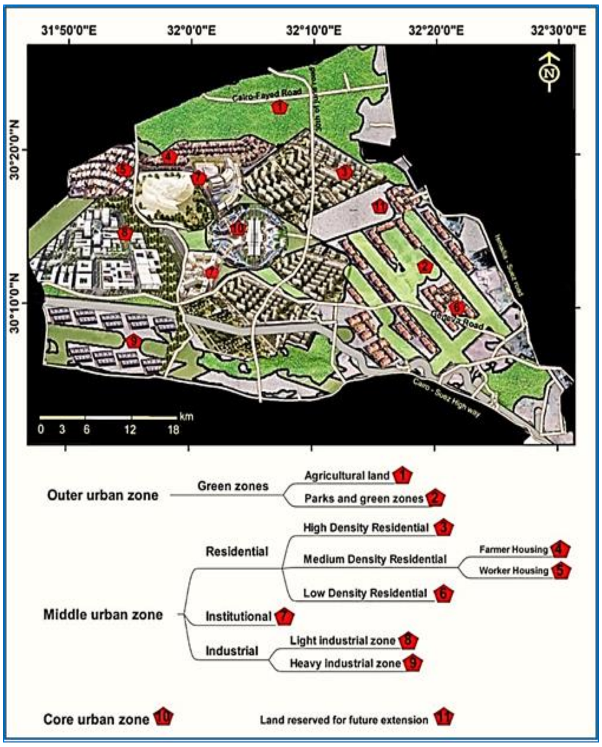

Figure (22): Urban master plan of the study area.

tion dealing with land use or the municipality's growth and development should correspond to the plan's purposes and policies. A master plan acts as a municipality's official policy guide, therefore any rule dealing with land use or the municipality's growth and development should adhere to the plan's aims and policies. Nothing in either master plan, however, is intended to prevent a court of law from evaluating the plan's reasonableness or appropriateness in relation to the governmental activity under consideration for determining governmental action.

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التخطيط العمراني لمنطقة غرب البحيرات المرة، الإسماعيلية، مصر، باستخدام العوامل الجيولوجية و التسلسل الهرمي التحليلي

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الملخص العربـــي

تهدف هذه الدراسة إلى تحديد الأراضي المناسبة لاختيار المواقع الملائمة للتنمية المستقبلية العمرانية والزراعية في منطقة غرب البحيرات المرة. حيث تنقسم الأراضي الحضرية إلى سكنية ومؤسسية وتجارية وصناعية. بينما تنقسم الأراضي المزروعة إلى أراضٍ زراعية ومتنزهات ومناطق خضراء. وطبقا للأبعاد الرئيسية لإستراتيجية التنمية المستدامة المصرية 2030 (SDS، 2030) وتشمل: الأبعاد الاقتصادية والاجتماعية والبيئية. فإن البعد الأهم و هو التنمية الاقتصادية التي تشمل تنمية و تطوير المناطق الزراعية، دعم الصناعات الزراعية (الصناعة الوطنية)، وإنشاء مجتمعات عمرانية جديدة لتحقيق التنمية المتكاملة. تم اختيار الأراضي المناسبة للتطوير المستقبلي وفقًا للمعايير الجيومورفولوجية، الهيدرولوجية، البيئية، الاجتماعية، والجيولوجية. و استخدمت هذه المعايير لإنشاء قاعدة بيانات جغرافية مكانية لمنطقة الدراسة. و لتجنب أي مشاكل مستقبلية قد تنجم عن سوء التخطيط، تم الأستعانة بمبادئ تخطيط استخدام الأراضي الحديثة بالاضافة إلى العمل الميداني، والاختبارات والتحليلات المعملية، و تقنيات الاستشعار عن بعد و نظم المعلومات الجغرافية. و تم تطبيق خطوات عملية التسلسل الهرمي التحليلي (AHP) للحصول على خطة التطويرالمناسبة. و تعتمد عملية التسلسل الهرمي التحليلي (AHP) لتحديد أفضل الأراضي المناسبة على استخدام مجموعة من البدائل و المعايير. و أخيرًا ، تم تقسيم منطقة البحث إلى ثلاث مناطق رئيسية لتصميم المخطط الحضري الرئيسي و هم: المنطقة الحضرية الأساسية، والمنطقة الحضرية الخارجية، ومنطقة الضواحي.