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LAND EVALUATION OF THE GREAT MAN-MADE RIVER INVESTMENT PROJECTS IN THE SIRT AND BENGHAZI

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ABSTRACT

Land elevations of the Sirt area ranged from sea -6 m to 30 m A.S.L. The elevations ranged between 30 to 60 m A.S.L., it is characterized by an almost flat slope, which ranges from 0-0.5 % covering about 70.21 % of the total area. The dominant aspect is the north facing direction, which represents about 71.64 % of the total area. While, land elevations of the Benghazi ranged between 50 to 160 m A.S.L., The area is generally considered flat, the dominant aspect is the south facing direction, which represents about 69.5 % of the total area.

In general, the soils in the study area of Sirt were characterized as non-saline, non-alkaline soils, low fertility, calcareous, low organic matter, light texture, and subjected to wind erosion. Soils are classified as Entisols and Aridsols, while, the soils are in the study area of Benghazi was characterized as high salinity and sodicity, soil texture is medium to fine with high levels of calcium carbonates, low soil moisture retention, low permeability. The soil is classified as Entisols, Aridisols and Inceptisols.

Agro-ecological land quality evaluation was carried out using MicroLEIS IP (Integrated Package) Pro & Eco model (De la Rose, 2000); including the assessment of general land use capability, land suitability for different agricultural crops, predicting the productivity of wheat and corn. According to the model prediction, most of the study area in the Sirt 60.2 % was classified as S3r, which is moderate capability with soil erosion risk as a limiting factor. MicroLEIS programme was used for determining soil suitability for agricultural crop pattern suggested by water utilization of Ajdabiya-Sirt system of Great Man-Made River.

According to the model prediction, most of the study area in Benghazi 62.60 % was classified as S3r, which is moderate capability with erosion risk as a limiting factor. MicroLEIS programme was used for determining soil suitability for agricultural crop pattern suggested by water utilization of Ajdabiya-Benghazi System of Great Man-Made River. We used also Almagra model programme to evaluate the productivity of wheat and corn.

Keywords: Great man-made river, Land evaluation, GIS, Sirt, Benghazi

INTRODUCTION

Sustainable land management in agriculture is a very complex and challenging concept. It encompasses biophysical, socioeconomic and environmental issues that must be viewed in integrated approach.

Inventory of land resources is a pre requisite for the adequate utilization and sustainable management of the natural resources base of any country. Accurate inventories become imperative for the assessment of available natural resources with reach in each country (FAO, 2002).

Geographic soil databases are presently popular due to the wide availability of Geographic Information System (GIS) software packages and vironmental data sources in digital form. In this case, GIS is used to store and retrieve existing database information, to analyze and integrate soil with other environmental data from various sources, and finally to generate nterpretative maps from attribute data. GIS has become an effective and efficient echnology for scientists, managers and decision makers to address multidisciplinary and complex environmental monitoring, assessment and management programs (Petersen *et al.*, 2000; Amarakul and Sanyong, 2000; Harahsheh, 1994; Suhaedi *et al.*, 2002; Varma, 1999; and Wu, 1998; Bahnassy *et al.*, 2001).

The idealistic use of land became very important, when rapid population growth and urban expansion are making available land for agriculture a relatively scarce commodity. Good management to keep equilibrium between human demands and agricultural production is needed. Therefore, it is very important to evaluate the environmental resources to be employed through the best uses. Accordingly, the land evaluation concept became very realizable. Information about soil properties and quality are important in understanding the functionality of major Earth ecosystems.

These new "informatic maps" are very powerful. Because of the possibility of storing practically infinite number of characteristics (spatial as well as temporal) of an area, they have become an essential tool for the municipality, the region, and or societies involved with land use and management (Sys *et al.*, 1993).

Land management is important for agricultural planning extension. Such planning could be attained through the process of land management to recognize the most beneficial use, and at the same time to improve and conserve the land resources for the future. Effective land information management is of particular importance to developing countries (Dale and McLaughlin, 1990).

Land use planning consists of making decision about the use of land resources (FAO, 1993). It is primarily conducted to achieve the best use of land, and its implementation is often driven by future generation needs in terms of productivity and environmental sustainability.

Digital Elevation Models (DEM) and the increased capability of computers to handle large volumes of data during the last few years have prompted soil scientists to arrange soil survey information into soil databases. The Great man-Made River Project (GMRP) is planned in five phases and the present study is concerned with the first phase, the development and use of water from the Sarir and Tazerbo well fields. Water from these well fields will be transferred to the coast where it will be used in agricultural development areas close to Benghazi and Sirt.

The main objectives of this study are:

- Assess the soil characteristics (physical, chemical and nutritional) of the selected areas for agricultural development in (GMRP) phase I.
- Land evaluation classification, which includes land capability, soil suitability and land evaluation and GIS.

STUDY AREA

The study area consists of two sites one at Sirt (Al-Gardabia Swawah Plain and AbcuZahia), located east of Sirt extending eastwards to Wadi Al-Henawa with a length of about 40 km.

It is boarded in the North by the Mediterranean Sea and in the South by the gas pipe line (Al-Brauqah-Misratah) with a width of about 8 km. The second site situated at about 25 km South of Benghazi, Its frontiers Al-Mekzaha Road in the North, the Suluq / Al-Abyar Road through Sidi Ibrahim in the South, Arrajmah heights in the east, and Benghazi /Suluq road in the West. (Figures 1&2) show the location of the study area.

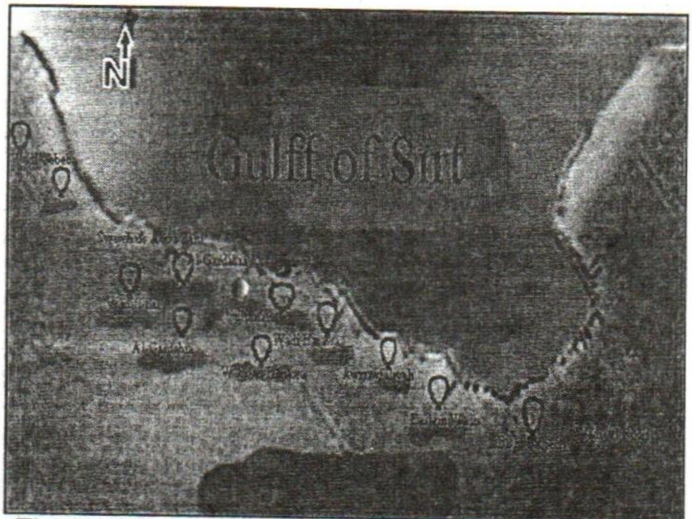

Figure (1): The location of the study area Sirt

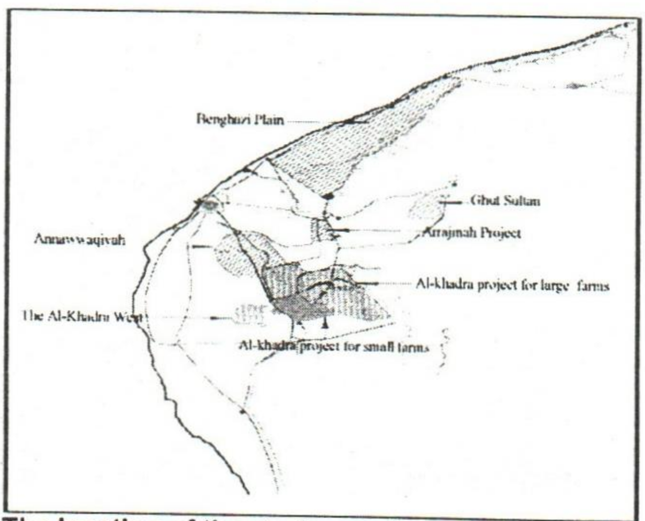

Figure (2): The location of the study area Benghazi

MATERIALS AND METHODS

Many data sources were collected which includes topographic maps, geological maps, soil maps, soil analysis data (physical, chemical and fertility properties), for the study areas, these data were interred into the computer in order to facilitate their use in the study.

These data used as an input for Arc View 3.2 programme to produce soil classification maps according to the modern United States soil Taxonomy, land suitability maps, and maps for chemical and physical properties of the soils were produced.

Agro-ecological land quality evaluation was determined using MicroLEIS IP (Integrated Package) Pro & Eco model, (De la Rose, 2000), including the following assessment: land capability, land suitability for agricultural crops, spatial analysis using GIS.

RESULTS AND DISCUSIONS

Sirt Geo – spatial Database:

Terrain Components:

Digital Elevation Model (DEM):

Land elevations of the Sirt area ranged from -6 m to 30 m from sea level. The elevations ranged between 30 to 60 m A.S.L., is characterized by an almost flat slope, which ranges from 0-0.5 % covering about 70.21 % of the total area. The dominant aspect is the north facing direction, which represents about 71.64 % of the total area.

Soil Taxonomic Units:

In general, the soils in the study area of Sirt was characterized as non-saline, non-alkaline soils, low fertility, calcareous, low organic matter, light texture, and subjected to wind erosion. These soils are classified as Entisols and Aridsols, while. (Figure 3) shows the distribution of the soil units of the study area.

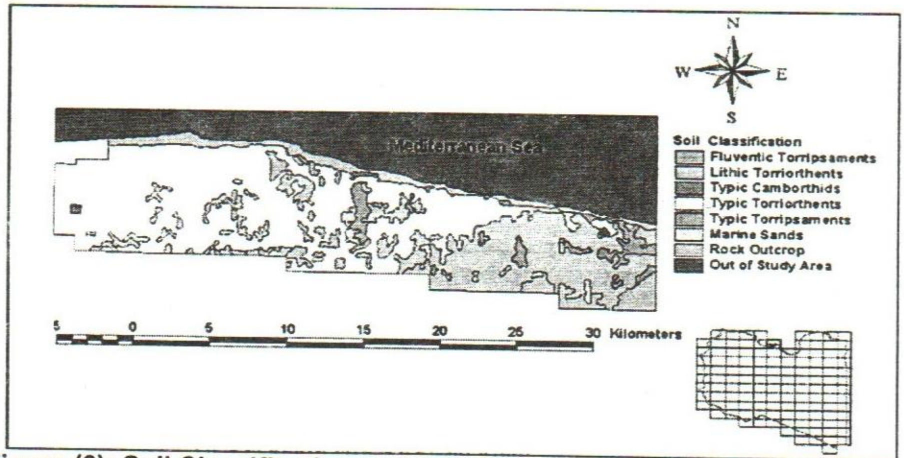

Figure (3): Soil Classification in the Al-Garadabia and Swawah Plain

Soil Thematic Maps:

Salinity:

(Figure 4) shows the distribution of the soil salinity in the study area using weighted average of soil horizons to represent the soil profile. It is clear that salinity is not variable and ranges, where the area and percentage of each salinity class is illustrated. The soils are non-saline and occupy 100 % of the total acreage.

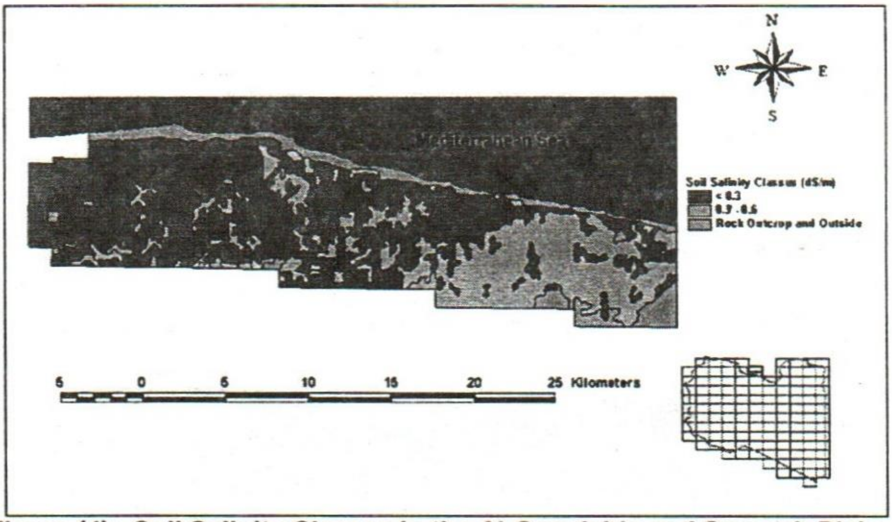

Figure (4): Soil Salinity Classes in the Al-Garadabia and Swawah Plain

Total Calcium Carbonate:

Total $CaCO_3$ ranged from 8 % to 21 %,and 99% of the area has $CaCO_3$ content less then 10% due to its sandy nature.

Soil Depth:

The soil depth ranged from shallow (< 50 cm) to moderately deep (50 – 100 cm). It's clear that about 67.30 % of the soils of study area were deep as shown in (Figure 5).

Land Suitability Units:

Agro-ecological land quality evaluation was carried out using MicroLEIS IP (Integrated Package) Pro & Eco model (De la Rose, 2000); including the assessment of general land use capability, land suitability for different agricultural crops, predicting the productivity of wheat and corn. According to the model prediction, most of the soils of the study area in the Sirt (60.2 %) were classified as S3r, which is moderate capability with soil erosion risk as a limiting factor (Figure 6). MicroLEIS programme was used for determining soil suitability for agricultural crop pattern suggested by water utilization of Ajdabiya-Sirt system of Great Man-Made River. Almagra model programme is also used to evaluate the productivity of wheat and corn, the results of these programmes as follows:

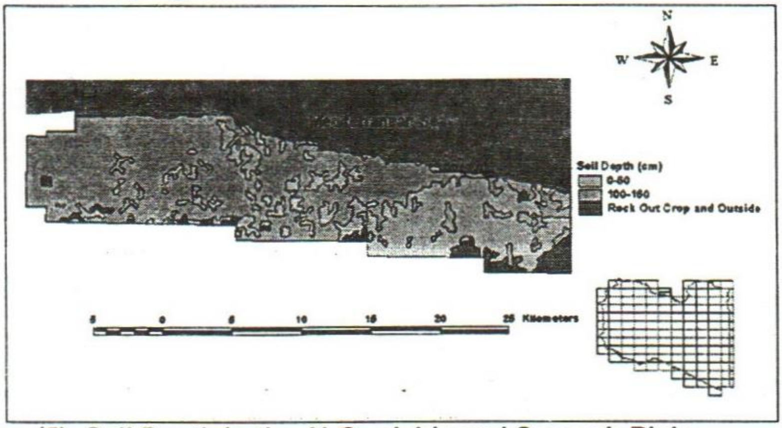

Figure (5): Soil Depth in the Al-Gardabia and Swawah Plain

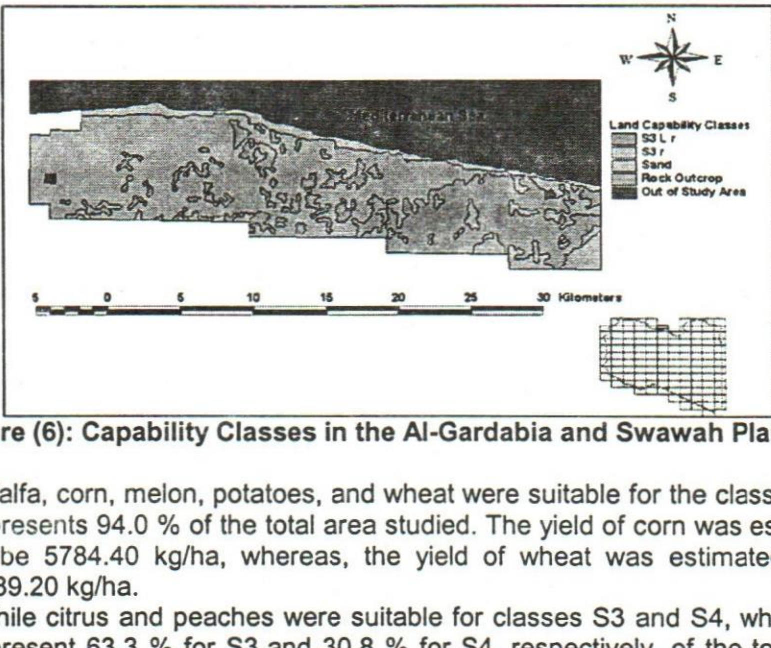

Figure (6): Capability Classes in the Al-Gardabia and Swawah Plain

- Alfalfa, corn, melon, potatoes, and wheat were suitable for the class S4 this represents 94.0 % of the total area studied. The yield of corn was estimated to be 5784.40 kg/ha, whereas, the yield of wheat was estimated to be 3589.20 kg/ha.
- While citrus and peaches were suitable for classes S3 and S4, which they represent 63.3 % for S3 and 30.8 % for S4, respectively, of the total area studied.
- Olive trees were suitable for classes S2 and S4; this represents 63.3 % and 30.8 %, respectively, of the total area studied.

Benghazi Geo – spatial Database:

Terrain Components:

Digital Elevation Model (DEM):

While, land elevations of the Benghazi ranged between 50 to 160 m A.S.L., The area is generally considered flat, the dominant aspect is the south facing direction, which represents about 69.5 % of the total area.

Soil Taxonomic Units:

Benghazi was characterized as high salinity and sodicity, soil texture is medium to fine with a high level of calcium carbonates, low soil moisture retention, low permeability. The soils were classified as Entisols, Aridisols and Inceptisols. (Figure 7) shows the distribution of the soil units of the study area.

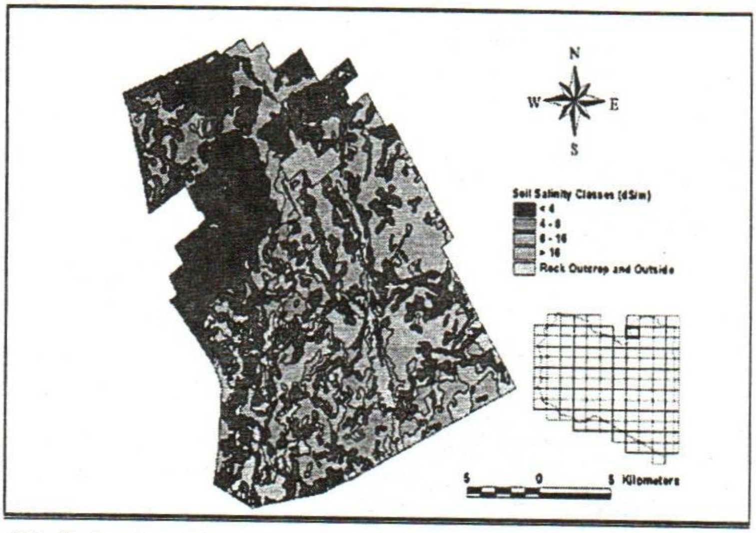

Figure (7): Soil Classification in the Northeast Al-Khadra

Soil Thematic Maps:

Salinity:

(Figure 8) shows the distribution of the soil salinity in the study area using weighted average of soil horizons to represent the soil profile. It is clear that salinity is highly variable and ranged from 0.36 to 31.18 dS/m, where the area and percentage of each salinity class is illustrated. The non-saline soils occupy 50.8 % of the total acreage, where moderately saline soils occupy 19.6 % of the total acreage, where saline soils occupy 26.54 % of the total acreage.

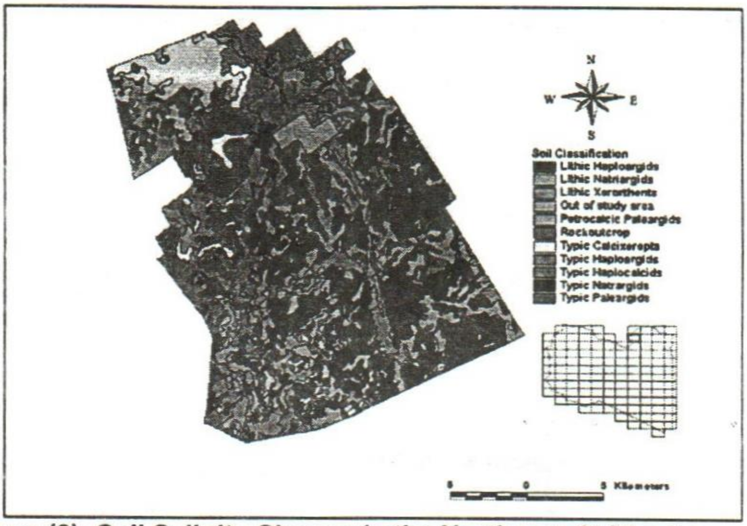

Figure (8): Soil Salinity Classes in the Northeast Al-Khadra

Total Calcium Carbonate:

Total calcium carbonate ranged from 8 % to 41% and classified as shown in (Figure 9). It is clear that most of these soils have high to very high calcium carbonate which represents (57.4 %) of the study area.

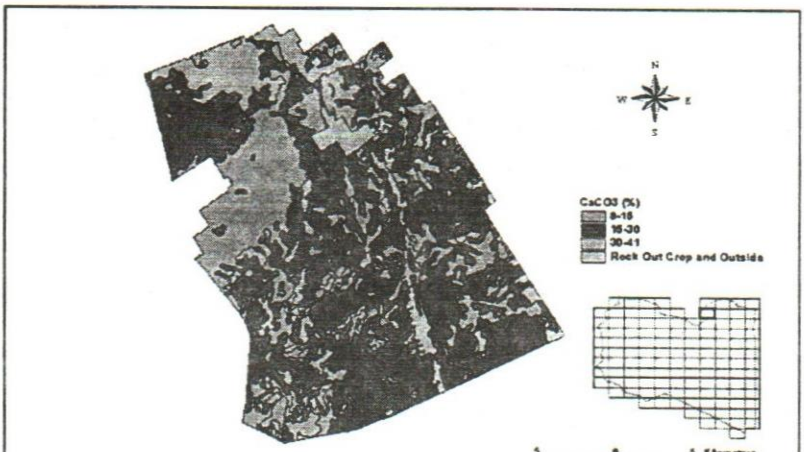

Figure (9): Distribution of $CaCO_3$ Classes in the Northeast Al-Khadra

Soil Depth:

The soil depth ranged from shallow (< 50 cm) to deep (100 – 150 cm). It's clear that about 66.85 % of the study area was deep as shown in (Figure 10).

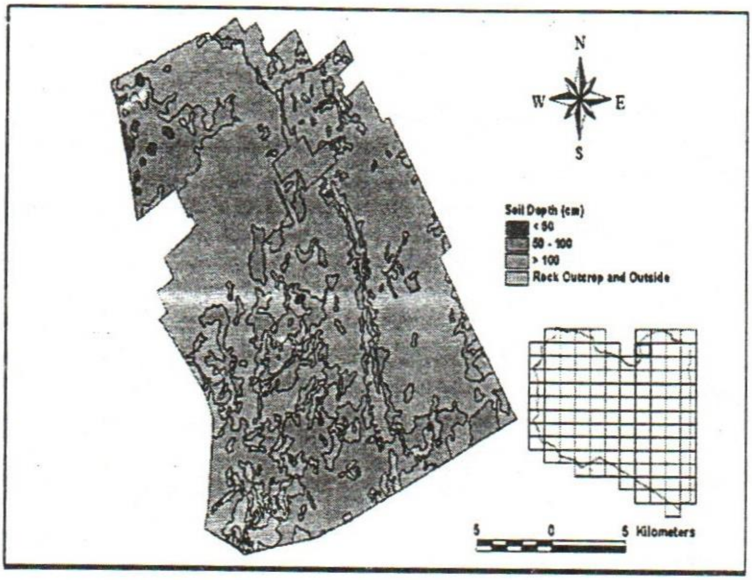

Figure (10): Soil Depth Classes in the Northeast Al-Khadra

Land Suitability Units:

According to the model prediction, most of the study area in Benghazi 62.60 % was classified as S3r, which is of moderate capability with erosion risk as a limiting factor (Figure 11).

Figure (11): Capability Classes in the Northeast Al-Khadra

MicroLEIS programme was used for determining soil suitability for agricultural crop pattern suggested by water utilization of Ajdabiya -Benghazi System of

Great Man-Made River. We used also Almagra model programme to evaluate the productivity of wheat and corn, the results of these programmes as follows:

- Alfalfa and wheat are suitable for the class S2, S3 and S4, these represent 39.7 %, 14.15 % and 16.5 %, respectively, out of the total area studied. The yield for wheat is about 4666.2 kg/ha.
- While citrus are suitable for classes S2, S3 and S4, these represent 5.1 %, 3.3 % and 62.0 %, respectively out of the total area.
- Corn is suitable for classes S2, S3 and S4, which represents 29.5%, 10.2 % and 14.15 %, respectively out of the total area. In addition to the class S5 which represents 16.5 %, this class is not suitable for any crop. Corn gives a yield of 6319.2 kg/ha.
- Melon and potatoes are suitable for the class S2, S3 and S4, which represent 34.1 %, 19.8 % and 16.5 %, respectively, out of the total area.
- Olives and peaches are suitable for the class S2, S3 and S4, which represents 4.6, 3.3 and 62.45 %, respectively, out of the total area. .

CONCLUSION

Ajdabiya-Sirt system of Great Man-Made River:

- The level of plant nutrients are low, a complete fertilizer programme will be used to meat the needs of each crop.
- Due to low cation exchange capacity, fertilizers should be applied at frequent intervals during the growing season rather than in one or two large application, it can easily be done through a system of fertigation.
- Calcium Carbonates values exceed 15% in two representative profiles, and in these soils nutrient imbalance could occur, particularly with phosphorous and iron.
- Agronomic research should investigate potential nutrient imbalance and fertility management systems under intensive production.
- Improved cultivation techniques and soil conservation will be necessary for improvement of land productivity.
- The area is subjected to wind blown sand, which as well as eroding fields can severely damage growing crops. The project should be protected by wind breaks and shelter belts.

Ajdabiya-Benghazi system of Great Man-Made River:

- The critical factor in developing this area for large-scale agriculture will be the successful amelioration of the restrictive levels of salinity and /or sodicity which extends over almost the entire area.
- Irrigation water should be applied in small amounts more frequently due to high infiltration rates and low water holding capacity of these soils.
- The high calcium carbonate levels reduce the fertility of these soils, particularly for phosphorous and iron availability.
- Improvement of land productivity resulting from actions which neutralize (or reduce) the influence of factors such as soluble salts, sodium and calcium carbonate.
- Deep plowing and subsoiling should be used to mix stratified soil profiles and this will improve soil permeability.

- A large appiication of organic matter enhances biological activity, which results in the formation of various substances, which improve soil permeability. Carbon dioxide will be produced will stimulates the dissolving of calcium carbonate to free calcium in calcareous alkaline soil.
- The area is subjected to wind and water erosion. The project area should be protect from erosion risks.
- Drainage will need to be provided particularly for those soils with shallow restricting layer.
- The area will require protection from flooding from the wadis.

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تقييـــم أراضى مشاريع استثمار مياه النهر الصناعي العظيم في سرت وبنغـــازي

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تهدف الدراسة إلى تقييم الموارد الأرضية لمشروع النهر الصناعي العظيم في كل مـــن منـــاطق الاستثمار في سرت وبنغازي، وذلك من خلال الأهـــداف الرئيسية التاليـــــه:

- بناء قاعدة معلومات باستخدام نظم المعلومات الجغرافية.
- تقييـــم صلاحيـــة الأراضي في مناطق الاســـتثمار.

ولتحقيق هذه الأهداف تم تجميع البيانات الخاصة بتحاليل التربة في مناطق الاستثمار المـــستهدفة وخرائط التربة والخرائط الطبوغرافية والجيولوجية والبيانات المناخية و غيرها من المعلومات ذات العلاقة.
وتتلخص النتائج التي توصلت إليها الدراسة في النقاط التاليـــــه:

- من خلال نموذج الارتفاعات الرقمية إن منطقة الاستثمار في سرت تتراوح ما بين -٦ إلى ٦٠ متر فـــوق سطح البحر. إما بالنسبة للميل فإن هذه المنطقة تعتبر مستوية حيث إن الميل السائد هو صفر إلـــى ٠,٥ ٪. إما بالنسبة لاتجاه الميل السائد هو الاتجاه الشمالي و يشغل حوالي ٧١,٦٤ ٪ من اجمـــالى المـــساحة. بينما في منطقة الاستثمار ببنغازي فاءن الارتفاعات تراوحت مابين ٥٠ إلى ١٦٠ متر فوق مستوى سطح البحر. وتعتبر هذه المنطقة بصفة عامة مستوية. وان اتجاه الميل السائد هو الاتجـــاه الجنـــوبي ويـــشغل حوالي ٦٩,٥ ٪ من إجمالي المساحة.
- بصفة عامة تتميز ترب منطقة سرت بأنها غير ملحية وغير صودية ، منخفـــضة الخـــصوبة، جيريـــة ، منخفضة في محتواها من المادة العضوية ، ذات قوام خفيف، ومعرضة بدرجة شديدة للتعريـــة الريحيـــة. ومن خريطة التربة لهذه المنطقة يتضح بأن ترب هذه المنطقة تتبع الـــرتبتين الأساســـيتين تـــرب حديثـــة التكوين (Entisols) والترب الجافة (Aridisols). إما ترب منطقة الدراسة ببنغازي فهي تتصف بأنها ملحية بدرجة مرتفعة وصودية ، وذات قوام متوسط إلى ناعم ، وتحتوى على نسبة عالية مـــن كربونـــات الكالسيوم ، ومن خريطة التربة لهذه المنطقة يتضح بأن ترب هذه المنطقة تقع في ٣ رتب أساسية وهـــى Entisols و Aridisols و Inceptisols.
- تم استخدام برنامج (Micro LEIS 2000) بهدف أجراء تقويم زراعي بيئي لنظام جودة الأرض لتحديد قدرة الأرض الإنتاجية وتحديد ملائمة الأراضي للمحاصيل المختلفة ، كما تم توقـــع إنتاجيـــة محـــصولي القمح والذرة.

ومن خلال هذا النموذج أتضح بأن حوالي ٦٠,٢ ٪ من مساحة الأراضي المدروسة في سرت تقع ضمن الدرجة S3r والتي تعتبر متوسطة الملائمة وذلك بسبب القوام الرملي. كما تبين بأن كل من البرســـيم والذرة والبطيخ والبطاطس والقمح والزيتون ملائمة للدرجة S4 وهى تمثـــل حـــوالي ٩٤ ٪ مـــن أجمـــالي المساحة المدروسة. وان إنتاجية الذرة كان حوالي ٥,٨ طن/هكتار وإنتاجية القمـــح حـــوالي ٣,٦ طـــن/هكتار. بينما كانت الموالح والخوخ ملائمة للدرجـــة S3 وبنـــسبة ٦٣,٣ ٪ و S4 بنـــسبة ٣٠,٨ ٪ مـــن أجمالي المساحة المدروسة.

اما بالنسبة لمنطقة بنغازي فانه حوالي ٦٢,٦ ٪ من المساحة تم تصنيفها إلى S3r وذلـــك بقـــدرة متوسطة بسبب الانجراف. ولقد تبين بأن البرسيم والقمح ملائمين للدرجات S2 ، S3 ، S4 وبنـــسب ٣٩,٧ و١٤,١٥ و١٦,٥ ٪ من أجمالي المساحة المدروســـة. وان إنتاجيـــة القمـــح كانـــت حـــوالي ٤,٧ طن/هكتار. بينما كانت أقل ملائمة لكل من الموالح ، والذرة والبطيخ والبطاطس والزيتون. ولقـــــــد خلصت هـــــذه الدراســـه إلـــى:

منطقـــة ســـرت:

- تعتبر الترب بمنطقة سرت فقيرة في عناصرها الغذائية وتحتاج إلى برنامج تـــسميدي متكامـــل و ينـــصح بإضافة الأسمدة على جرعات متكررة خلال موسم النمو.
- حماية المنطقة من خطر التعرية الريحية و ذلك بزراعة مصدات الرياح والأحزمة الوقائية.

منطقة بنغـــازي:

- يجب القيام بعمليات استصلاح الترب بهذه المنطقة وذلك نظرا لمشاكل الملوحة والصودية قبل اســـتزراعها واستخدام الحراثة العميقة لتكسير طبقات التربة المتماسكة وتحسين نفاذيتها.
- إضافة المادة العضوية لتشجيع النشاط الحيوي في التربة و تحسين خواص التربة الطبيعية.
- حماية المنطقة من خطر الانجراف المائي.
- تنفيذ شبكة صرف للتخلص من مياه الغسيل لمنع تغدق التربة.