An Information System for Combating Soil Salinity and Alkalinity Hazards (IS-SAH)

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ABSTRACT

Planning for sustainable utilization of agriculture sector depends on possibilities to get accurate and enough information of the studied area. This is rather essential for scientific planning, implementing updated technologies, removing constrains and controlling environmental desertification. Also, it is critically needed to introduce new investments for the agricultural sector aiming to improve and develop new area for optimum agricultural production. Moreover, accurate data of the proposed IS-SAH are urgently needed to face day by day constrains of sustainable agriculture.

Geographic map of the country is divided into horizontal sectors not more than 9 starting from the north direction; each sector is divided into vertical sub-sectors not more than 9 starting from the west. Each sub-sector is divided into horizontal locations not more than 9 starting from north. So, each location is representing by a directory of 3 numerical values starting from 111 and not more than 999. The meaning of the numerical value of each location, starting from the left; first is the number of the sector, second is the number of the sub-sector and third is the number of location. If the location is of wide area, it may be divided into vertical areas starting from the west, each denoted by a character e.g.: A, B, C, …up to Z (i.e. 26 areas), which is added at the right of the location numerical value e.g. 158-A, 228-B…etc. in vertical arrangement starting from the west. On the basis of this grid-system, the locations (and their areas) are cited on a geographic map of the country showing its numerical values and the site of the studied area. On level of different countries, the above details are to be conducted with each country, then the country name is to be added at the left of the numerical value of location and separated by a dash e.g. Egypt-198-G, Saudi-337-H, Sudan-828-D, …etc.

The directory of each location comprises the following sub-directories*:*

1-Site details, 2-Soil resources, 3-Water resources, 4-Climatic conditions, 5-vegetative growth, 6-Dynamic strategies and scientific planning, 7-Updating the information unit at intervals, 8-Training and recruiting needs for development, 9-Facilities need for development and 10-Evaluation of Salinity and alkalinity hazards of location. Each of these sub-directories comprises different sub-sub-directories and the concerned files (as needed for the studied location).

All directories of locations and/or area are connected with the (IS-SAH) in harmony with scientific planning for all locations, which will be subjected to updating activities that needed for sustainability and development of the agricultural sector in the studied country or on the level of different countries. As applied example for the IS-SAH, the available inputs of the area denoted as Egypt-353-S are presented and evaluated for combating soil salinity, alkalinity and waterlogging hazards.

Keywords: Climatic conditions, Information system, Soil Salinity and Alkalinity hazards, Salt affected soils, Waterlogging.

INTRODUCTION

The main objectives of agriculture sector, worldwide, are optimum agricultural production of crop yields and quality to satisfy the demand of the growing population. This makes further study and optimal utilization of soil resources of the earth imperative and urgent (Szabolcs, 1976). Also, these problems are rather critical in either developed or undeveloped countries, which are facing limited soil and water resources, as extreme of these problems are found in arid and semi-arid regions where salt-affected soils are increased and their people are continuously fight against hunger. Elgabaly (1972) showed that most of the Middle Eastern Countries are characterized by arid and semi-arid climates where evaporation exceeds precipitation as the summers are usually hot and dry and the winters are cool with rainfall varying from 0.0 - 400 mm. Important aspects within this broad spectrum are the amelioration and agricultural utilization of salt-affected soils and the prevention of further soil deterioration.

Soil salinization, alkalization and waterlogging are important desertification processes facing farmers in arid and semi-arid regions (Balba, 1976; Kovda, 1976 and Yadav, 1981). These constrains are reducing drastically the land's capability to produce optimum crops yield or even leading to complete failure of agricultural production in different countries. Under these conditions, all activities of reclamation and/or improvement of arable land are depressed or failed.

Possibilities to design and plan for future strategies and sustainable development needs accurate data that must be completely prepared to satisfy the requirements of the policy makers, designers and researchers questions. These data must introduce in easy form for direct handling and simple applicability by the users. Elgabaly, (1972) showed that implementation of new

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and updating technologies for land reclamation and improvement are of serious costs, so, it requires collection of different basic information depending on the needed technology. Also, simple data are preferred for application of amendments and updated technologies to reclaim and ameliorate salt-affected soils.

Additions of soil conditioners and amendments are of great importance to remove alkalinity from soils. Singh et al. (1981) introduced different amendments to improve characteristics of alkali soils. In this connection, additions of organic materials, as soil amendments, had been reported to increase the improving efficiency of salt-affected soils (El-Shakweer et al. 1997; El-Shakweer, 2001 and Abdel-Hafeez, 2008). Also, local calcareous deposits showed significant ameliorating effect on sodic soils (El-Shakweer et al. 2001). So, it could be stated that optimum additions of soil amendments are related to the data of its constituents and the tested soil that may be introduced in such information system.

Predictive data of soil deterioration and desertification are essential for policy makers to get accurate prediction and to plan for optimum preventive programs for sustainable development of salt-affected soils (Balba, 1976). Gad and Abdel-Samie (2001) and Gad et al. (2001) focused their studies on monitoring, evaluation and controlling desertification process. They showed that predictive data are essential and helpful for planners to operate active precautions to save soils from secondary salinization, alkalization and waterlogging i.e. combating desertification. El-Nahry et al. (2001) evaluated the environmental hazards as a preliminary stage of land degradation and showed that chemical hazards were represented by salinization and alkalinization, while soil compaction and waterlogging represented the physical hazards. El-Kady and Mustafa (2001) showed the essentiality of environmental management of water resources and the need to improve water sector database as a valuable tool to build systematic preventive water problems programs, therefore, the stored data should be scientifically analyzed in order to solve day–by-day the problems facing sustainable agriculture.

Information system is the key element for decision-making as the information must be continuously reanalyzed and renewed. Information becomes volatile if it is not registered, indexed and updated, while an information system that refers to a data relate to actual facts result in series of data subjected to be analyzed and processed to provide a perfect decision (Moussa et al. 2001). In some cases, plan makers failed to get final solutions of some problems related to salt-affected soils. This is mainly due to the insufficient data of the focused area and, perhaps, the available data are not compensating to that needed for land reclamation and improvement. It could be indicated that, some data are misleading the planners or policy makers due to its insignificant indication on a specific aspect or trend.

Kovda (1976) stated that, actually, we are looking for simplified presentation of scientific materials based on accurate information to be applied to the farmers, surveyors, engineers, scientists and policy makers.

Since simple, easy and suitable data and information are highly recommended for direct use and handling for field application, this work is aiming to introduce an information system for combating salinity and alkalinity hazards.

MATERIALS AND METHODS

2.1. Scope of the proposed information system unit:

The proposed information system unit comprises all locations and areas (on the levels of country or different countries), which are connected with information system in harmony with scientific planning subjected to update activities of reclamation and development of salt-affected soils. Different directories, each contains sub-directories and each of which contains different files comprise the data and information of the location. Moving within the existed directories, sub-directories and their files show all essential information of salinity and alkalinity hazards of the location, meanwhile, introduce concepts of the main problems of the location and its solutions. This information system may be presented to the interested users, researcher, and policy maker in different computerized forms i.e. CD and/or web site.

2.2. Dividing the country into sectors, sub-sectors and locations:

On the country level:

The geographic map of the country is dividing into horizontal sectors not more than 9 starting from the north directions; meanwhile, each sector is divided into vertical sub-sectors not more than 9 starting from the west. Then, each sub-sector is divided into horizontal locations not more than 9 starting from north. So, each location is representing by three numerical values starting by 111 and not more than 999. The meaning of the numerical values of each location, starting from the left first is the number of the sector, the second is the number of sub-sector and the third is the number of location. So, maximum locations of a country will not exceed 9 sectors x each contains 9 sub-sectors x each contains 9 locations = 729 locations. On the basis of this grid-system, the locations are cited on a geographic map of the country and showing its numerical value. If the location is of wide area, it may be divided into vertical areas starting from the west, each denoted by a character e.g.: A, B, C, …up to Z (i.e. 26 areas), which is added at the right of the location numerical value e.g. 158-A, 228-B…etc. in vertical arrangement starting from the west. On the basis of this grid-system, the locations (and their areas) are cited on a geographic map of the country showing its numerical values and the site of the studied area. The above details are to be conducted with the country, then the country name is to be added at the left of the numerical value of location and/or area then separated by a dash e.g. Egypt-198-G, Egypt-337-H..…etc.

On the level of different countries:

The above details is to be conducted with each country, then, the first letters of the country name is to be added at the left of the numerical value and separated by a dash e.g. Egypt-198, Saudi-337, Iraq-222, Sudan-828 and Oman-435…etc.

2.3. Main directories, sub-directories and files of each location:

The proposed information system (IS-SAH) is designed to contain a main directory for each location and/or area, and then each location and/or area contains sub-directories, each of which contains one or more files as needed. So, the main sub-directory of the location and/or area involved the following:

2.3.1. Site details:

This sub-directory contains the following files:

File 1-Information of total area, area of salt-affected soils and area subjected to either pre-reclamation or reclamation stages.

File 2-Geography and field report.

File 3-Topography of the location.

File 4-Population data.

File 5-Detailed maps.

2.3.2. Soil resources:

This sub-directory contains the following sub-sub-directories, and focus on:

A-Soil characteristics:

This sub-directory contains the following files:

File 1-Physical properties such as particle size distribution and texture class, total porosity, bulk density, hydraulic conductivity, permeability, Field capacity, wilting point, available water, pore size distribution (Quickly drainable pores, Slowly drainable pores, Volume drainable pores, Water holding pores, Fine capillary pores, Useful pores).

File 2-Chemical properties: organic matter, calcium carbonate, pH (in soil paste), ECe, soluble cations and anions, C.E.C and exchangeable cations.

File 3-Geological properties: stratification of soil layers and clay mineralogy.

File 4-Biological properties: biological components of soil in the area.

File 5-Sources of soil salinity, alkalinity and waterlogging: saline irrigation water or upward movement of ground water, near to saline sea or lakes and/or natural sources.

B-Researches conducted for reclamation and improvement of salt-affected soils in this location or area:

This sub-sub-directory contains the following files:

File 1-Applied research already conducted.

File 2-Theoretical research already conducted.

File 3-Researches still needed

C-Activities needed for soil reclamation and improvement:

This sub-sub-directory contains the following files:

File 1-Calculation of leaching requirements: tests in laboratory and/or in field.

File 2-Amendments: use of either organic and/or inorganic amendments, and calculating the requirements needed from each amendment.

File 3-Sub-soiling activities needs and frequency of its use.

2.3.3. Water resources:

This sub-directory includes the following three sub-sub-directories:

A-Precipitation (Rain):

This sub-sub-directory contains the following files:

File 1-Rate of annual, monthly and daily rain precipitation.

File 2-Availability of rains water to plants.

B-Irrigation:

This sub-sub-directory contains the following files:

File 1-Surface irrigation (rivers, canals and wells) calculated in m^3 discharge at the location.

File 2-Sub-surface waters (seepage) estimated or calculated (as possible) in m^3/feddan discharge at the location and/or area.

File 3-Need to complementary irrigation, (in m^3/feddan).

C-Underground water:

This sub-sub-directory contains the following files:

File 1-Weighted average of depths of ground water (annual, monthly and daily).

File 2-Critical depth of ground water, (as recommended by local researches).

File 3-Soluble salts of ground water (the critical salinity to the cultivated crops and its correlation to the critical depth of location).

2.3.4. Climatic conditions:

This sub-directory contains the following files:

File 1-Meteorological data:

Records of maximum, minimum and mean of annual, seasonal, monthly and daily records for temperature, humidity, wind speed and sunshine.

File 2-Evaporation:

Daily, monthly and annual records of the minimum and maximum evaporation.

File 3-Connection to salt accumulation on surface layer of soil.

File 4-Connection to salt / water balance of the area.

2.3.5. Vegetative growth:

This sub-directory includes two sub-sub-directories:

A-Vegetative growth of natural biomass:

This sub-sub-directory include two files:

File 1-Natural non-halophytes vegetation species and varieties.

File 2-Halophyte vegetation species and varieties.

With the mentioned files of non-halophytes and halophytes, varieties must be arranged in alphabeta descending order, showing with each variety its botany classification, rate of growth and its actual and possible use in the location.

B-Possible future cropping pattern: This sub-directory contains 6 files:

As recommended by researches or local experiences of farmers in relation to the species and varieties of the following:

File 1-Field crops.

File 2-Forestry.

File 3-Orchards.

File 4-Vegetables.

File 5-Forage.

File 6-Medical plants.

2.3.6. Strategies and plans:

This sub-directory includes 4 files each shows the strategy and plans that proposed for different stages of reclamation. Accurate timetable and a range of allowed errors must be defined for each stage. Dynamic strategies and scientific planning are to be fixed and aimed to get sustainable agriculture, updated development and optimum economic utilization of soils in the location with the following stages, each conducted in a file as follows:

File 1- Strategy for planning stage.

File 2- Strategy for pre-reclamation stage.

File 3- Strategy for reclamation stage.

File 4- Strategy for post reclamation stage.

2.3.7. Updating data:

Updating the information system of land reclamation and improvement will be at intervals using all data available from the concerned researchers, universities, Institutes and Ministries. So, updating the sub-directory includes new updated copies of all sub-directories (and their files) of the location and/or area that are subjected to updating. Updating data and information are to be recorded with each file, then, senior soil scientist must edit and subject the updated information to evaluation. Thereafter, editing the renewed and updated files to be in completely updated forms.

2.3.8. Training and recruiting needs:

This sub-directory includes the following 2 sub-sub-directories:

A-Training need:

This sub-sub-directory includes three files:

File 1-Training courses.

File 2-Symposiums.

File 3-Workshops.

Each of the above-mentioned 3 files must include complete information of the type of training and its timetable, who will be trained and duration, in addition to the estimated costs and methods of evaluation at the end of training. Total allowed budget for training must be recorded and divided for each of the three items of training.

B-Recruiting for vacancies:

This sub-sub-directory includes different files containing the following needs:

File 1-Experts and consultants.

File 2-Engineers.

File 3-Technicians.

File 4-Labors.

The above-mentioned 4 files are to indicate clearly if the need to recruiting will be locally or from abroad, if for full or part-time, duration of work and allowed salary of each.

2.3.9. Facilities need:

This sub-directory includes three sub-sub-directories, each of which contains different files:

File 1-Equipment.

File 2-Raw materials.

File 3-Other supplies.

The three sub-directories must be divided into files to introduce complete information and data of the needs to facilities. The files must prepared to be ready for announce as tenders on local and/or international journals, and also at the sites of Internet.

2.3.10. Evaluation of salinity and alkalinity hazards of the location:

This sub-directory includes 4 files to show the following:

File 1-The salinity hazard of the location.

File 2-The alkalinity hazard of the location.

File 3-The waterlogging hazard of the location.

File 4-How to control each of salinity, alkalinity and waterlogging hazards.

RESULTS AND DISCUSSIONS

3. Conducting the proposed information system

Conducting the proposed information system comprise the following successive stages:

3.1.Dividing the country into sectors, sub-sectors and locations:

As mentioned before in item 2.2, the numerical values are cited on each location. If a location comprises different areas vary in their properties of salt-affected soils, the location may be divided into different areas as mentioned in chapter 2.2

3.2. Establishing the main directories, sub-directories and files of each location and/or area:

This includes looking for more accurate definition of the file name to be easier at handling its data and information. The same definition and nomination must be followed with the same files of the other locations and/or areas to get easily comparison for some data or information of more than one file.

3.3. Prepare and fill all information data in their files:

As possible, information of the file must be arranged in a standard quantitative form. Then, data of the files must be edited in a standard form like similar files of other locations and/or areas. These arrangements and editing will help users for easier comparison of the same column of different files. Also, the arrangement will help for getting graphical interpretation of data (i.e. using Excel program or others) and for statistical comparison of their difference through statistical analysis to indicate its significance (i.e. using SPSS program or others for comparison). Senior soil scientist of high experience in statistical analysis must try these comments and introduce final conclusions and recommendations in a standard form.

3.4. Update all data and information at intervals:

Updating the information system (as mentioned in section 2.3.7) is designed to be at intervals using all data available from researchers, universities, Institutes and Ministries. So, updating a sub-directory includes getting copies of the original sub-directories and their files that are subjected to updating, then, update all. Then the PC operators are responsible for recording update data and information of each file. Senior soil scientist who is responsible to state and show his remarks, comments and recommendations must subject all file data and information for evaluation. Thereafter, renewing and updating the original sub-directories and their files may be allowed and certified.

3.5.Testing the validity, applicability and utilization of the (IS-SAH):

At intervals, validity of the proposed information system must be tested to realize its applicability under field conditions. Validity tests of the proposed information system are to be conducted periodically (not more than 3 months) by senior soil scientists to decide weather it is valid or not and if the system need some modifications before application. Actually, the costs of reclamation projects are relatively expensive, so, such error at application on a large scale may result in large losses from the total capital and investments devoted for reclamation of a location, which may reflected some constrains on the land reclamation policy of the country. So, it must follow with testing the applicability and utilization of the proposed information system.

4. Parallel activities needed for supporting the (IS-SAH)

1- **Direct and indirect connections** are essential with departments of soil survey, GIS and the concerned authorities of land reclamation and improvement in the country.

2-**Cooperative scientific activities** are to be established with researchers, universities and scientific institutes involved in reclamation and improvement of salt affected soils on both the country and international levels.

3-**Dynamic connections** are to be operated with laboratories of soil, water and plant analysis on the country and International levels.

4-**Applied functional exercises** must be operated at intervals as to apply functional trails of development aiming to update the proposed information system for better applicability and utilization.

5. Supported research needs

1-Fundamental researches on the properties and processes of salt-affected soils are still essential.

2-Further efforts are necessary to elaborate detailed and comprehensive classification of salt-affected soils with particular reference to reclaim ability.

3-Efforts must be focused on standardization of soil survey and laboratory analytical methods and field experiments at application on salt-affected soils.

4-For operative measures, the elaboration of a monitoring and prognosis system on salt-affected soils is necessary.

5-An essential need for such data in irrigated lands where an increase of salinity and alkalinity hazards is to be expected.

6-Appropriate methods to prevent secondary salinization as related to local conditions, are to be developed for each salt-affected area.

7-At intervals, the sub-directories and files of the information system are to be subjected to continuous update aiming modification and researches; according to the updated computer knowledge and new programs, which always give us more easier applicable information and data.

6. Discussions, reports and guides of the information system

Discussions must hold between the staff of the proposed information system and the different levels of users to face such constrains at the forthcoming stages to get easy and efficient utilization of the information system.

6.1. Level of discussion:

Continuous discussion as seminars or workshops must be held between the staff of the proposed information system and the users who are policy makers, researchers, planners, agricultural engineers and farmers. Discussion must be extended and be allowed to the entire private and governmental sector dealt with land reclamation and improvement.

6.2. Intervals of discussions:

The discussions must be held at intervals not more than 3 months with each group of the users. The discussion may be held as formal meetings (i.e. seminars or workshops) or as field meetings (i.e. in a reclaimed village) to discuss the applicability of the information system and facing constrains on site day-by-day to get accurate modification of the proposed information system.

6.3. Reporting results to the users:

Continuous reports are to be presented for the different levels of users and according to their actual needs. The reports differ according to the user i.e. reports to engineers and farmers may be in forms of journal, magazine, video films, computer outputs and/or radio, meanwhile, additional reports concern with researchers and policy makers may be in diskette, CD and/or web site. These reports comprise the main data, results and information, which must be presented to the users in a simple and direct meaning at their request to remove each of the constrains facing the users at the stages of land reclamation and improvement.

6.4. Prediction from reports:

Reports resulted from the proposed information system must comprise predictive data and specific reports on the focused problems of the location such as: salt accumulation, sources of salinity, salt/water balance, water evaporation, water consumption, drainage regime, leaching efficiency, amendments and fertilizers recommendation.

6.5. Guides presented for policy makers and researchers:

The proposed information system must introduce guidelines to the policy makers in the involved ministries and departments and, also, to the researchers. The guideline is to consist specific remarks and guides such as policy for budget and costs, efficient soil utilization policy and socio-economic targets.

6.6. Guides presented for soil users (engineers and farmers):

The guides to be presented for the users are generally related to predictive problems that face land reclamation stages and their efficient solutions. The national targets and policy may be included in the reported guides to aware soil users.

7-Applied Example of the (IS-SAH), Inputs of the area denoted as Egypt-353-S

The following are summarized inputs of the sub-directories and files comprising its information and data involved with the area denoted as Egypt-353-S:

7.1. Site details:

This sub-directory contains the following files:

File 1: Maps of the area Egypt-353-S:

Figure 1 shows dividing the country “Egypt” into sectors and sub-sectors while Figure 2 shows dividing the sub-sector “Egypt-35” into locations and areas showing the studied area “Egypt-353-S”, which lies in

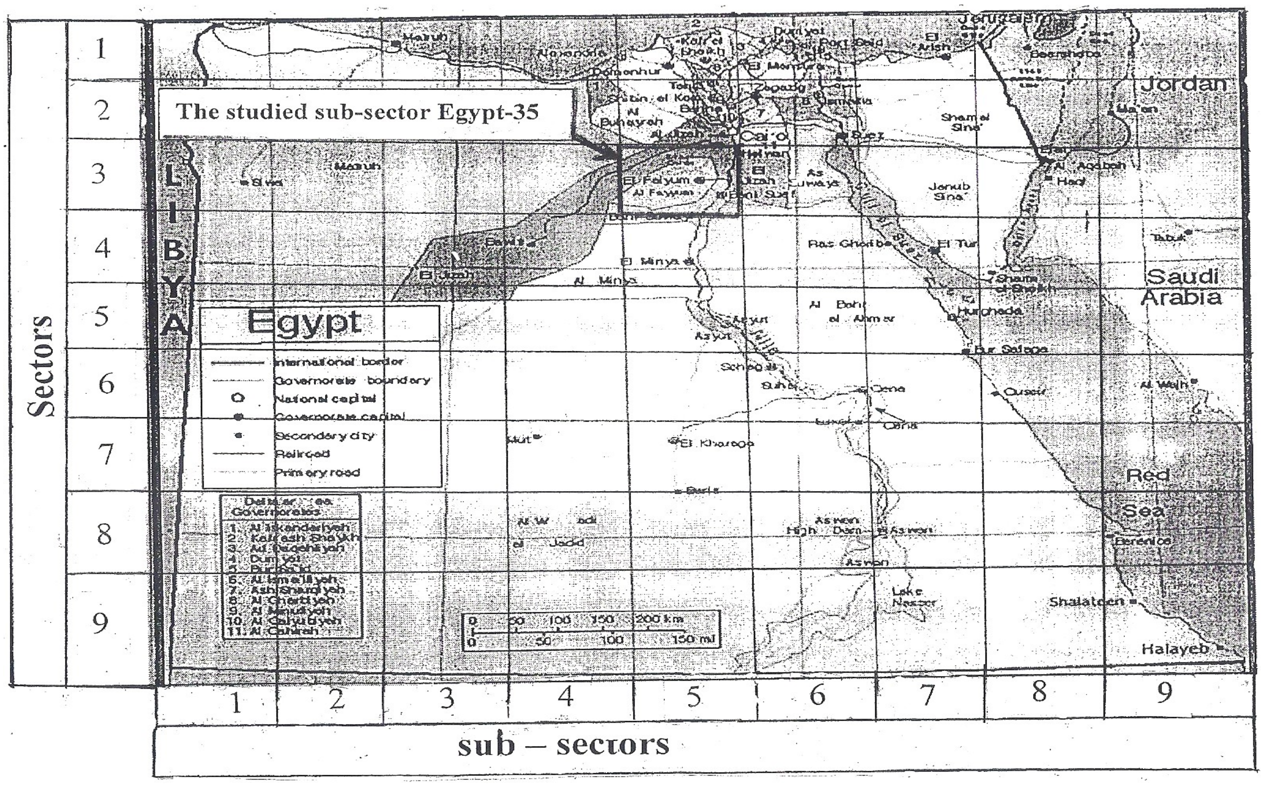

Figure 1. Dividing Eygypt into sectors and sub-sectors

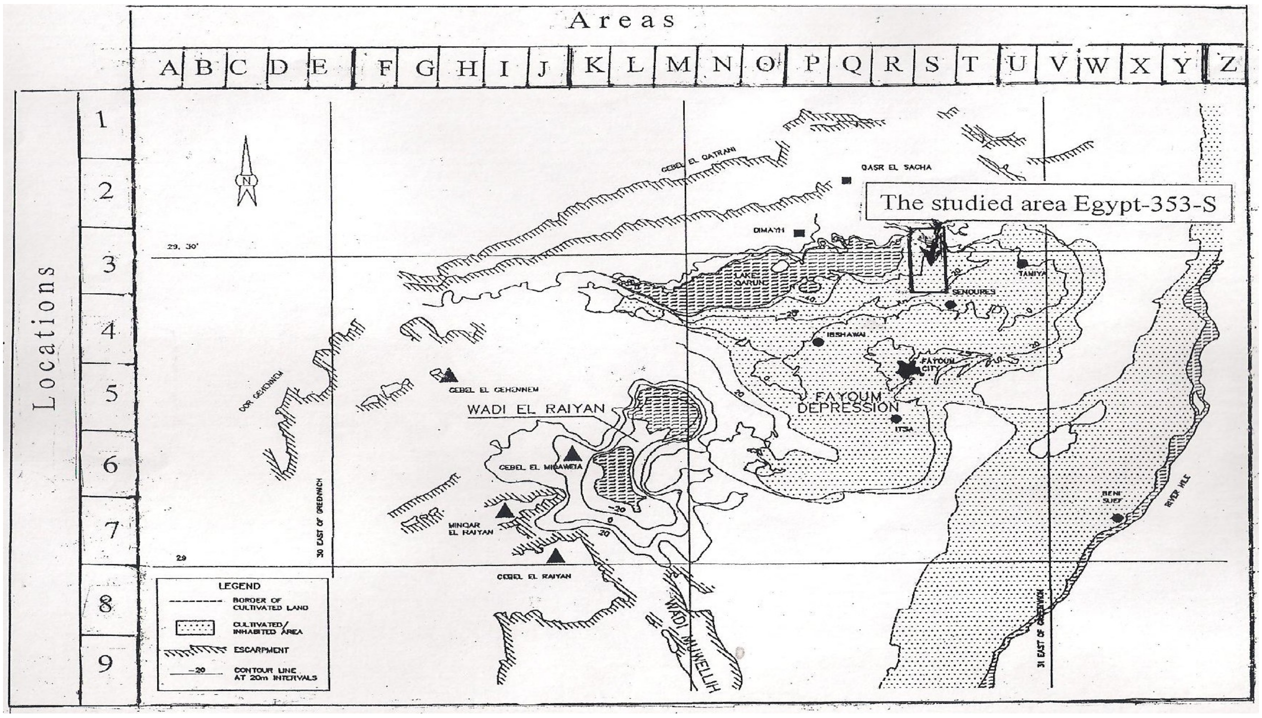

Figure 2. Dividing the sub-sector Egypt-35 into locations and areas showing the studied area (Egypt-353-S)

the southeast of lake Qarun. According to Figure 1 and 2, the studied area “Egypt-353-S” lies at Latitude of 29^o, 25' North and at Longitude of 30^o, 50' East of Greenwich.

File 2: Geography, topography and field report of the area:

- Fayoum (the sub-sector Egypt-35) is a natural depression plain covering some 12000 km^2. Fayoum Governorate lies some 90 km SSW of Cairo with some unique features to its environmental and natural resources. Every gram of water, salt or pollutants that enters the basin accumulates there.
- The depression has a single inlet to east, where the Hawara (Lahun) gap provides the vital link with the Nile valley in the form of natural Bahr Yousef canal and the Bahr Hassan Wasef. Fayoum proper is the only inhabited sub-basin, a depression 50 km in diameter sloping down to Lake Qarun (the overall slope in the plain ranges from 0 to 6 %), to be some -40m below the sea level.
- The studied area “Egypt-353-S” slopes from –20m to –40m below sea level.

The following is soil profile description in the studied area:

-Landscape: plain, Relief type: lower terraces, Lithology: fluvio lacustrine materials, Land form: basin, Slope: gently sloping (0-2%), Altitude: 30 m below sea level, Land use: few natural saline plants and crops, Human influences: non, Soil moisture regime: aquic, Soil temperature regime: thermic, Depth of groundwater: ranged from 60 to 130 cm, Drainage conditions: imperfectly well drained, Evidence of erosion: slightly water erosion, Soil classification: calcic aquisalids.

The horizons of the profile are as follows:

Horizon A (depth 0-20 cm): dark grayish brown (2.5 Y 4/2) moist, grayish brown (2.5 Y 5/2) dry, black mottles; silty loam; weak medium subangular blocky; slightly sticky, slightly plastic, firm, hard; many fine pores; nodules of $CaCO_3$; calcareous; clear smooth boundary; pH = 8.4

Horizon B (depth 20-30 cm): Grey (5 Y 5/1) moist, white (5 Y 8/1) dry, sandy loam; moderate medium angular blocky; sticky, plastic, firm, hard; many fine and medium pores; common nodules of lime concretions; very strongly calcareous; gradual smooth boundary; pH 8.5

Horizon C_1 (depth 30-60 cm): very dark grayish brown (2.5 Y 3/2) moist, dark grayish brown (2.5 Y 4/2) dry, loam; moderate medium sub angular blocky; sticky, plastic, firm, hard; common fine random pores; common nodules of lime concretions; strongly calcareous; clear smooth boundary; pH 8.6

Horizon C_2 (depth 60-110cm): very dark grayish brown (2.5 Y 3/2) moist, dark grayish brown (2.5 Y 4/2) dry, clay; moderate medium sub angular blocky; very sticky, very plastic, firm, hard; common fine random pores; common nodules of lime concretions; strongly calcareous; pH 8.7

File 3: Population data of the area:

The following are summarized comments on population in the studied area:

-Approximate recent population data of Fayoum shows that total population rises to more than 2 million, of which 0.5 million lives in urban cities and 1.5 million lives in rural Fayoum.

-As still no recent accurate census in the area, approximate population in the studied area “Egypt-353-S” is expected to range between 5300-6500 rural people cultivates the available low capability land resources in the area.

-The population has been growing at a rate of 3.6% annually since 1960. This rate is falling as a result of birth control programmes.

-A dense human population of 1.5–2.0 million cultivates a limited land resource (1428 km^2).

-It is promising that an uninhabited sub-basin in Fayoum with two largely unused freshwater lakes represents a development potential for population.

File 4: Information of total area, area of salt-affected soils and area subjected to either pre-reclamation or reclamation stages:

Total area of the area Egypt-353-S is about 6500-7000 feddan.

All of the area affected by salinity, alkalinity and water logging.

All of the area is subjected to waiting pre-reclamation and reclamation programmes to avoid the current constrains in the area.

7.2. Climatic conditions:

This sub-directory contains the following files:

File 1: Meteorological data:

The Fayoum is hot and dry with scanty winter rainfall and bright sunshine throughout the year. Average annual rainfall is 10 mm but with great variability from year to year. In some years no rain falls while as much as 44 mm has been recorded in one day. This variability becomes more marked with further south direction in the depression as the trends of climatic changes will also tend to be more pronounced. Temperatures in the rainless summer average 28^o C but can reach nearly 50 ^{o} C. A degree or more of forest is possible on winter nights.

The following is the available climatic data (2004) obtained under El-Fayoum conditions.

File 2: Evaporation:

As seen in Table 1, higher rates of evaporation throughout the months of the year are observed, which makes Fayoum depression the most arid places on the earth.

File 3: Connection to salt accumulation on surface soil layer and salt/water balance of the area:

As the area Egypt-353-S is subjected to the following 3 reasons:

1- Higher rates of evaporation throughout the months of the year.

2- Neighborhood to the lake Qarun, as the salts in the Lake is about 4.5-5.0 g/L.

Salinity of the lake increased year after year and deteriorates the adjacent area.

3- Altitude of the area is ranged between –30 and –40 m below sea level.

So, the area Egypt-353-S is subjected to active ground water movement, which affect salt accumulation on surface soil layer due to the unbalanced movement of water, as the movement upwards is extremely higher than downwards.

7.3. Soil resources:

This sub-directory contains the following sub-sub-directories, which focus on:

A-Soil characteristics:

This sub-sub-directory contains the following files:

File 1: Physical properties:

Variability of physical properties values were recorded for the area Egypt-353-S, as the values were:

- -Soil texture varied from sandy to sandy loam to sandy clay loam.
- -Land cover intensity varied from no crop cover and low crop intensity to moderate intensity of crop cover in some parts.
- -Drainage conditions varied from imperfect drainage to slightly perfect but needs more improvement and ground water control.
- -Evidence of erosion varied from no erosion to slightly water erosion in the area.
- -Bulk density varied from 1.45 and 1.73, gcm^{-3}.
- -Hydraulic conductivity varied from 8.5 and 10.50, cm/h.
- -Field capacity varied from 10.2 to 19.9 %.
- -Wilting point varied from 5.4 and 9.2 %.
- -Available water varied from 5.7 and 11.1 %.
- -Total porosity varied from 23.1 and 32 %.
- -Quickly drainable pores varied from 14.5 and 19.9 %.
- -Slow drainable pores varied from 5.9 and 7.5 %.
- -Volume drainable pores varied from 21.5 and 25.5 %.
- -Water holding pores varied from 5.4 and 9.2 %.
- -Fine capillary pores varied from 4.7 and 6.9 %.
- -Useful pores varied from 11.7 and 15.3 %.

Table 1.The climatic data (2004) of Fayoum Agrometoerological Station located At Fayoum Governorate (latitude 29.3 N^o and longitude 30.85 E^o)

Month	Temperature, ^{o}c			Humidity %	Wind-speed, Km/day	Sun-shine, Hours	Solar radiation, Mj/m^2/day	Rain Fall, mm	ET$_o$ Penman mm/day
	Aver	Max.	Min.						
Jan.	15.0	21.2	8.8	58.4	143	6.9	12.5	2	1.8
Feb.	16.2	23.8	8.6	60.2	159	7.8	15.5	0	2.1
Mar.	17.8	25.2	10.4	55.8	195	8.7	19.7	0	3.9
April	21.4	29.7	13.1	51.3	200	9.9	23.6	0	5.1
May	31.8	41.3	22.2	26.1	215	10.7	25.7	0	9.9
Jun.	28.0	36.5	19.4	51.8	215	11.1	26.6	0	8.1
July	30.2	39.0	21.3	51.3	195	13.2	29.5	0	8.5
Aug.	28.7	36.1	21.2	53.3	191	12.4	27.3	0	6.3
Sept.	26.4	34.2	18.5	52.7	203	11.4	23.7	0	5.8
Oct.	25.1	31.8	18.3	53.9	180	9.6	18.3	0	4.2
Nov.	20.9	28.1	13.7	54.8	171	7.7	13.3	0	3.2
Dec.	14.7	21.2	8.2	58.9	166	6.6	10.9	8	1.8
Year	23.0	30.7	15.3	52.38	185	9.6	20.7	10	1855.3

File 2: Chemical properties:

Table 2. The chemical properties of the horizons of a profile in the area Egypt-353-S.

Soil properties	Horizon and Profile depth			
	A(0-20 cm)	B(20-30cm)	C_1(30-60cm)	C_2(60-110cm)
EC_e	5.2	8.5	5.1	5.5
Soluble cations (m.e./100g.soil):				
Ca^{++}	1.5	2.3	1.3	1.8
Mg^{++}	10.9	12.4	4.8	5.5
Na^{+}	36.3	62.5	33.0	43.9
K^{+}	1.4	1.4	0.7	1.4
Soluble anions (m.e./100g.soil):				
CO_3^{--}	0	0	0	0
HCO_3^{-}	0.7	1.1	0.5	0.6
Cl^{-}	27.3	50.2	20.2	21.6
SO_4^{--}	22.1	23.3	29.1	30.4
$CaCO_3$ %	12.5	21.9	21.5	15.6
ESP	14.9	12.4	15.6	19.7

Variability of chemical properties are recorded for the studied area Egypt-353-S, as the values were:

-Cation exchange capacity (C.E.C.) varied from 6.7 and 11.0 mol /kg soil.

-Salinity of saturated soil paste extract varied from 2.1 and 7.8 dS/m.

-PH of saturated soil paste varied from 7.8 and 8.7.

-$CaCO_3$ % varied from 5.3 and 29.4 %.

-Exchangeable sodium percentage (E.S.P.) varied from 14.8 and 44.3%.

-Organic matter contents varied from 0.7 and 1.1 %.

File 3: Geological properties:

Fayoum depression is a marine sedimentary basin, which has undergone alternating periods of erosion and deposition since the late cretaceous period 70 million years ago. It contains some of Egypt's best fossil deposits, laid down 30 million years ago by the ancient Libyan River. The present depression was formed at least 1.8 million years ago, probably by wind erosion in the desert. The basin then subsides relative to the Nile, allowing the river to break through in flood and deposit fertile alluvial sediments. Lake Qarun dates from this time, and the late Stone Age remains have been found on its ancient shore. So, the studied area Egypt-353-S is formed at the shore east south of the Lake Qarun.

File 4: Biological properties:

-Organic matter contents of soils of the area Egypt-353-S varied from 0.6 and 1.0 %.

-No previous study is available for organic components and Organic forms in soils of the area Egypt-353-S.

-Soil organisms including microfuna, macrofuna, microflora and Macroflora and enzymes activities did not study in soils of the studied area.

File 5: Sources of soil salinity, alkalinity and waterlogging:

Sources of soil salinity, alkalinity and waterlogging of the area Egypt-353-S are reported to be as follows:

-The area is adjacent to the lake Qarun indicating active movement of saline ground water upwards, which resulting in accumulation of salts on surface soil layer.

-Use of saline water or mixed water after Bats drainage station for irrigation in the studied area.

-High rates of evaporation in the area throughout the months of the year.

Since many years ago, the above three sources are functioning actively, so, it is expected that processes of soil salinity and alkalinity are very active in the studied area, moreover, lake Qarun affect the salinity of ground water in the area.

B-Researches conducted for reclamation and improvement of salt-affected soils in this location or area:

This sub-sub-directory contains the following files:

File 1: Applied research already conducted:

-Physical and chemical properties of some parts in the area had been conducted.

-Different studies on the lake Qarun had been conducted.

-Meteorological data of the area had been implemented in different stations.

File 2: Theoretical research already conducted:

-Prediction of salt accumulation in the Lake Qarun and the surrounding area had been conducted for future years.

-Different investigators had recorded discharge of the main outlet of drainage water in the Lake Qarun for many years.

-Hydrology of the lake Qarun had been studied.

File 3: Researches still needed:

-Priority attention of researches must be paid to water resources management in the area to improve water use efficiency in the studied area.

- Environmental impacts assessment must be focused for the available irrigation water use in the area, and stressed on the impacts on reuse of drainage water in the area focusing on soil salinization, alkalinization and water logging.

-Activities needed for soil reclamation and improvement:

This sub-sub-directory contains the following files:

File 1: Activities needed:

The following activities are still needed in the studied area:

-Calculation of leaching requirements in laboratory and in field using applied tests.

-Calculations of permeability in the area at the months of the year.

-Survey all water resources in the area and suitability of their waters for irrigation throughout the months of the year.

-Annual soil survey to indicate salinity status in the area.

File 2: Amendments needs:

-Testing and calculation of gypsum requirements in the area, and also testing the availability and quality of gypsum in the region.

-Calculation the requirements to organic amendments and which kinds are available in the area.

File 3: Need to sub-soiling activities and frequency of use:

According to the permeability and compaction status of soil layers in the studied area, the need to sub soiling and its frequency to use will be decided.

7.4. Water resources:

This sub-directory includes the following three sub-sub-directories:

A-Precipitation (Rain):

File 1-Fayoum lies at the southern edge of the Middle Egypt rainfall zone. At this zone, a climate belt with winter rainfall ranging from 10 mm to 25. To the south of Fayoum the country is “virtually rainless, with a rainfall of some 10 mm once every ten or more years”. The summer season is rainless and hot, with an average minimum temperature of 28.5^{o}C and an absolute maximum of 48.5^{o}C.

B-Irrigation and drainage systems:

This sub-sub-directory contains the following files:

File 1: Surface irrigation:

Without Nile water, Fayoum would be desert. Management of water quantity and quality is therefore the paramount relationship between man and the natural water resources of Fayoum. It is well known that 85% of the gross area of Fayoum is served by irrigation system. Management of this system has two broad aims: the first is to ensure adequate and uniform supply to the area, and the second is to prevent any increase in waterlogging and soil salinity. So, the main problem is the difficulty of balancing water supply with crop demand. Distribution is clearly biased in favor of the upper basin, while tail end areas suffer water shortages. The factors causing this include illegal pumped extractions, official modifications to the original equitable design, dimensional changes in canals because of maintenance excavation, and aquatic weed growth. Irrigation water management in Fayoum is actually facing seasonal imbalances in water distribution. So, planning for crop demand is close to impossible because of the great diversity of crops and seasonal changes in cropping intensity. Irrigation efficiency (the ratio of plant demand to water supply) averages 68% for the whole basin. The schematic conclusion of the Fayoum basin water balance could be summarized in the following:

1-Allowed irrigation for Fayoum = 2.3 x 10^9 m^3 /year (100%).

2-Crop evapotranspiration = 66% and open water surface evaporation = 3%.

3-Drainage to Wadi Rayan lakes= 0.25 x 10^9 m^3 /year (11%) and to Lake Qarun = 0.47 x 10^9 m^3 /year (20%).

The studied area Egypt-353-S is considered tail end areas, which suffers irrigation water shortage throughout the summer months of year. Parts of this area receive drainage water directly, while other parts use mixed drainage water with water from the nearest canals and few parts of the area receive suitable irrigation water from irrigation canals. So, problems of water management in the studied area are: insufficient quantity and low quality of the available water to the farmers. Meanwhile the area is needed to complementary irrigation regime.

File 2-Sub-surface waters:

Since the drainage system is insufficient in the studied area, it is expected that higher rates of seepage may received from farms of higher slopes to that of deeper slopes, then affect its ground water level. The quality of seepage water may allow it to contribute in crop demands.

C-Shallow ground water:

This sub-sub-directory contains the following file:

File 1: This file must comprised the following:

-Weighted average depth of ground water (annual, monthly and daily) in the area.

-Critical depth of ground water for cropping (as recommended by researches).

-Soluble salts of ground water (the critical salinity of the cultivated crops and its correlation to the critical depth of location).

-Actually, the obtained data show that depths of groundwater in the studied area are ranged from 50-160 cm.

-The salinity of lake Qarun is about 4.5-5.0 g/L.

-Salinity of the lake increased year after year and deteriorates the adjacent area.

-The studied area “Egypt-353-S” is sloping to be from –25 to –40 m below sea level.

7.5. Possible future-cropping pattern:

As recommended by researches or local experiences of farmers at the studied area, Egypt-353-S, the possible future-cropping pattern could be summarized as follows:

-The winter season: Wheat and barley, berseem clover (Egyptian clover, Trifolium alexandrinum) and to a lesser extent beans (predominately Vicia faba with some Phaseolus spp. and winter vegetables mainly tomato and cabbage)

-The summer season: Fodder maize (hybrid varieties or local), cotton, and to a lesser extent sunflower, vegetables (mainly melon species), rice and sorghum.

-The Nile flood (Nili) season: Mainly fodder maize (hybrid or local) and tomatoes.

-Trees and orchards fruits: Where ground water depth is allowed; date palms, citrus, apricot, mango and olive could be practice.

-Medical plants and forestry: may be promising if salt tolerance species are introduced to the area.

7.6. Strategies and plans:

This sub-directory includes 4 files; each shows the strategy and plans for the stages of reclamation as follows:

File 1: Strategy for planning stage:

For optimum economic utilization of soils in the area Egypt-353-S, plans must include the main target to be designed for the area; weather plans to agriculture or to other activity. If to agriculture, which activity of agriculture is more suitable for the area? Accordingly, the following strategies are to be implemented. Accurate timetable and a range of allowed errors must be defined to get sustainable agriculture, updated development and optimum economic utilization of soils in the area.

File 2: Strategy for pre-reclamation stage:

Pre-reclamation stage of the area, must comprise the following:

-Implementing detailed soil survey including soil analysis accepted for reclamation activities in the area (testing leaching requirement and water availability).

-Design optimum plans for efficient irrigation system to correct and avoid constrains of irrigation in the area. All water resources must be surveyed and analyzed.

-Design efficient drainage systems considering the critical depth of drains and total and specific salinity of ground water table in the area.

-Design the proposed cropping pattern to be applied in the area.

-Design the needs to total and monthly budget and timetable of all costs.

File 3: Strategy for reclamation stage:

Reclamation stage comprise the following activities in the area:

-Application the needed gypsum requirement, and considering the availability and quality of the used gypsum.

-Application the requirements to organic amendments after testing which kinds are useful and available in the area.

-Application the needed quantity of water for leaching salts.

-Permeability and compaction status of soil layers in the studied area, will decide the need to sub soiling and its frequency to use.

File 4: Strategy for post-reclamation stage:

-The proposed cropping pattern is to be applied in the area starting by the crop required more water to leach more salts from soil layer.

-Dynamic strategy and scientific planning are to be fixed and aimed after completion all reclamation activities. Targets to sustainable agriculture and environment must be focused.

7.7. Updating data:

Updating at intervals all data available from the concerned researchers, universities, Institutes and Ministries. So, updating includes establishing new data copies of all files of the area Egypt-353-S to complete updating. Then, senior soil scientist must subject updated information to evaluation. Thereafter, editing the renewed and updated sub-directories and their file to be in completely updated forms.

7.8. Training and recruiting needs:

This sub-directory includes the following files:

File A-Training need:

This sub-sub-directory includes three items:

1-Training courses introduced for engineers and farmers.

2-Symposiums held to improve knowledge of engineers and farmers.

3-Workshops held to discuss the related subjects with engineers and farmers on the village level.

Each of the above-mentioned items must include complete information of the type of training, its timetable, who will be trained, duration, in addition to the estimated costs and methods of evaluation at the end of the training. Total allowed budget for training must be recorded and divided for each of the three items of training.

File B-Recruiting for vacancies:

This sub-sub-directory includes the following 4 items of needs:

1-Experts and consultants.

2-Engineers.

3-Technicians.

4-Labors.

With each of the above-mentioned 4 items, it must indicate clearly if the need to recruiting will be locally or from abroad? If full-time or part-time? duration of work and the allowed salary of each.

7.9. Facilities need:

This sub-directory includes three files:

File 1: Equipment.

File 2: Raw materials.

File 3: Other supplies.

Each of the three files must introduce complete information and data of the needs to facilities. The files must prepared to be ready for announce as tenders on local and/or international journals, and also at some sites of Internet.

7.10. Evaluation of salinity and alkalinity hazards of the location:

This sub-directory includes 4 files showing the following:

File 1: How to control each of salinity, alkalinity and waterlogging hazards:

To control hazards of soil salinity, alkalinity and water logging; the following precautions must be conducted:

1-Efficient drainage system must design to keep and maintain the depth and salinity of ground water of the studied area far from these hazards.

2-Efficient irrigation system must design to introduce good quantity and quality of irrigation water to the studied area.

2-Optimum use of irrigation water with optimum cropping pattern must be applied to prevent as possible secondary salinization in the studied area.

3-Annual maintenance of the irrigation and drainage systems must be conducted.

File 2: How to get sustainable agriculture system:

To get sustainable agriculture system, the following practices must be applied:

1-Apply and conduct all precautions needed to control each of salinity, alkalinity and water logging hazards (as mentioned in File 1 seen above).

2-Annual design policy to improve soil fertility status in soils of the studied area must be followed. This policy must include optimum fertilization either inorganic or organic fertilization.

3-Annual design policy for pest control must be practiced with each cropping season.

4-Annual design of cropping pattern that gain highest income return to the farmers.

File 3: How to get sustainable environmental system:

To get sustainable environmental system, the following practices must be applied:

1-Apply, and conduct all practices needed to get sustainable agriculture system (as mentioned in File 2 seen above).

2-Apply annual environmental protection programs to keep the studied area far from environmental hazards.

3-The standard measurements of ISO 14000 must be applied in the studied area.

3-Continueous recycling of wastes (either organic and inorganic) produced in the area to achieve pollution prevention to adjacent area.

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الملخص العربي

نظام معلوماتي عن مكافحة مخاطر ملوحة وقلوية الأراضي

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يعتمد التخطيط للتنمية المستدامة للقطاع الزراعي على إمكانيات الحصول على معلومات كافية ودقيقة عن المنطقة التي يتم دراستها. ويعتبر ذلك ضروريا للتخطيط العلمي لإدخال التكنولوجيات الحديثة وإزالة المعوقات وكذلك لمكافحة التصحر. وأيضا تستدعى الحاجة إلى بيانات دقيقة لتعديل الأبحاث التطبيقية لمواجهة معوقات الزراعة المستدامة. وذلك من خلال برنامج يتم فيه تقسيم الخريطة الجغرافية لقطر ما إلى قطاعات أفقية لا تزيد عن ٩ تبدأ من الشمال ويقسم كل قطاع منها إلى تحت قطاعات رأسية لا تزيد عن ٩ تبدأ من الغرب ثم يقسم كل تحت قطاع إلى مواقع رأسية لا تزيد عن ٩ تبدأ من الشمال، وبذلك فإن كل موقع يكون ممثلا بثلاثة أرقام تبدأ من ١١١ ولا تزيد عن ٩٩٩، وأرقام آي موقع ابتداء من اليسار تعنى رقم القطاع وتحت القطاع والموقع وذلك للأرقام الأول والثاني والثالث على الترتيب. وإذا كان الموقع مساحته كبيره يقسم إلى مساحات يرمز لكل منها بالحروف الأبجدية أ، ب، ج وهكذا حتى ٢٦ حرف تبدأ من الغرب.

وبناء على هذا التقسيم توضع خريطة جغرافية للقطر موضع الدراسة موضحا بها أرقام المواقع التى تستخدم فى نظام المعلومات المقترح (IS-SAH). وفى حالة إنشاء هذا النظام لأكثر من قطر تنفذ نفس الخطوات بالتفاصيل على أن يضاف إسم القطر على يمين الأرقام مع فصلها بعلامة-مثل: مصر-١٩٨، السعودية-٣٣٧، ليبيا- ٥٦٥، السودان-٨٢٨، الإمارات-٥٥٥، عمان-٣٢ وهكذا.

وكل موقع من المواقع التى يشملها النظام(IS-SAH) له فهارس كل منها به ملفاته بحيث تشمل:

١- تفاصيل الموقع المحدد

٢- المصادر الأرضية

٣- المصادر المائية

٤-الظروف المناخية

٥- النمو الخضرى

٦- الإستراتيجيات والتخطيط العلمى

٧- تحديث المعلومات على فترات

٨- احتياجات التدريب والتوظيف

٩- الإمكانيات المطلوبة.

١٠-تقييم مخاطر التملح والقلوية فى الموقع.

وترتبط جميع المواقع فى نظام المعلومات المقترح تحت إسم (IS-SAH) فى تناسق وتخطيط علمى للموقع أو المساحة التى يشملها النظام والتى يتم فيها بصفه دوريه أنشطة التحديث والتطوير المطلوبة لتحقيق الزراعة المستدامة والتنمية فى القطاع الزراعى.

وكمثال تطبيقى للنظام المعلوماتى المقترح IS-SAH فقد تم تقديم وعرض كل المعلومات والبيانات الخاصة بملفات وفهارس الموقع Egypt-353-S ثم تقييم الموقع ليكون جاهزا للإستفادة من بياناته فى مجال مكافحة مخاطر ملوحة وقلوية الأراضي.