

Applications of Remote Sensing to Water Resources Management in Syria

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Abstract

Remote sensing are presently being used for solving problems like degradation of land, by water lagging; soil erosion; contamination of surface and ground resources, changes in ecological parameter and many more. Watershed approach for optimum planning, development and management aims at harvesting all natural resources for sustainable development and better living.

Many countries in the world complain of water problems especially our region complains of great water shortage. This problem increases greatly in result of great increasing of the population, agricultural projects and investments. That will make additional pressure on water resources. Also, the water storage had begun complaining of pollution problems. The General Organization of Remote Sensing sets to combat the water problems in Syria by the following directions:

1- Exploration of new sites of groundwater for providing the water needs. GORS has carried out many studies on exploration of groundwater by using Landsat and SPOT images with processing and filtering for getting the faults and drainage layers in completion with Geographic Information System (GIS) in addition to using Global Positioning System (GPS) for locating the best wells sites. Then we applied geo-electrical resistivity methods for getting information on the layers of the land. The studies included Salamyeh, South part of Damascus and Coastal Area. We get very good results by these studies. In addition to locating submarine outflows along Syrian and Lebanese Coast by using thermal infrared surveys. GORS has detected 58 fresh water spring in the sea.

2- Management of available water resources GORS has carried out a study on mathematical model for Al-Zabadani area in cooperation with ACSAD by using Indian satellite images with Mudflow software. In addition to a study on water harvesting in Edlib Region by using 3D images. GORS has adopted the new issue on Integrated Water Resources Management (IWRM) in Syria.

3- Protecting of water resources from the pollution. GORS is carrying out a study on monitoring the pollution in Al-Sin spring in the Coastal area by using Landsat, SPOT and Ikonos images with wells water samples. For drawing the protected area.

Introduction

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The General Organization of Remote Sensing sets to combat the water problems in Syria by the following directions:

1- Exploration of new sites of groundwater for providing the water needs.

Groundwater is concerned with water in the saturated zones beneath the surface of the Earth. Groundwater information most useful to water resource managers includes: the presence or absence of groundwater in designated areas, the depth to groundwater, the quantity and quality of water available for development, recharge rates to aquifer, the possible impact of pumping on land subsidence, a real extent of the aquifer, locations of recharge and discharge areas, and the interaction between withdrawals at wells and natural discharge into rivers. Whereas this information is generally sought by hydrogeologists using conventional methods, remote sensing can help in the planning of conventional measurements and can be used to estimate some hydrogeological variables quantitatively and others qualitatively.

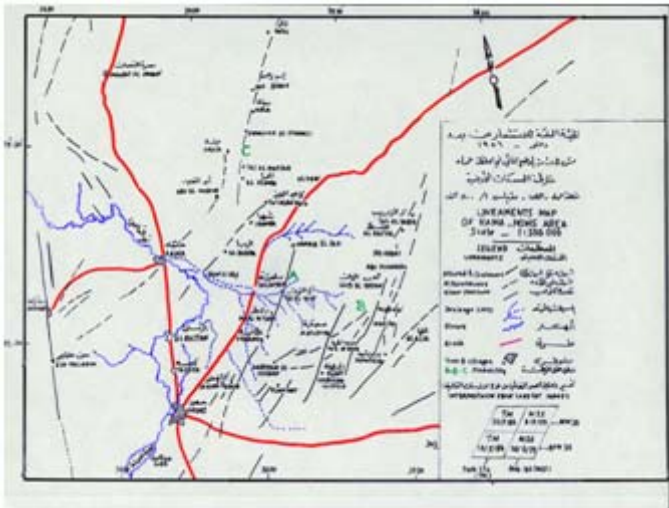
The storage capacity of ground water reservoirs depends on their extent, which depends on geological properties of the area. Ground water forms the base flow for many streams and is the source of water for springs and seeps.

By processing, analyzing of space images, compiling thematic maps of drainage, lineaments and main faults with their intensity and crossing in addition to maps of all drilled wells with their discharge and existing springs in the study of each area, study of wet faults at the end of summer through thermal band in Landsat images, subsurface faults through radar images, cross of separated faults with their accurate coordinates by using GPS and carrying out geo-electrical sounding for perspective locations and analyzing the resulted curves and assurance of existing groundwater with their water table.

We had identified many locations in Salamyeh, Sweida, Dara,a, Lattakia, Tartous and Damascus cities by using this methodology. We had drilled many of wells in the studied perspective locations, and we had good results.

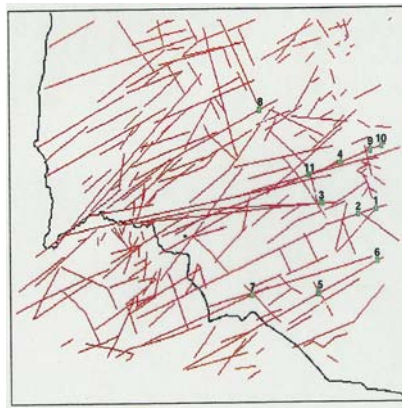
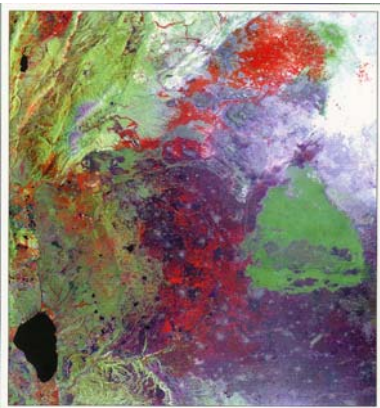
1- Exploration of groundwater in Salamyeh region.:

We have started the work with expert from FAO in Salamyeh region within depletion of groundwater in that area. We should depend on space images in Landsat – TM to detect –the unclear faults. We have identified three perspective areas for groundwater with good discharge for drinking water and irrigation. By mapping of wells, springs, faults, lineaments and drainage.



2- Exploration of ground water in southern part of Syria

This study has been carried out in cooperation with GORS, BGR and FAO by using remote sensing techniques (Landsat and SPOT images). General Organization of Remote Sensing requested FAO technical assistance for



strengthening its capacity in the field through a joint study in selected parts of the country, allowing for the necessary technology transfer by on-the-job training of its staff and preparation of detailed guidelines for the application of the methodology developed and tested in the field to other parts of the country.

In view of distinct environments occurring in the country and to fully test new approaches and technologies, three different hydrogeological environments were selected, namely; 1. the basaltic terrain of southern Syria, 2. the sedimentary terrain in coastal area, and, 3. the interior alluvial plain (Aldao Basin) in the Syrian steppe.

To achieve its objectives in the above environments, the project developed specific methodologies based on the integration of satellite remote sensing, GIS, traditional hydrological data and field investigations. Geophysical investigations and test drilling in selected sites were undertaken to confirm the methodological approach and theoretical assumptions made during the study.

Furthermore, the project and its results in distinct hydrogeological environments should be regarded as an application of satellite remote sensing to groundwater exploration, for future use, not only in other areas of Syria, but in similar environments outside Syria as well.

The search for promising groundwater areas involved satellite remote sensing, GIS, traditional hydrological data and field investigations-

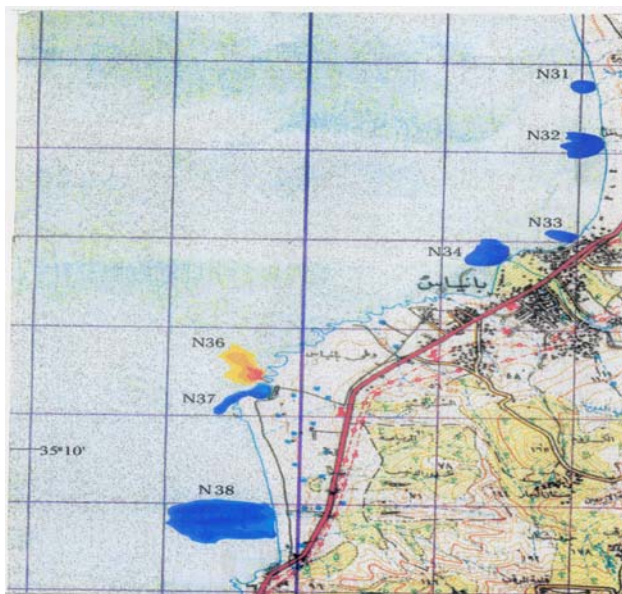
3- Thermal Survey of the Mediterranean Coast of Syria:

The survey was done for the part of the coast line of the Mediterranean sea from Raas Elbasit on the north to the border of Lebanon on the south. The width of the surveyed surface was up to 5 km from the coastal line, the length along the coastal line was up to 150 km. The survey was aimed to find places of the unloading of fresh water springs under sea water according to supposed temperature anomalies at the sea surface. There were discovered numerous (several dozens of) temperature anomalies, part of which coincides with the anomalies discovered earlier by space photography methods. Acquired results may serve as premises for industrial application of potential sources of fresh water.

All anomalies in processed images can be divided into four groups:

- River outfalls,
- Sub-water springs,
- Pollutions at the sea surface,
- "Hot" anomalies.

1. The performed work showed that thermal survey from board an aircraft is rather promising in the examination of natural resources of the Earth.
2. Suggested methods of work and apparatus proved to be applicable.
3. Results of the thermal survey of the coastal strip were verified by space survey methods and local data. Many unknown before temperature anomalies were found.
4. Processed results of the survey and compiled thermal maps open premises for industrialization of the potential sources of fresh water.



4- Study of Water Perspective in Western Area of Damascus by Using Remote Sensing Techniques

This study has been carried out for Western area of Damascus in the region from Maadar in the North to the West of Qattana in the South according to the request from the specialized bodies for getting the perspective sites for drilling water wells that will be a new water resource for Damascus City and its countryside.

We depended on identifying the water perspective for study area that its area is 314 km² on available geological and hydrogeological data of study area and on results of tectonic study that we carried out by analyzing and interpreting of space images taken by visible and radar bands.

Through the geological, water and tectonic data, we had identified three hydrogeological sections, among these sections, we identified the most perspective sites of existing ground water.

We had the following results:

1-Through space data enable in identifying main faults zones paths accurately in addition to manifesting many lineaments, cracks and secondary faults that not mapped on the geological map and it is difficult to be identified by field works.

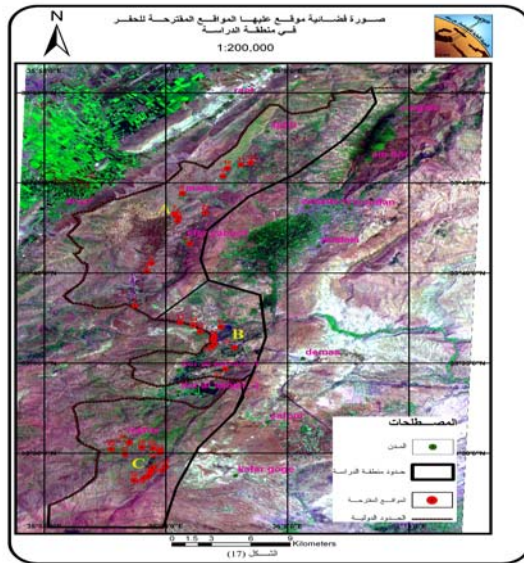
2-The study area has been divided to three different hydrogeological sections, and there is hydraulic connection for water table in their aquifers.

3- A study of water charge in the study area has been carried out through putting a group of layers (lineament layer, lineament intensity layer, drainage layer, drainage intensity layer and cross of lineament intensity layer with drainage intensity layer), we had the benefit of these layers for identifying the water charge paths for identifying the suggested wells locations.

4- By studying the lineament intensity layer with the drainage intensity layer, that reflects intensity of tectonic cracks which is connected directly with water charge. It was possible to get an important result of water tables of ground water in the study area, might move in a quick swing according to the precipitation for exploiting of ground water by pumping from the drilled wells.

5-Six waterfall basin have been identified in the study area by putting waterfall basin layer by using space images for environmental purposes for drawing inviolable areas that enable in exploitation and taking an overview of continuity of water table of ground water, because of connecting this system with the area of waterfall basin.

6- 36 suitable sites have been identified for drilling water wells in the study area

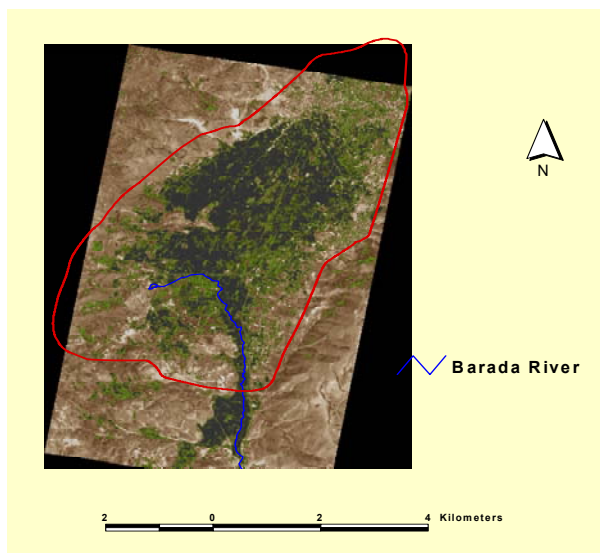


2- Management of Available Water Resources

1- Water Resources Management of EL- Zabadani Basin:

Zabadani sub-basin is one of the most important basin in Syria, it is considered as a strategic source of drinking water for Damascus City. The historical Barada spring is flowing this basin an average rate of 3m³/sec.

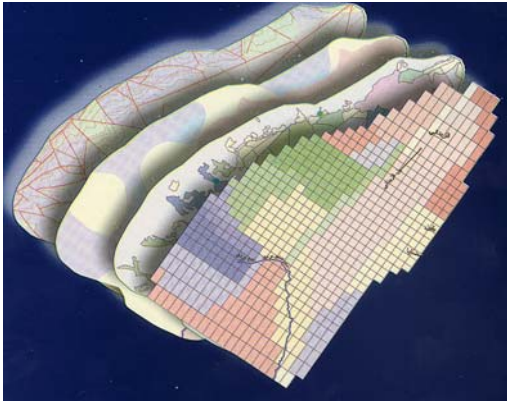
This study aims to build a mathematical model, to simulate the groundwater flow system and produce a tool for the decision maker to manage and set up proper plan for the basin water resources. This was carried out by defining the water balance components and predicting the effect of the present and proposed plans on the water system of the aquifer.



The work plan is implemented according to following five consecutive phases:

1-Collection of the available data and evaluation of the present status.

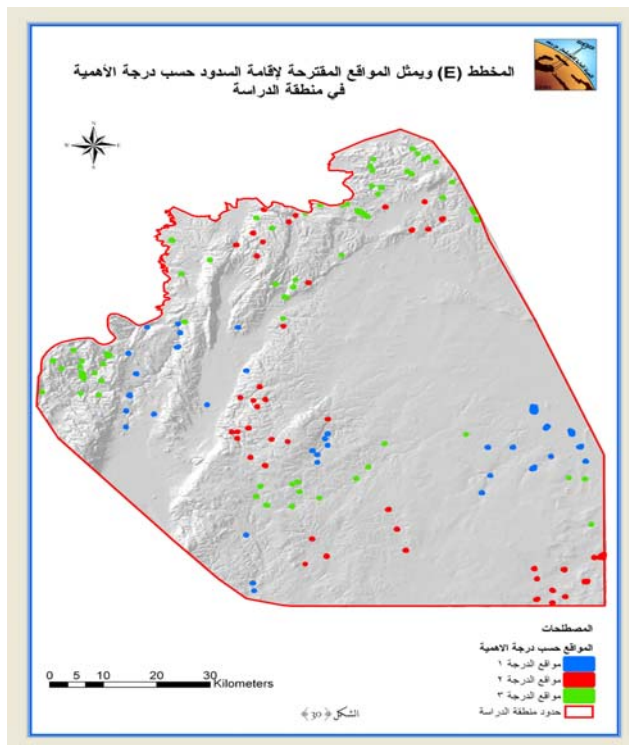
- 2-Performing field survey to fill the gaps of present status. This included the periodical measurements of water levels during the calibration period.
- 3-Establishing databases linked to GIS so the data will be readily available to the mathematical model.
- 4-Running and calibrating of the model, and
- 5-Testing the response of the aquifer water system according the various scenarios of the future plans.



Water harvesting in Edlib region by using 3 D images:2

Selecting the suitable site for water project whether it was dam or water storage is very important in regard with environmental and economical reflections as result of such selection.

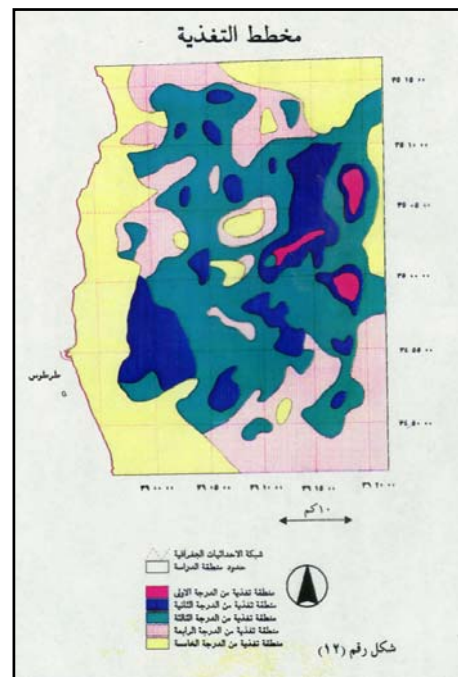
The rural development directorate in Idlib has requested GORS to select the applicable sites to build dams and water storages for storing rain, snows and springs in the selected locations.



GORS has adopted the new issue on Integrated Water Resources Management (IWRM) in Syria.

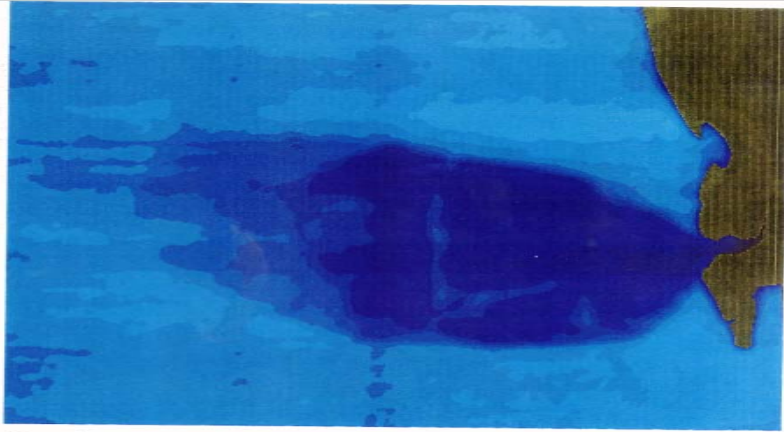
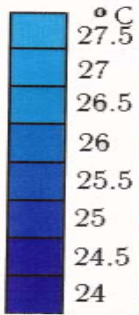
According to the Global Resources Partnership (GWP- 2004), integrated water resources management is an approach towards an end, rather than an end itself. An IWRM approach seeks to address a country s key water- related development problems – water for health, water food, water for energy, water for environment – more effectively, efficiently than is possible using traditional approaches. It seeks to avoid the lives lost, the money wasted, and the natural capital depleted because of fragmented decision making about developing and managing water resources that did not take into account the larger ramifications of sectoral actions. It aims to ensure that current demands for water are met without jeopardizing the ability of future generations to meet theirs. Overall, it seeks to advance a country s social and economic development goals in ways that do not compromise the sustainability of vital ecosystems. Integrated approaches, of course, will imply deliberately moving away from fragmented approaches. On the natural system front, they might involve integration of land and water management, of surface water and groundwater.

3- Protecting the Water Resources from Pollution in the Coastal Area



GORS is carrying out a study on monitoring the pollution in Al-Sin spring in the Coastal area by using Landsat, SPOT and Ikonos images with wells water samples, for drawing the protected area.

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تطبيقات الاستشعار عن بعد في إدارة الموارد المائية في سورية

مروان قضماني

الهيئة العامة للاستشعار عن بعد ، دمشق ، سورية

الاستشعار عن بعد في الوقت الحاضر يُستَعمَل لِحَلِّ المشاكلِ مثل تدهور الأرض بسبب شح المياه؛ وتعرية التربة؛ وتلوث الموارد السطحية والجوفية، تغيّر العوامل البيئية وغيرها الكثير. لذا فإنه من المهم دراسة الشبكة المائية وبتخطيط أمثل في تنمية وإدارة أهداف حصاد كُلاً الموارد الطبيعية لتنمية مستدامة وحياة أفضل.

إن العديد من دول العالم تعاني من مشاكل المياه وخاصة منطقتنا تعاني من عجز كبير في المياه. هذه المشكلة تزداد بشكل كبير نتيجة الازدياد الكبير في عدد السكان والمشاريع الزراعية والاستثمارات. مما يسبب ضغط إضافي على الموارد المائية وأيضاً عجز المياه بدأ يعاني من مشاكل التلوث.

لذلك بدأت الهيئة العامة للاستشعار عن بعد بالتصدي لهذه المشاكل في سورية من خلال المحاور التالية:

- 1- استكشاف مواقع جديدة للمياه الجوفية والتزود بالاحتياجات المائية
- 2- إدارة الموارد المائية المتوفرة.
- 3- حماية الموارد المائية من التلوث.

الكلمات المفتاحية: التطبيقات, الاستشعار عن بعد إدارة الموارد المائية , سورية