Location	South Eastern Turkey
Contractor	Senter International
Period	2001 - 2002

Scope of the project

In June 2001 a consortium consisting of Grontmij Consulting Engineers, the International Institute for Land Reclamation and Improvement (ILRI), WaterWatch and Kentkur investigated the possibilities for irrigation in the GAP region (South-eastern Anatolian region) and perform a feasibility study for an irrigation development project. WaterWatch researched the current irrigation practices in the region using Remote Sensing tools. A water balance analysis for feasibility of implementing irrigation schemes was conducted.

Study approach

The Harran plain, situated close to the border with Syria (see figure), was selected as area of investigation. NOAA and Landsat TM images of the 2000 growing season were acquired. SEBAL was applied to calculate the following products:

- actual evapotranspiration;
- biomass growth;
- relative soil moisture in the root zone;
- potential evapotranspiration (Penman-Monteith);
- potential evapotranspiration (Priestley&Taylor).

The revisit frequency of NOAA is one day. As a result every cloud free day is covered. With a NOAA time-series the growing season can be precisely followed but it lacks detail.

The revisit frequency of Landsat-TM is 16 days therefore chances of obtaining cloud free images are much lower as compared to NOAA. The generation of a time-series on the basis of Landsat-TM alone is not feasible. The combination of NOAA (high temporal resolution) with Landsat-TM (high spatial resolution) combines the best of both systems.

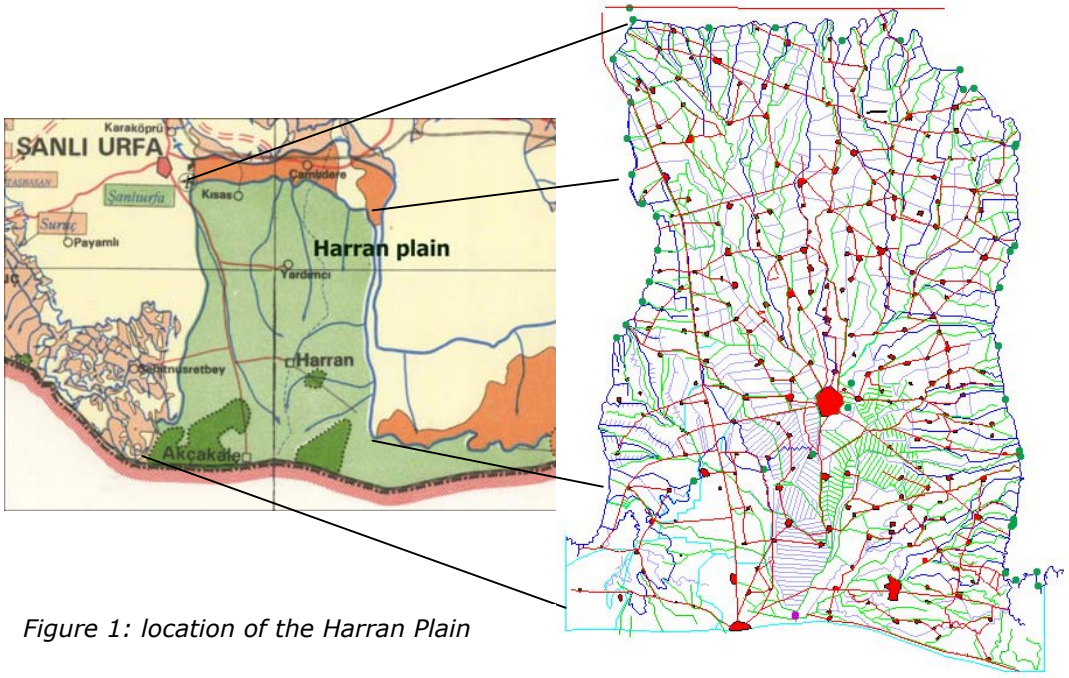
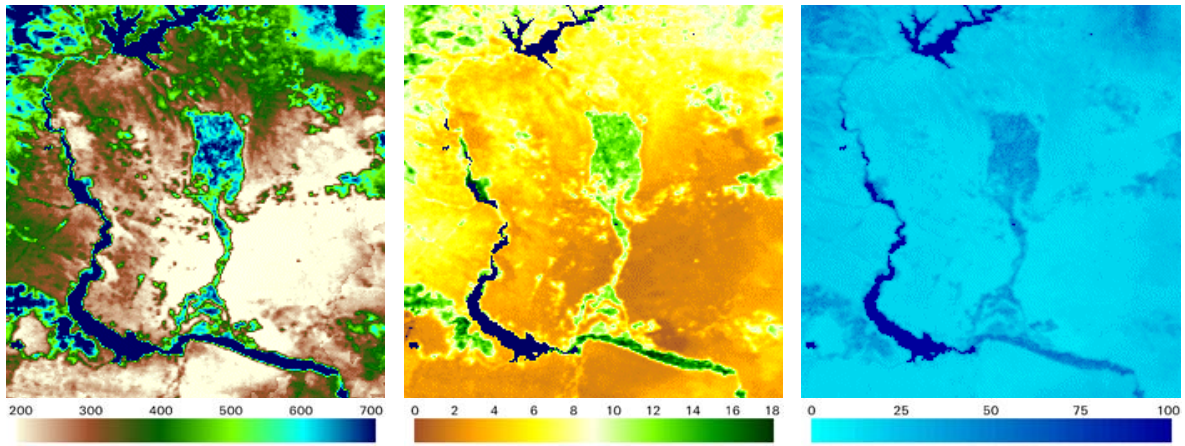


Figure 1: location of the Harran Plain



Total actual evapotranspiration in mm | Total dry matter production in ton/ha | Mean relative soil moisture in the root zone in %

Figure 2: Seasonal totals on the basis of the NOAA results: 6 February – 5 November 2000

27 NOAA images (resolution 1km) and 4 Landsat-TM (resolution 30m) have been processed. With the meteorological data the daily NOAA products were integrated into weekly results to get the overview of the whole season.

The Landsat-TM and NOAA time-series products have been combined and integrated to calculate the total dry matter production and water use from for the whole season with a resolution of 30m.

Results

The seasonal totals are displayed in the figure above. Clearly visible is the Harran plain with total seasonal evapotranspiration ranging from 500 to 700 mm. Dry matter production is approximately between 9 and 16 tons/ha.

Based on the Landsat TM images a crop classification was made for the Harran plain (see figure on the next page).

Cotton yield

The total biomass map combined with the cotton classification yields the total dry matter production for the individual cotton fields. Applying a harvest index of 12% results in the cotton yield.

As can be seen from fig. 3, there is high spatial variation in the yield, ranging from around 2.1 to 2.7 tons per hectare.

Water productivity

Water productivity (yield divided by $ET_{a,seasonal}$) varies between 0.40 and 0.55 These figure correlate well to the values for cotton given in FAO33, which gives a range of 0.40-0.60

Future

capability to predict levels of ET has proved to be a valuable asset for water resource managers and planners. ET is a good indicator of irrigation effectiveness and total water consumption from vegetation. Evapotranspiration information is useful for irrigation supply planning, water rights regulation, and river basin hydrologic studies.

The results of the Remote Sensing investigation of irrigation practices in the Harran plain have shown that ET is highly variable in both space and time. It is variable in space due to the wide spatial variability of precipitation, hydraulic characteristics of soils, and vegetation types and densities. It is variable in time due to variability of climate. Satellite images provide an excellent means for determining and mapping the spatial and temporal structure of ET.

Remote sensing has great potential for improving irrigation management, along with other types of water management by providing ET estimations for large land surface areas using a minimal amount of ground data.

Next, the maps of biomass production, cotton yield and water productivity haven proven their value in identifying high and low productive areas. With this new methodology spatial and temporal analysis of crop growth and water productivity has become an option.

The next step will be the integration of Remote Sensing derived information in the management of irrigation systems.

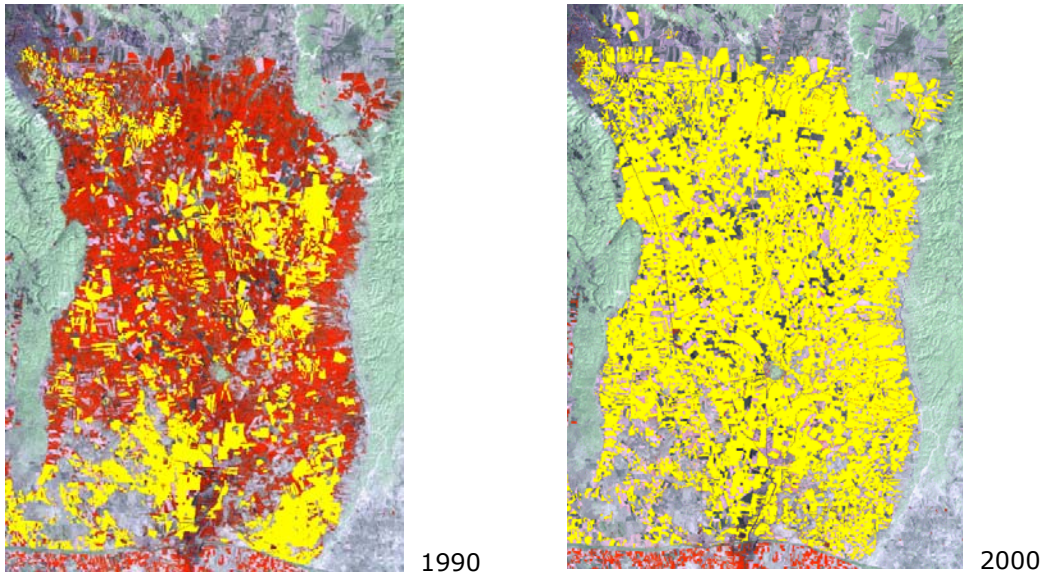


Figure 3a: Cotton (yellow) classification superimposed on a Landsat image

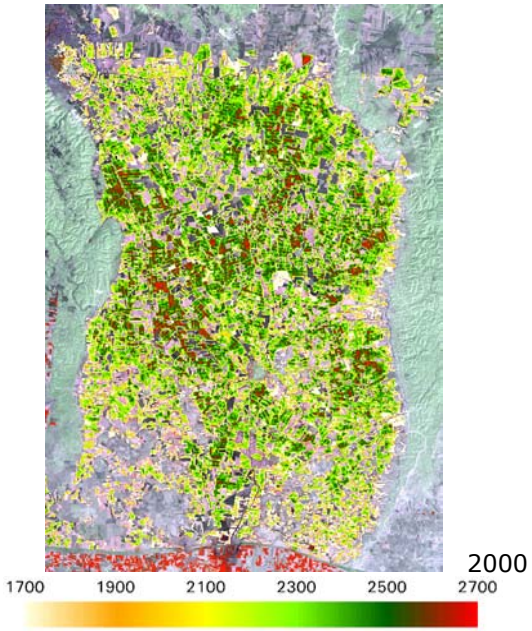


Figure 3b: Cotton production, 2000

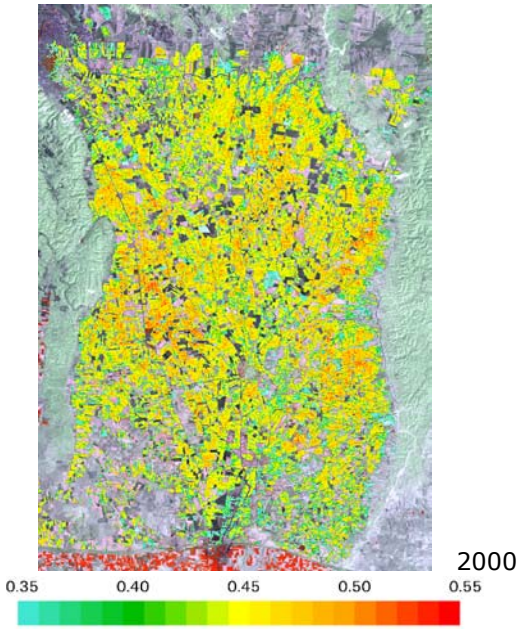


Figure 3c: Water productivity (kg/m^3)

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