Location	Tarim Basin, northwestern China
Contractor	World Bank
Period	2001 - 2002

Scope of the project

The Tarim Basin II Project supports agricultural services development, along with rehabilitation and improvement of irrigation and drainage systems in the Aksu Prefecture. The Tarim Basin has several water management problems, which are typical for irrigated river basins in arid climates: occurrence of water shortage and water logged areas in the same region, soil salinity development, and as a result, significant variability in agricultural production.

One project goal is to establish and enforce water use quotas for each sub-basin, in order to ensure that adequate amounts of water are delivered to the middle and lower reaches of the Tarim River. This requires an integrated water resource management approach for the entire basin. The Tarim Basin II Project foresees improvement in management and in water use efficiency so that quota requirements can be met. This implies that improvement of irrigation and drainage systems is necessary and that saline land must be reclaimed. The project objectives can be met by maximizing Consumptive Use (CU) and Beneficial EvapoTranspiration (BET) and minimizing Non-Beneficial EvapoTranspiration (NBET) and drainage.

Study approach

The Surface Energy Balance Algorithm for Land (SEBAL) is a new remote sensing algorithm for computing various biophysical surface parameters. Remote sensing data from Landsat and NOAA satellites are combined and used as input for the computation and mapping of spatially distributed and time-accumulated biomass production and evapotranspiration values. These spatially distributed values have been combined with: (i) a land use classification (fig. 3) and (ii) a map of Water Use Associations (fig. 2) to produce information such as the fraction of CU, BET, and water productivity for each of the Water Use Associations. A comprehensive validation study conducted in the Hei He basin, Gansu Province indicates that the accuracy of these computations exceeds 92% on individual satellite overpass days. The accuracy increases when computations are for longer time periods.

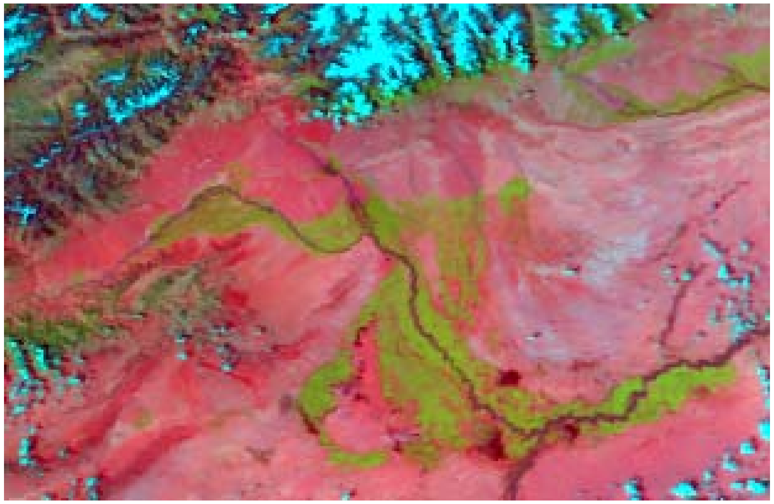

Figure 1: Location of the Tarim basin on a NOAA image

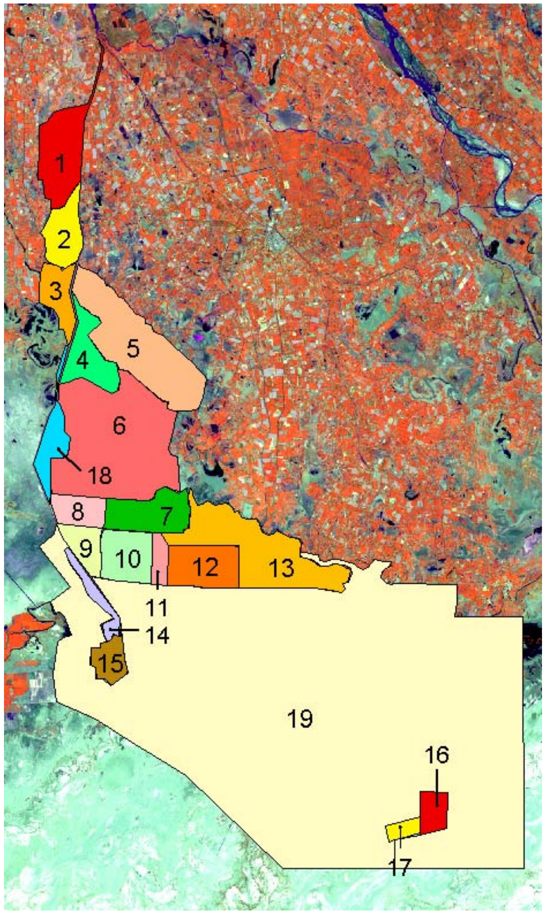

figure 2: location of Water Users Associations (WUA) in the Awati pilot area

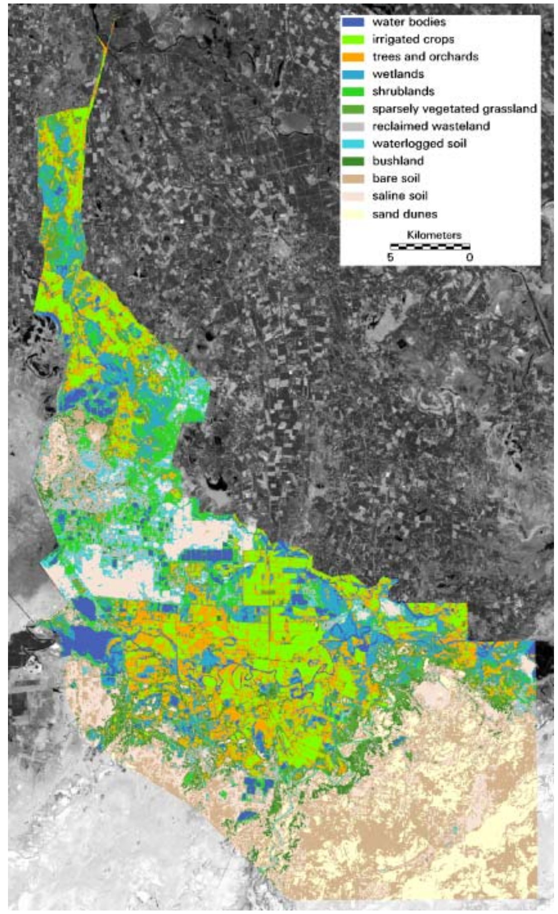

figure 3: Land use classification based on Landsat TM image (2000)

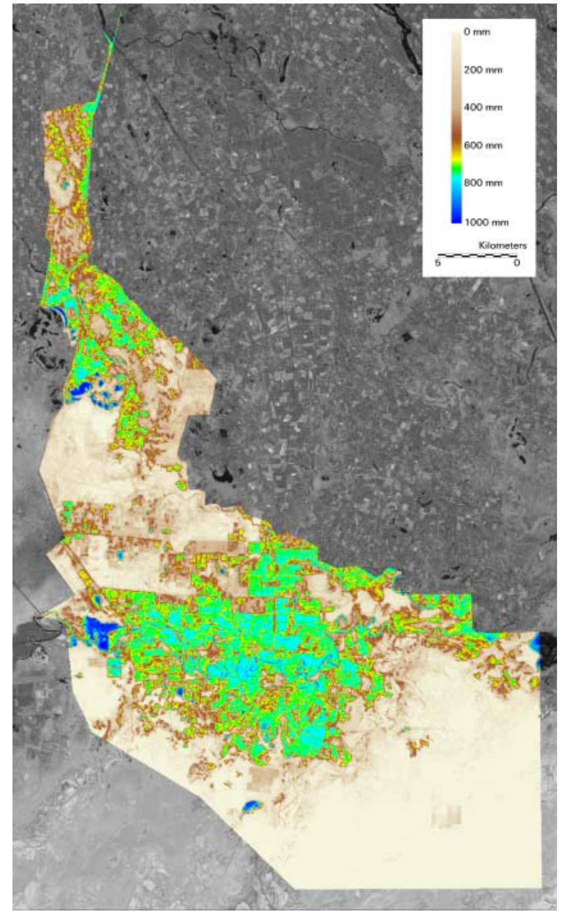

figure 4: seasonal total actual evapotranspiration (March-November 2000)

Results

At the start of the Tarim Basin II project in 1999, a diagnosis showed more inflow from irrigation and precipitation than outflow via land surface evapotranspiration. The excess of water is not drained out and a net accumulation of water occurs (visible from the increase of open water bodies). The results from SEBAL show that irrigated lands receive about 2.5 times more water than is consumed by crops, which gives an irrigation efficiency of 40%. The excess water percolates to the groundwater system and is reused by non-cropped surfaces. It can be beneficially used by wetlands and other natural ecosystems, or non-beneficially extracted by bare soils over a shallow water table. The water use distribution for Awati County is as follows:

- CU crops 47% (107.2 Mm^3)
- BET ecosystems 24% (55.3 Mm^3)
- NBET 29% (65.2 Mm^3)

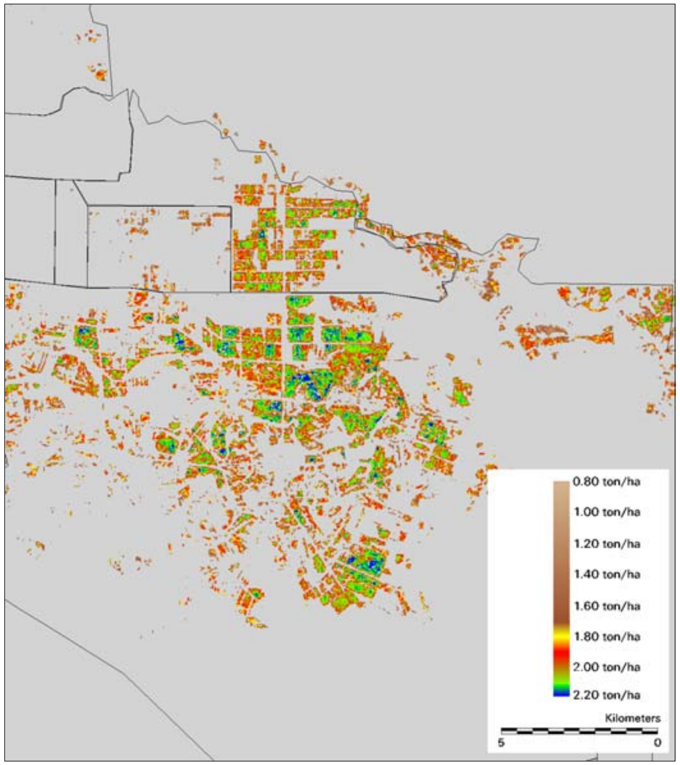

Figure 5: Cotton yield 2000

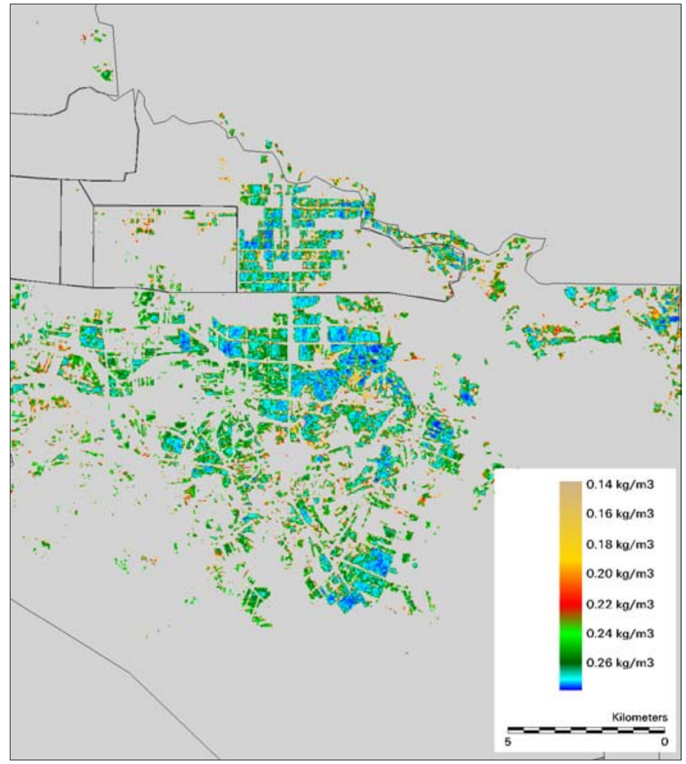

Figure 6: water productivity for cotton 2000

The water productivity per unit of water in the irrigated cotton fields in Awati County is 0.24 kg/m^3 (fig. 5). This is 30% lower than the global mean, but is well within the range of values observed around the world.

Recommendations:

The water resource management of Awati county should focus on:

- (i) increasing the total evapotranspiration in order to balance total inflow (precipitation and irrigation) with total water use
- (ii) transforming NBET into BET by reclaiming saline soils.

If the present policy to prohibit land use changes and land reclamation is not changed, irrigation deliveries should be decreased in order to increase agricultural yields. Taking less water from the Aksu River will leave more water available to the middle and lower reaches of the Tarim Basin.

The study exemplifies how advanced remote sensing techniques can be applied for predicting agricultural and irrigation performance, which otherwise are difficult to obtain on a regional scale. Evapotranspiration maps created using SEBAL can be routinely used to provide input into daily and monthly operational and planning models for irrigation and drainage planning and for hydrologic river basin studies. Although the following case study is based on a relatively small pilot project of 79,500 ha, this method could also be implemented over the entire Tarim River Basin and other large irrigated river basins in the world.

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