Location	Baro-Akobo Basin, Ethiopia and Sudan
Contractor	WorldBank
Period	2001

Background of the project

This project describes a short exploratory study to the dynamics of the actual evapotranspiration and rainfall for the Baro-Akobo basin. The Baro-Akobo basin covers both Sudan and Ethiopia and is thus an international river basin. The source of the Baro and Akobo rivers lie in the Ethiopian highlands. When crossing the border of Ethiopia the two rivers merge into the Sobat river.

Aim of the project is to quantify the effect of disconnecting the Machar Marshes in Sudan from the Sobat river.

Study approach

The actual evapotranspiration of the Baro-Akobo basin has been mapped for the year 2001 using the SEBAL algorithm (Surface Energy Balance Algorithm for Land). SEBAL converts the satellite measured spectral radiances into surface energy balances including evapotranspiration. The algorithm is crop independent and uses satellite data with a thermal infrared sensor. Data from the MODerate resolution Imaging Spectroradiometer (MODIS) satellite has been used to estimate the land surface energy balance at basin scale with use of SEBAL. The large MODIS swath width of 2330 km and its daily repetitive image acquisition, is suitable to cover large river basins such as the Tana-Beles Basin. An overview of the Baro-Akobo basin is shown in Figure 1.

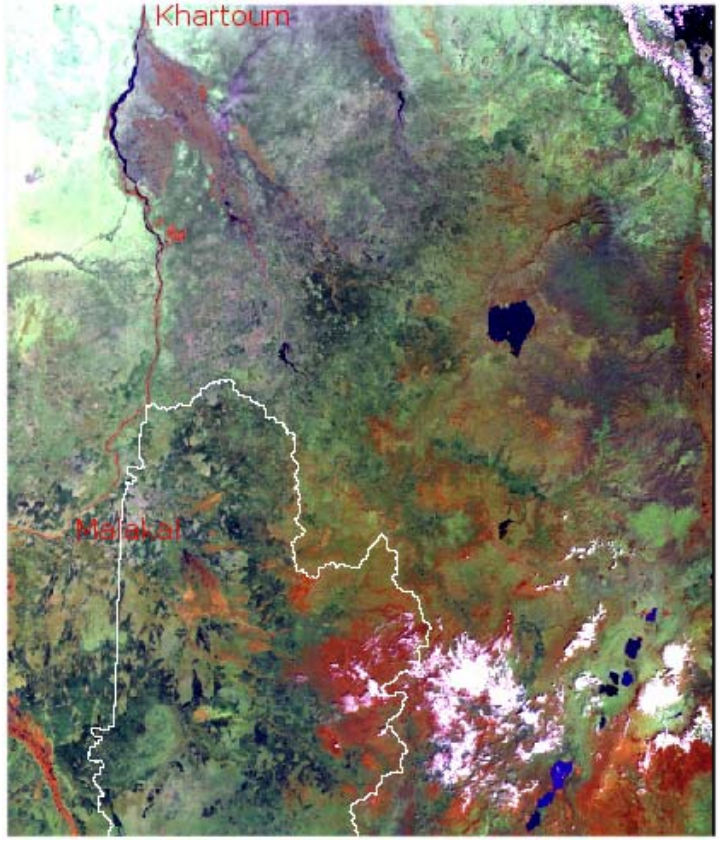

Figure 1: An overview of the Baro-Akobo basin outlined in white

The study relied on limited field knowledge and data. Meteorological data were the additional inputs besides the remote sensing data.

Aim of the study is to quantify the impact of disconnecting the Machar marshes from the Sobat river. This was done by mapping the monthly and annual evapotranspiration of the Machar Marshes and it's direct surroundings. An area of 5 km around the marshland is considered as the surrounding area.

Results

The difference between the evapotranspiration values of both regions has been identified as 1.033 km3/year. An

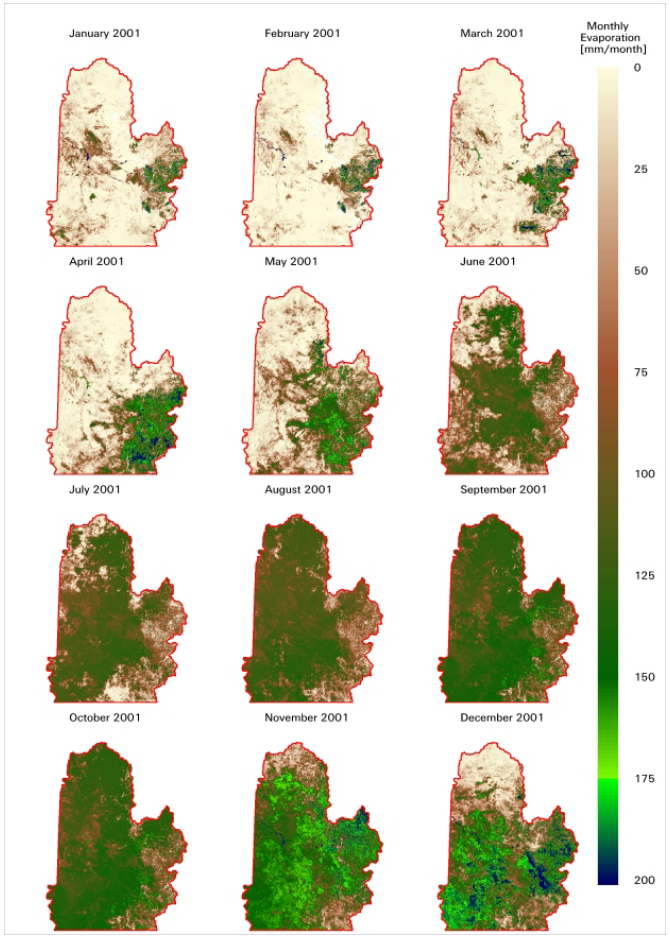

Figure 2: Evaporation Dynamics of Baro-Akobo Basin, 2001

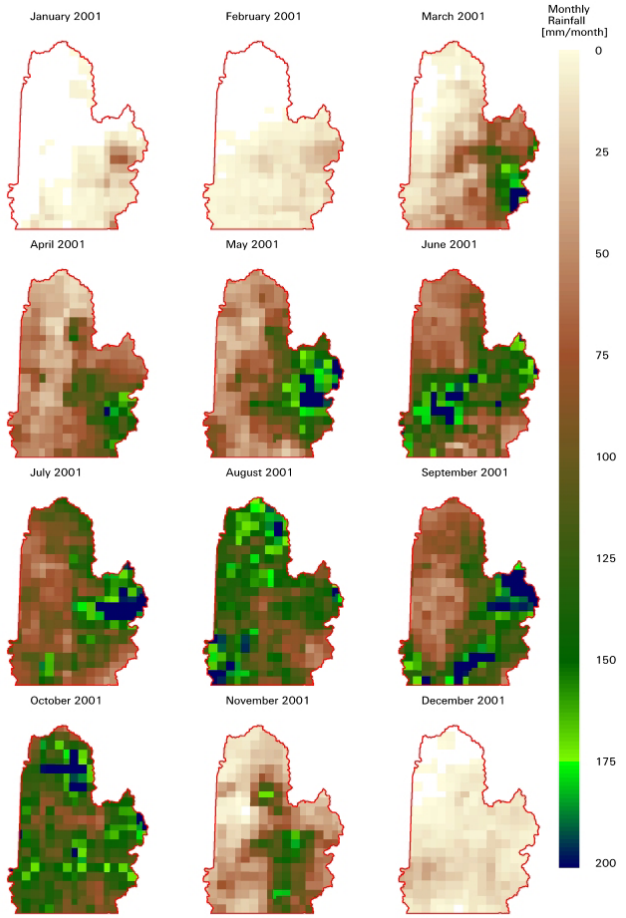

Figure 3: Rainfall Dynamics of Beles Basin, 2001

efficiency factor of 0.8 was introduced to account for water seepage and creation of new marshlands downstreams. The potential stream flow increase in Sobat River is estimated to be 0.8266 km3/year if embankments are build that prevents the Sobat river from flooding the Machar marshes.

The map with the monthly ET for the Baro-Akobo basin in 2001 is presented in Fig. 2. Another map with the monthly rainfall for the Baro-Akobo basin in 2001 is presented in Fig. 3

The area of the Machar marshes has been mapped for each month. Figure 4 shows the change in area of the Machar marshes during the year 2001. In February, March and April the area of the Machar marshes decreases. Most of the wetlands are then dry, and no vegetation is present.

Disconnecting the Machar marshes from the Sobat river has been calculated by comparing the evapotranspiration from the marshes with the surrounding area, with the surrounding area being a strip of 5 km around the marshes. The difference in evapotranspiration can then be calculated and the mean loss or gain is dependent on the area of the Marshes. Figure 5 shows the yearly trend of these potential water savings. In the spring and early summer most of the water savings take place, while in fall and early winter more water will be taken out from the Sobat river then the present situation. Overall disconnecting the Machar marshes will lead to an increas in flow in the Sobat river

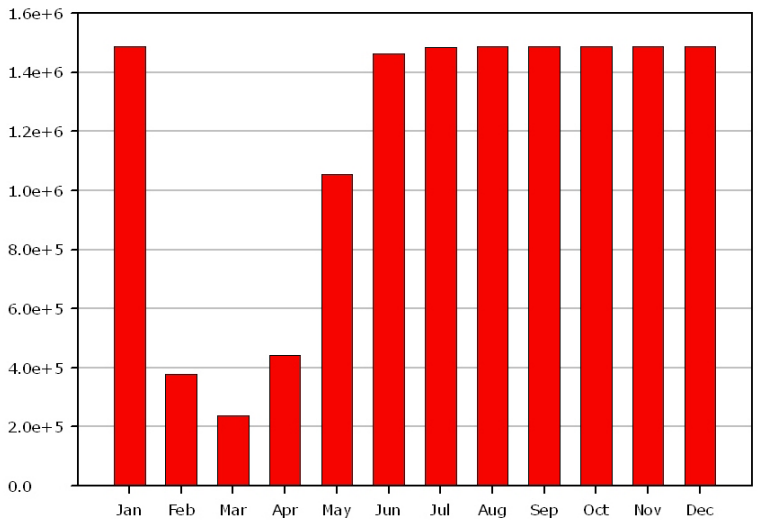

Figure 4: Change in Area of the Machar Marshes during the year 2001.

Evaporation dynamics

The evaporation in the baro-akobo basin is largely driven by the rainfall patterns. The only notable exception are the Machar marshes. The range of evaporation is from 300 mm for the barren lands in the north-west to 1500 mm for the forested areas in the east of the Baro-Akobo basin.

Rainfall dynamics

The peak of the rainfall is concentrated in the summer period. The amount of yearly rainfall ranges from 800 mm in the north-west of the basin to 1500 mm in the forested areas in the east of the basin.

Soil Moisture dynamics

The dynamics of the soil moisture closely follows the rainfall dynamics. The basin is dry in the winter months, with the exception being the Machar marshes. The basin is the wettest in September after the period with the largest rainfall

Conclusions

The potential stream flow increase has been calculated by comparing the evaporation values of the Machar marshes with it's

surroundings. The potential stream flow increase in Sobat River by disconnecting the Machar marshes from the Sobat river is 0.8266 km^3. An efficiency factor of 0.8 has been used to account for seepage loss and the possibility of creating new marshes downstream.

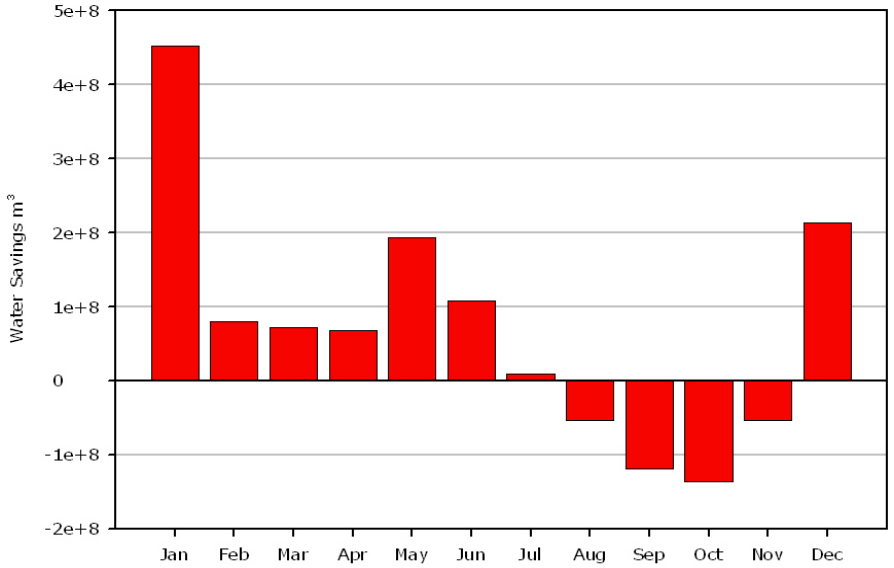

Figure 5: Potential water savings when disconnecting the Machar Marshes from the Sobat river calculated for the year 2001.

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