Water Resource Management of river oases along the Tarim River in North-West of China

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1. Introduction

The Tarim River Basin occupies 1.02 x 10^6 km². The Tarim River is one of the longest endorheic rivers in the World (1,321 km) and flows its water in the northern part of the Taklamakan desert in Xinjiang, North-west of China. Precipitation is 50-500 mm per year and potential evaporation varies between 2000-3000 mm per year. Aksu, Yarkand and Hotan Rivers form the Tarim River and supply 73.2%, 23.2% and 3.6% of total water respectively. Currently (2011) more than 9 million people are living in the area and the extent of the irrigated areas is more than 14.000 km².

The Tarim River Basin is unique due its riparian Tugai vegetation, consisting of forests of Euphrat-Poplar (*Populus euphratica*), various Tamarix species, reed (*Phragmites australis*) and Dogbane (*Apocynum pictum*).

The region is one of the biggest cotton and other cash crops producers in China, so most Tarim water is utilized for agricultural activities.

The aim of the project is to support decision makers, planners and engineers to find right measures in the area for the further development of the region under climatic and societal changes .

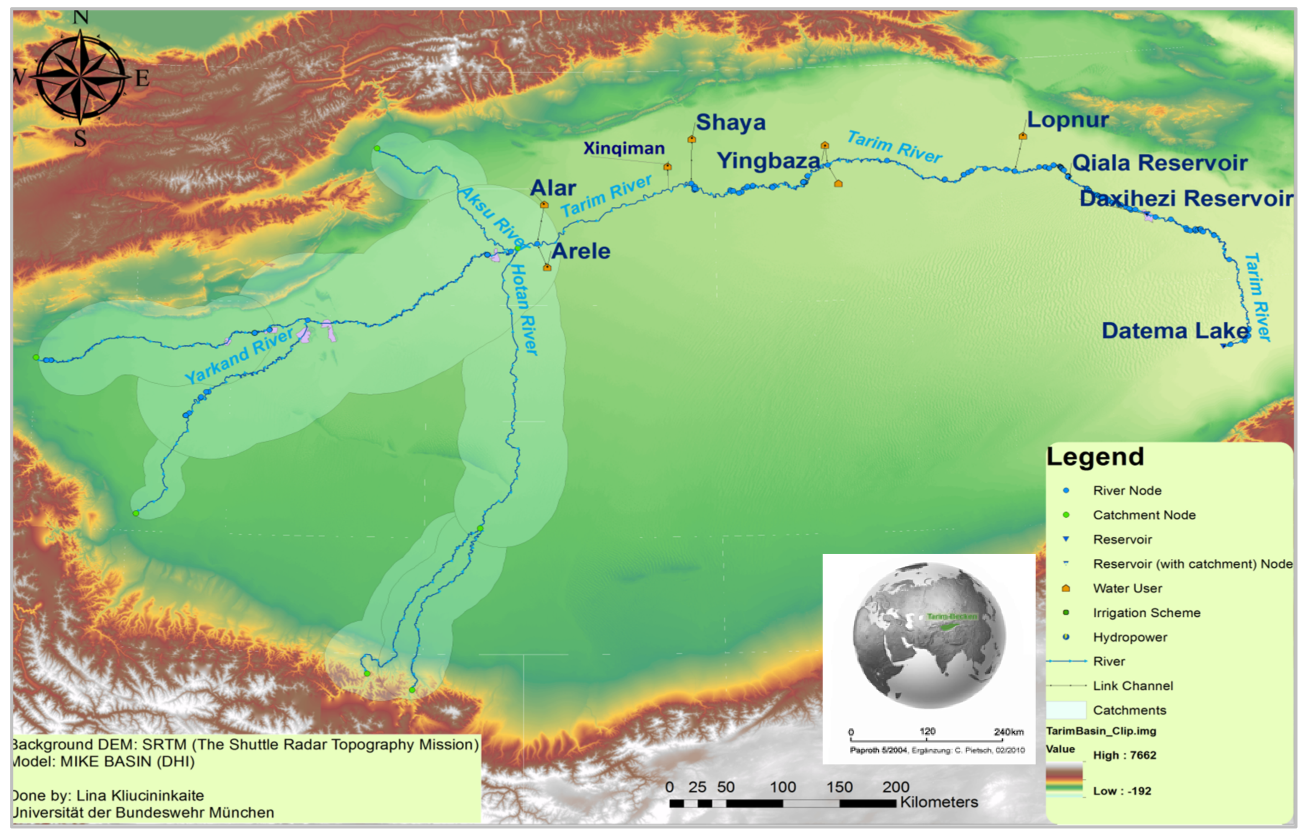


Figure 1: Tarim Basin DEM and conceptual plan of the Tarim River, its main Tributaries and the main water users in MIKE HYDRO Model (DEM from USGS SRTM30)

2. Water resources and salinization

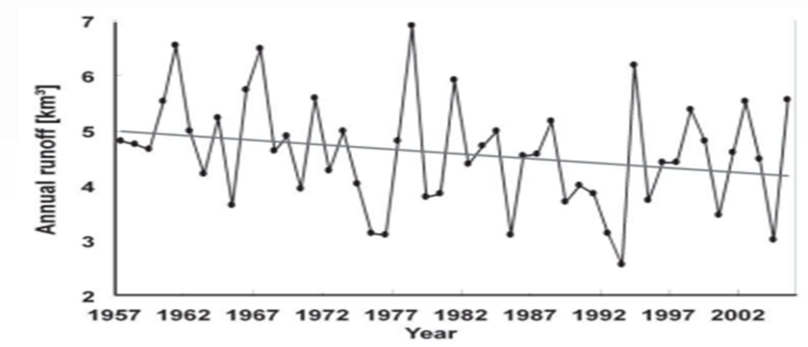
Due to nearly 1°C temperature increase over the past 50 years in the Tarim River Basin, more water was available in the mountainous areas for the headstream discharges of the Tarim River. Increase of 25×10^8 m³ was recorded in the headstreams in recent 10 years, but to the mainstream of the Tarim River it was less than 1×10^8 m³ [5].

The discharge at the Alar station and other hydrologic stations along the Tarim River has a significant linear decreasing trend for the period of 1957-2002. The terminal Taitema lake and more than 320 km of the lower Tarim dried up from 1972 to 2000 [4].

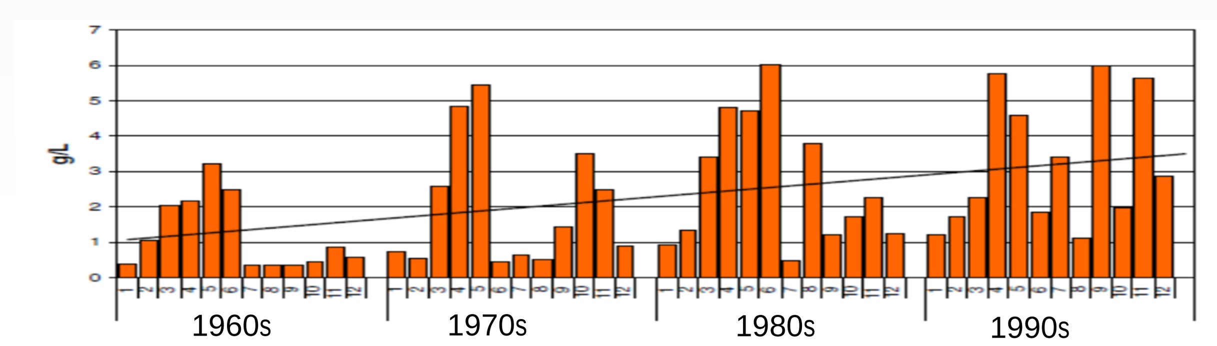
The water usage was increasing in the upper part of the Tarim River for the past 40 years. Statistical data showed that the irrigated areas increased from 34.8×10^4 ha to 125.7×10^4 ha and the water consumption also increased from 50×10^8 m³ to 155×10^8 m³ during 1950's - 2000's.

The salt concentration in the soil around the city of Alar is high, seeking around 20 - 80 g/kg. Almost 40% of discharge water from the Aksu River by Alar Water Station is drained water from farmlands with high mineralization rates, which is 1-3 g/l from old irrigation areas and 3-15 g/l from newly claimed irrigation land.

Annual discharge at the Alar water station, 1957-2002 [1]



Changes of monthly salt concentration at Alar Hydrological Station [2].



Annual discharge along the Tarim River from upstream to downstream [3]

Gauge station	Number of years	Mean runoff (10^8 m³)
Alar	47	45.86
Xinqiman	47	37.50
Yingibazar	47	28.91
Qiala	45	5.81

Changes in water consumption in different parts of the Tarim River, in [100×10^6 m³] [2].

Time period	Water consumed (100 million m³)		
	Upper	Middle	Lower
1957-1959	14.8	25.8	15.6
1960-1969	16.4	24.4	12.4
1970-1979	15.0	22.1	6.7
1980-1989	18.2	22.7	3.9
1990-1995	17.1	19.2	3.1
Average	**16.3**	**22.5**	**7.7**

3. Model building

The main objective of the SuMaRiO project is to cover different research scales, starting from the field scale and ending with the whole Tarim River. MIKE HYDRO (DHI) model is used to model the macro scale. It is a surface water mass balance and planning tool to address water allocation, conjunctive use and reservoir operation issues.

USGS SRTM30 (USGS, 2006, Shuttle Radar Topography Mission) Digital Elevation Model is used to identify catchment size and flow directions.

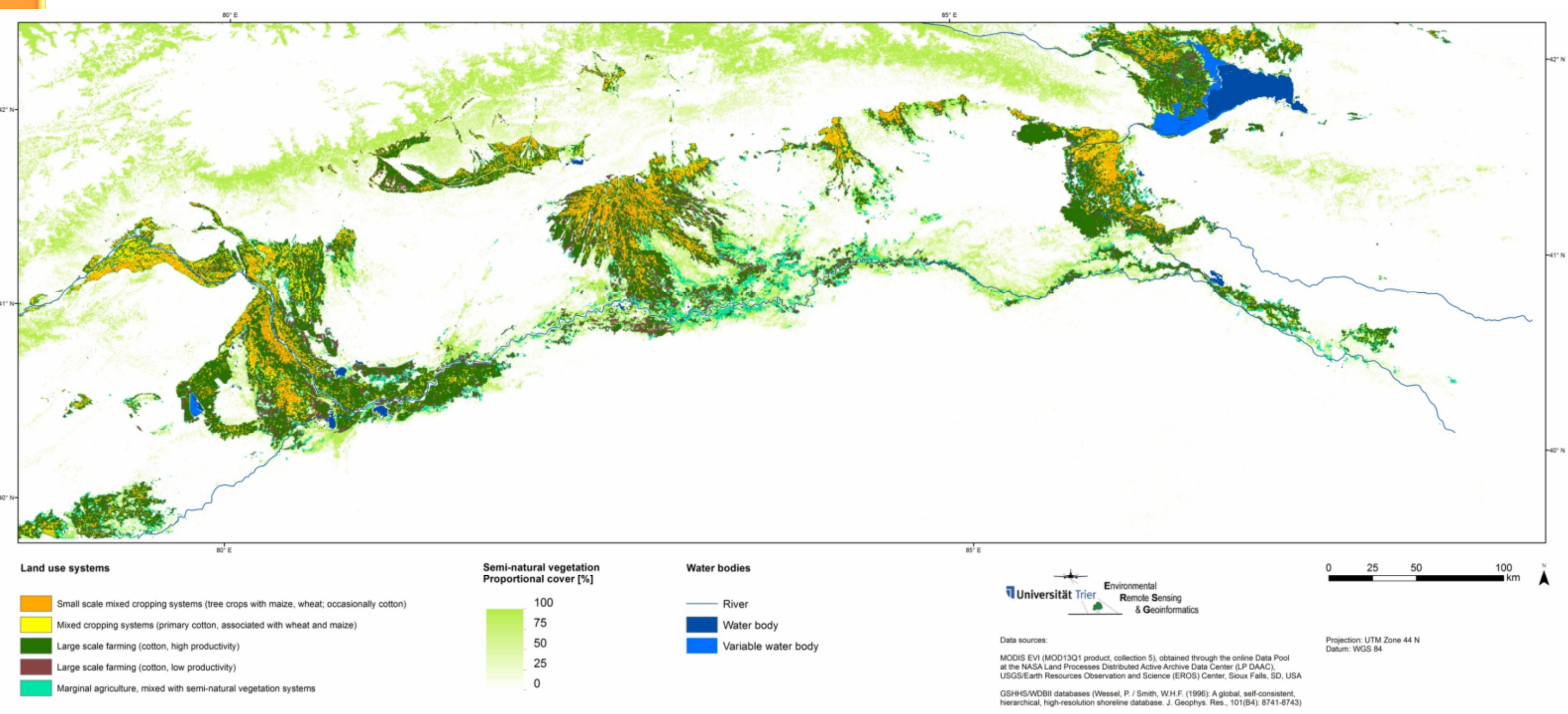


Figure 2: Land Use Systems. Input data for the MIKE HYDRO Model (background data: MODIS EVI, MOD13Q1 product, collection 5) (Maders, Hill, 2013)

A MODIS (LP DAAC) Remote Sensing data for different years is currently in pre-procession phase in order to identify land use cover and track its change in the area (Hill, University of Trier).

Outcome results of another Work Packages of the project will be integrated in the model in the final stage and different scenarios will be calculated to predict water use change in coming few decades.

4. Summary and Outlook

This study is on a development and data acquisition stage. The construction of the model has started in March 2012. Calibrated models for the Tarim River are not available yet due to insufficient discharge and diversion data throughout the basin.

As a second step, water resources management measures and Decision Support System (DSS) will be suggested in order to restore the ecological balance in the area and allocate water in more sustainable way.

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