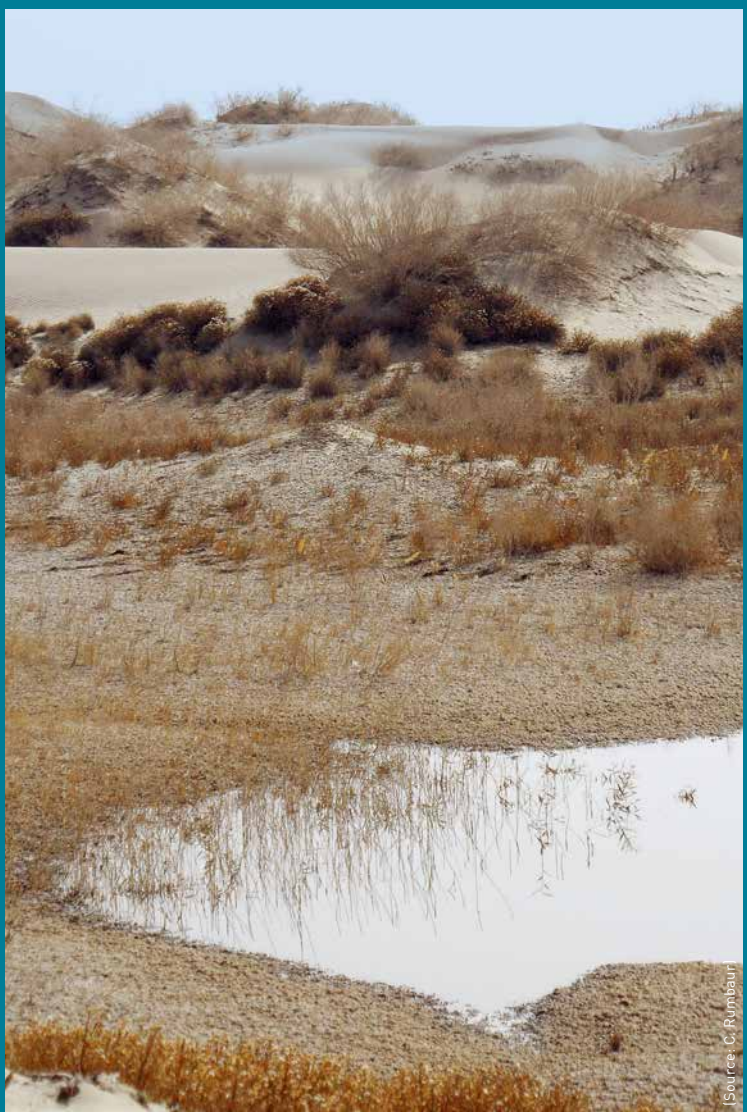
SUSTAINABLE LAND MANAGEMENT

A MANAGEMENT PLAN FOR THE TARIM



(Source: C. Rumbaur)

Lower reaches of the Tarim in summer.

Xinjiang's main agricultural product: cotton.

The Tarim Basin is China's most important cotton growing region. The cotton farms depend on the water carried there by the River Tarim. Artificial irrigation is causing ecological problems in the region however. A German-Chinese research team is now working to develop a sustainable use concept for the oasis landscape.

The Tarim Basin in the extreme north-west of China is a very special landscape: no other region in the world lies as far from an ocean. Enclosed by the foothills of the mighty Tian Shan, Hindu Kush and Kunlun Shan mountains, this extremely arid region has an annual precipitation of only 50 millimetres per square metre. It is only in the early summer that rainfall in the mountains increases, the snows thaw and the glaciers melt, causing torrents of water to come flooding into the valley so that life flourishes along the 1400 kilometre long river – particularly in the form of cotton farms, which have spread out over the oases along the river and which take water from it for their crops. »Without artificial irrigation the cotton farmers could grow nothing here«, says Professor Markus Disse, a hydrologist from the Universität der Bundeswehr München. But as a result, the floodplain ecosystem is deprived of the water removed from the river for cotton. Disse has therefore set himself the objective of balancing the demands of the people and the environment in terms of water volume and quality, and thereby achieving the sustainable management of water and land resources.

Disse seeks to implement this in the project »Sustainable management of River Oases along the Tarim River«, or SuMaRiO for short. The German Federal Ministry of Education and Research is giving 7.5 million Euros in funding for the joint German-Chinese project. Scientists from ten German universities and research institutions and eight Chinese universities and scientific institutions are working together on the project. Their aim is to set up a sustainable oasis management system for the Tarim Basin which meets the demands of land and water users fairly in these times of climatic change and social upheaval.

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The objective of the SuMaRiO project is ambitious, because many lay claim to the meagre volume of water available in the Xinjiang region. They include the ten million people living in the oases along the Tarim, who rely on the river for drinking water, the cotton farmers, local industry, and the animal and plant species of the floodplains. In this respect the cotton is both a blessing and a curse for the region. 40 percent of China's cotton production is harvested in the fields along the river, representing around 15 percent of world production. This brings a degree of prosperity to the region, and feeds the employees of the big state-owned and military

Soil salinization.

farms and the small farmers. However, this agriculture is also causing major ecological problems because the cotton requires a lot of water. The farmers obtain this by diverting water from the Tarim along

»The hydrological and ecological system is disrupted nearly everywhere.«

artificial canals, particularly in the summer months. Cotton cultivation has increased dramatically in recent years, and the effects on the middle reaches and especially the lower reaches of the river are plain to see. »The hydrological and ecological system is disrupted nearly everywhere«, asserts Professor Bernd Cyffka, a geographer at the Catholic University of Eichstätt-Ingolstadt. The scientist, head of the Neuburg Floodplain Institute on the Danube, is investigating the ecosystem services provided by the riparian forests along the Tarim in the SuMaRiO project. He says that the problems are obvious: in the past 30 years so much water has already been removed from the upper and middle reaches to irrigate the cotton and wheat fields after the snows melt that a 380-kilometre stretch of the lower reaches receives hardly any water at all.

Sometimes this section of the river has lain dry for years. »All the water is used up over the summer for cotton growing«, says the ecologist. The irrigated agricultural land also oversalinates the water.

Euphrates poplars.

Protection for the Euphrates poplar

Because man-made dykes separate the river from the natural riparian forests, there is a shortage of water for the animals and plant species there that rely on regular flooding, such as the Euphrates poplar. The habitat along the River Tarim is extremely important for this tree species, as 60 to 70 percent of the world's Euphrates poplars grow here. In order to better protect the rare poplars and intact floodplains and to renature the disturbed sections of the river, Cyffka is drawing up a management plan. This will show which measures should be implemented in which areas of the riparian forests in order to breathe more life back into the forests. The plan will serve as a basis for making proposals to the local authorities as to how they might distribute the water among the oases. »Vigorous riparian forests are important as so-called ecosystem service providers«, says the ecologist. »They provide shade for people and domestic animals in the desert regions, they supply oxygen, they lower temperatures a little and they offer protection from the many sand and dust storms.« This last ecosystem service is a particularly important one for China because without this »green belt« of riparian forests it would cost the country a lot to keep the roads clear of sand for example. Cyffka is now measuring soil humidity on test sites in the lower and middle reaches while his colleagues record groundwater levels, and he is mapping the forestry to find out whether the Euphrates poplars are receiving an adequate water supply. Wind measurements are also being taken and

The natural Tugai vegetation: Euphrates poplars, reeds, tamarisks and species of apocynum.

special devices used to trap drifting sand so that the scientists can also quantify the ecosystem service of sand protection.

Data from 250 enterprises

A change towards a more sustainable water distribution would have consequences above all for the agriculture in the Tarim Basin. For this reason a group of researchers led by Dr. Reiner Doluschitz, Professor of Agroinformatics and Business Management at the University of Hohenheim, is gathering business data from the farms. So far he has surveyed around 250 enterprises, mostly smaller family businesses but also production units of the state farms that the central government in Beijing has established since the 1950s to encourage settlement in the region. Doluschitz wants to know what crops the farmers are growing, how high their yields are, what their outlays are and much more besides. »These figures are important because we want to find out how the farms adjust their cultivation and production methods when external factors change«, says the agricultural scientist. For example if less water is made available to the farmers for their crops in future, Doluschitz's team of experts can predict the effects that this will have on individual businesses using mathematical models. And if the price of water increases, for example, or the world cotton market changes, or there is a shift in demand towards particular types of fruit and vegetable, the Hohenheim model should indicate how agricultural business management will develop. As Doluschitz

Village life in the Tarim region.

says: »The objective is to develop a farm model for the whole region which simulates the effects of different market and political scenarios on the agriculture here.«

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Ecologist Dr. Niels Thevs from the University of Greifswald is also working closely with the farmers in another SuMaRiO sub-project. He is investigating which other crops the local farmers can grow to break their economic dependence on cotton. Thevs is considering two plant species which occur naturally along the Tarim: firstly reeds, which are also widespread in Germany wherever soil moisture levels are high enough. And secondly, a plant with pinkish-white flowers in the Dogbane family with the scientific name Apocynum pictum. »This plant is perfectly adapted to the changing water conditions in the floodplains«, says Thevs.

The plants grow up to a metre in height, and a tea can be made from their leaves which lowers blood pressure. Fibres can be extracted from the stems to manufacture textiles. While the ecological characteristics of reeds are already very well known, little is known about Apocynum pictum as yet. Thevs is therefore conducting fundamental research: in what

On the edge of the oasis – the start of the desert.

Lower reaches of the Tarim in summer.

types of soil does the species grow? How much moisture does it need? How well does it tolerate salt? How is the plant distributed along the river? But this is only one of the tasks that Thevs has set himself. Above all the German scientist is seeking to offer an alternative source of income to those farmers in the middle and lower reaches of the Tarim who are particularly affected by the volume of water removed from the upper reaches. »Private cotton farmers have no certainty that there will be enough river water for their fields in May or June, when the water shortage is at its worst before the thawing of the snow in the mountains«, says Thevs. So time and time again, the farmers lose their whole crops.

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Apocynum pictum – and the closely related species Apocynum venetum – could offer an alternative, because unlike cotton these plant species rely on ground water rather than surface water so they are better able to withstand dry years. Thevs is also drawing up a nutrient balance assessment for the herbaceous perennial. The hypothesis is that harvesting of the leaves removes more nutrients than gathering of the dried stems no longer needed by the plant in winter. »This would suggest that use of the plant for tea puts it at greater risk than using it for the manufacture of textiles«, he says. Another argument in favour of use of the stems is that the small farmers have very little income in the autumn. »This could be an important source of extra money for the families«, says Thevs.

Software for local authorities

The scientific knowledge gained from the sub-projects, which include for example many regional climate studies and extensive hydrological analyses of the River Tarim, is intended to lead to the development of a decision support system. The project objective is for the SuMaRiO scientists to present this in 2016 as the end product of their investigations. The software-based system supported by 78 indicators is intended to provide the local authorities with sustainability analyses for land and water management. »For example if cotton production in the Tarim catchment area further expands, the system can show the effects of this on water, soil, climate and natural vegetation«, explains project coordinator Dr. Christian Rumbaur from the Universität der Bundeswehr München.

Or to give another example: how will land use in the Tarim catchment area change if the regional climate changes over the next few decades? The German-Chinese research team's integrated approach of bringing sustainable thinking into land and water use and fostering ecosystem services is something quite new for the provincial government and local authorities working with the SuMaRiO scientists. »Of course there is always a risk that the decision

River Tarim in autumn.

support system will not be implemented«, says project leader Disse. But he does not believe this will be the case: »The politicians and authorities are now recognizing the positive services that an intact ecosystem provides. They are fully aware of the fact that the natural system in the Tarim Basin is extremely fragile.«

Great political interest

The scientists are well served by the fact that the Chinese central government also has a political interest in developing the region in the longer term: firstly, because the Xinjiang region is thought to hold the biggest oil and gas reserves in China, and secondly, because the region is home to the Uyghur minority, which makes up half of its population. »There are social tensions. It is an important responsibility of the politicians to break these down in the future«, says Disse.

To further encourage acceptance of the decision support system, the SuMaRiO scientists also hope to involve authorities such as the local Department of Water Resources at an early stage by holding workshops. »The aim is to train the management staff so that they can use the software themselves«, says Rumbaur. And perhaps even more importantly: »The officials need to learn how to enter new data independently in order to keep the system up to date«. Only in this way can the support tool continue to be used after the project ends in 2016.

Production systems that are being investigated in the region are: agricultural systems (intensive and extensive), Forestry, Settlement

SuMaRiO
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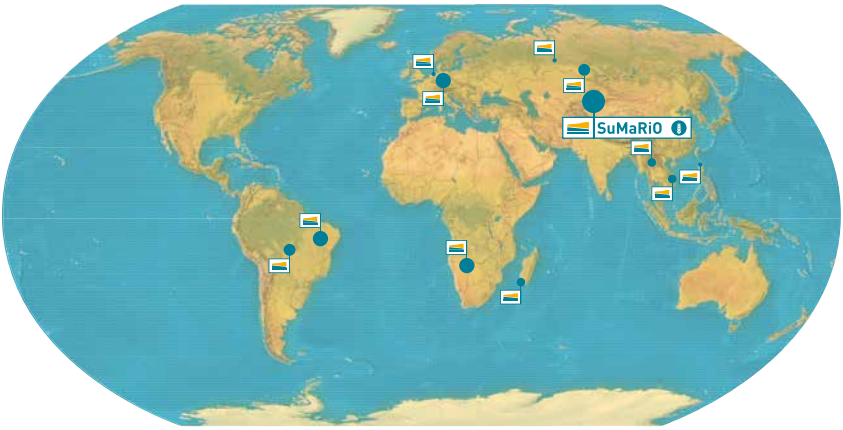

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