

Answers to the referees

We really appreciate the valuable comments of the two referees. These comments really helped to improve the paper. In the following we have listed the answers of the authors of the paper.

Answers to referee 1:

1. Goal and type of the paper

(i) For me it is really not clear what the goal of this paper is.

- (1) Is the goal of the paper to bring some new interesting results of sustainable management of the Tarim river basin?
- (2) Is the goal of the paper to give an overall and quite scientific challenging project description, what the 37 researchers have done?
- (3) Is the goal of the paper to show some new scientific results in economic, ecological and other perspectives? This is all not clear. In the introduction the authors should clearly and precisely write what they want to achieve with this paper, what knowledge they want to transport and what they want to tell the reader. This has to be done in any case because as I said it is not clear at all.

The goal of this paper is stated in the abstract (lines 50 to 54): “After the data collection phase has been finished this year, the present paper brings together the results from the fields of climate modeling, cryology, hydrology, agricultural sciences, ecology, geo-informatics, and social sciences, in order to present a comprehensive understanding of the effects of different water availability schemes on anthropogenic activities and on the natural ecosystems along the Tarim River.” as well as in the last paragraph of the introduction (line 123 to 130): “The first objective of this paper is to bring together the results from the fields of climate modeling, cryology, hydrology, agricultural sciences, ecology, geo-informatics, and social sciences, in order to present a comprehensive understanding of the effects of different water availability schemes on anthropogenic activities and on the natural ecosystems along the Tarim River. The second objective is to present the project structure of the whole consortium, the current status of work, i.e. major new results and findings, explain the foundation of the decision support tool as a key-product of this project, and conclude with findings for application in the region.”

(ii) Also it is not clear what is new in this paper. Is the sustainable management of the Tarim river basin in China new? Are the scientific results new or what is new? Also this is not clear and should be clarified.

The scientific results and their inter-linkage are new to the region:

- (a) **The impact of climate change on river run-off and the further development of the region based on the medium-term increase of the discharge,**
- (b) **the role of glacier outburst floods and their importance for the water availability and for the groundwater discharge**
- (c) **the importance of the height of groundwater level for the riparian forests**
- (d) **the impact of the distance of riparian forests to the river course**
- (e) **the explanation for the missing rejuvenation of riparian forests (missing river course dynamics**

- (f) fast expansion of agricultural land to produce cotton**
- (g) developing a decision support tool for the region**

(1) Also it should be clarified what type of paper this is. Is it a research report? Is it a description of what has been done by this group? Is it a scientific paper with a clear-cut scientific question and new scientific results? Also this should be clarified.

The paper is an interdisciplinary overview of the work done by the project consortium.

(iii) The final point: This paper has 37 authors. It should be clarified in what kind of order the authors are brought? Why is Rumbaur No 1, Thevs No 2 and R. Yu No 37? There is no alphabetical or other order. The authors should at least explain this.

The order of the authors was chosen because: The first author coordinated and gave the idea of the structure and the content of the paper, made the revisions and consistency of the text; the second author is the corresponding author, made also the revisions and consistency of the text, uploaded the paper; the third author is the project leader; authors four to 37 are the project members contributing to same amount to the paper, that is also the reason why they are in an alphabetical order.

2. Structure of the paper

The paper needs a much clearer structure. After the introduction, where the authors should clearly say what the goal of the paper is, what new is and what type of paper it is, it should follow a chapter called "project description" with explanations what precisely this research team did, what the project goal was and what they achieved. So that an interested reader sees on three to four pages what was the goal of the paper and what has been achieved and for example if there have been conflicting goals between economic and ecological matters etc..

The structure of the paper was changed and a chapter called "Project description and research sites" (line 131 to line 182) was inserted after the introduction as recommended. The authors decided to give only a short description of the project structure in order not to disturb the flow of reading of the paper too much.

The chosen structure is also explained in the chapter "methods" in the line 175 to line 186.

3. Scientific purposes

The scientific purposes are quite often hidden and it is not clear what the scientific purposes of this paper are. There are a lot of empirical results presented but in a lot of cases it is not clear whether the authors fulfil the ceteris paribus conditions, if they undertake a trend analysis or just present correlations. Also if the authors want that the paper has a stronger scientific background, they should clearly formulate two to four hypotheses and then later on empirically test them, but at least undertake an attempt to fulfil the ceteris paribus conditions. This means after the project description the author should formulate the hypotheses and empirically test them. If this is not the intention, they can make a longer and more detailed project description. After that, the authors should then bring out some policy and then they should discuss the major results and give some policy recommendations. The authors could end for example - and this would be fascinating and highly stimulating - how difficult this project was with respect to the interdisciplinary work, what helped here, what were obstacles and how one could overcome them?

This paper wants to give an overview of the results of the project combining different disciplines. For each discipline the ceteris paribus conditions are fulfilled. In the end all these results are combined in the decision support tool delivering future scenarios for the region.

The intention of the paper was not to formulate hypotheses and empirically test them. This is done in papers of each single scientific discipline. In the end the authors bring some applicable findings to improve the water and land management including ecosystems in the region.

Findings (line 1044 to line 1182):

- **due to climate change melting of the glaciers and snow will increase**
- **river run-off of the Tarim River will increase in the nearer future**
- **due to more available water agricultural producers may feel motivated to further increase their production area**
- **water use efficiency will be reduced, since much irrigation water is needed for leaching salts out of the root zone**
- **confirmation of the long term ecological restoration of degraded riparian Tugai forests along the lower reaches of the Tarim River has beneficial influence on the Populous euphratica growth**
- **in the Tugai forests, the stem diameter increment of Populus euphratica decreases with an increase in tree age and in the distance to the groundwater**
- **along our study plots near Yingbazar, groundwater distance rather than tree age is the principal reason for the differences in stem diameter increment**
- **Impairment of shoot growth due to wood harvest by the local population can be excluded as a major influencing factor on shoot growth**
- **only the poplars on the plot with the small groundwater distance, but not the trees growing at larger distances to the water table exhibited a significant correlation between the standardized stem diameter increment and the preceding year's river runoff**
- **decision makers can compare social costs and benefits in terms of the same measuring units, i.e. money, in order to decide if the realization of such a project is socially profitable and, therefore, advisable or not. In this use the CVM is a political decision tool.**

The authors added the difficulties of the interdisciplinary and intercultural project and show what helped to solve the difficulties.

Difficulties:

- 1) **Scientists from various disciplines have different "language" and definitions of common used termini**
- 2) **The point of views on a specific research topic, scientific methods and the way of communication are different in the three different cultures (German, Chinese and Uighur)**

Solutions:

Regarding 1) and 2) (see line 1045 to line 1057) communication was the only way to avoid and clarify misunderstandings. The main communication platform of SuMaRiO is the project's official and internal web page. The description of the project, the goals of every workblock and the detailed work plan can be found there in the project's main languages, German, English and Chinese. Exchange of data and the access to reports and the project's publications is achieved via the internal web page.

Nevertheless, the main and most efficient way to exchange ideas, solving misunderstandings between disciplines and cultures is the personal communication in workshops, conferences in Germany and China but also via telephone. Another important way to improve the intercultural cooperation is staying in the respective foreign country giving a better understanding of how work is done in the other culture. Trust and motivation for the interdisciplinary and intercultural cooperation was strengthened by collective informal gatherings.

For future cooperation between German and Chinese institutions as well as to foster the relationship between the scientists involved, the common platform 'Sino-German Joint Research Center for the Management of Ecosystems and Environmental Changes in Arid Lands (MEECAL)' was established. It provides the basis for the exchange on issues to arid lands and its ecosystems – with a special relation to Xinjiang.

4. Overall evaluation

To summarize let me clearly say this is in principle a fascinating piece of research but as it stands now it is a mixture of a project description and of some scientific results and it is unclear what the goal of the paper is. This should be clarified. Then I can recommend this paper for publication.

The goal of the paper is to present an overview of the work done by the paper consortium on the regional problem of water and land use caused by human activities on natural ecosystems along the Tarim River. New results and findings and the project's product – the decision support tool are presented.

Answers to referee #2:

The paper deals with a broad interdisciplinary topic on a remote region in China, where scientific knowledge is scarce and global water resource problems and climate change problems are increasing during last decades.

ABSTRACT: Main problem and aim is well written, but single disciplinary results from the consortium are not deeply interlinked for common interpretation and main result statement. It ends in an aim, and not in a result conclusion or home message, related to the regional problems.

The abstract is rewritten and the remarked points are added.

INTRODUCTION: Region and problem statement with increasing water resource conflicts is documented in a short sufficient manner. In relation to the multiple result description research aim is too descriptive and must be more related to the international problem of Integrated watershed management and Ecosystem services.

The introduction is rewritten the research aim is stated in the new chapter called "Project description and research sites" (line 131 to line 182). The aim and the content of the

paper is also closer related to the interlinkage between the hydrology and ecosystem services.

METHODS AND STUDY SITES: In a broad manner the used methods for a multidisciplinary research group, written for each discipline, are documented precise and sufficient. Regional, global datasets (climate, hydrology, satellite images e.g. MODIS, own plot analysis, agro-economic statistics), own questionnaires for household analysis and models (e.g. SWIM, STARS, CCLM, MIKE-SHE) were used to analyze backward LUC, trends in climate (T, R) and discharge and forward with climate emission scenarios future climate change (for water balance scenarios foreseen). Further on plot based detailed analyses of the riparian vegetation (with plant physiology monitoring) in relation to ground water level, summer floods and soil water development were done. Ways of stakeholder analysis (mainly because of political restrictions with scientists and official governmental people) and data management are also well signed out.

Thanks.

RESULTS: According to the methodical subchapters the results are described for the different disciplines, with a lot of very interesting detailed new results (e.g. influence of glacier melt of a sub-basin on the discharge dynamic and development, role of glacier lake outburst floods, ground water level and distance to main river channel for vitality and juvenile trees in the riparian ecosystem, high increase of large farmland with cotton etc.).

Some remarks on this: text and tables to prove the water use efficiency of irrigation methods are not sufficient - which water consumption have the different crops?,

The text and tables to prove the water use efficiency and the water consumption of cotton production is added (line 696 to line 717). The authors assessed only the water consumption of cotton as this is the main and most important crop in and for the region.

Data and discussion to the amount of capital investment to improve irrigation systems is missing, how different farm types have possibilities for water sharing?

Data is added in line 724 to line 726. "Fixed investment costs for the drip irrigation system were estimated between 180 and 350 US-\$ ha⁻¹ a⁻¹ by Wang et. al (2012)."

role of soil salinization in a spatial sense and in the agro-economic role is to short discussed;

The role of soil salinization is added in line 718 to line 721 and in table 1 (line 703)

p. 1244 row 1-7 reference to tables is missing;

The reference to tables was added.

in the WTP method (p. 1246) the comparison of Xinjiang and Peking seems strange - there is no description on actor analysis and how the respondents were selected?

It is now explained in line 884 to line 895): "The overall social benefits from a large-scale environmental project in an ecological sensitive region will accrue not only to the people on site but also in other parts of the whole country. That is at least what is to be expected. While the people living on site will benefit from an improved water management directly there are also benefits from such a project which have nothing to do with the direct utilization of the Tarim water and the ensuing ecosystem services. Also people living in

Beijing care for what is going on in the Tarim area and what the living conditions of the local people are. From the perspective of Beijing citizens "desertification" was the most serious environmental problem occurring in the Tarim area (cf. Figure 14). A possible explanation for this result might be that many parts of China are endangered by desertification. Sandstorms can even be experienced in the city of Beijing (from the Gobi Desert). Therefore also people living in Beijing were willing to contribute financially to an improvement of the water availability situation in the Tarim area."

Fig. 10 and 11 gives only general information on environmental questions of whole arid/semi-arid China - not related to the research area and project aims.

The figures 10 and 11 changed now to figures 13 and 14. The descriptions of the figures relating to the region were added.

Chapter 4.3 and 4.5 are only weak related to the main aim and topic of water use conflicts and competition (see Introduction).

In chapter 4.3 and 4.5 text was added to establish the relation to the overall goal of the paper and to the water issues in the regions. In chapter 4.3 the relation to water management and the salinity problem of soils are added. The impact of increasing salinity on crop yields is shown. The costs of the two main irrigation strategies, drip irrigation and flood irrigation, are analyzed.

In chapter 4.5 it is directly related to the improvement of the environment in the Tarim River Basin and the reason why people in China's capital are also willing to pay for the improvement in Xinjiang.

DISCUSSION and OUTCOMES: In relation to the detailed result documentation this chapter is really rough, too short and general. Discussion with literature references must go more in detail and must focus on the linking up of the single disciplinary results (e.g. future change in discharge regime and consequences on irrigation agriculture; more reservoirs and dams - dangerous consequences for the Tugai forests ...). In the discussion the planned outcomes (e.g. steps for the DST) are discussed, not the results. This chapter must be written new, the written content can be used for an outlook and conclusion chapter.

The chapter was written new and the decision support tool was moved the results section. Difficulties in an interdisciplinary and intercultural project and how these difficulties are solved were inserted. The strategy of the upcoming implementation of the project's results is shown. The impact of the climatic change on the hydrologic regime of the Tarim River and the consequences of the change in river run-off to the irrigation agriculture are discussed. Consequences of the changing discharge regime, especially for the *Populus euphratica* tree and the restoration of *Populus euphratica* forests, will be shown more in detail. In the end the willingness to pay for the restoration and preservation are explained.