

Interactive  
Comment

## ***Interactive comment on “Establishment and maintenance of regulating ecosystem services in a dryland area of Central Asia: the Kökyar Protection Forest, Aksu, NW China, as an example” by S. Missall et al.***

**S. Missall et al.**

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Comment 01: “This article describes a success story for a huge human effort dealing with difficult environmental problems on one of the most challenging contexts for urban settlements on Earth. The paper presents the case for dust storms, a severe environmental problem limiting environmental quality in urban settlements in NW China, and the potential of urban protection forests to improve environmental services. The article explains the process of creation of the urban protection forest and its management with sufficient detail. A very brief survey and a superficial cost-benefit analysis

Full Screen / Esc

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Interactive Discussion

Discussion Paper



are used, and results presented on their basis. The social and economic procedures are visibly weak; this might be justified by the limitations of the socio-political context in relation to lack of transparency and some additional difficulties, however, I consider the information presented is valuable material for the understanding of sustainability. In my opinion as a reviewer, the authors need to make many changes in the article to reach an acceptable academic standards, I would kindly suggest the author to rewrite the paper on the light of these comments, because the topic is extremely relevant. The list of suggestions below, including changes on the structure of the article, justify in my opinion the need of a MAJOR REVISION.”

Response: Comment adopted. Changes required by Anonymous Referee #1 and the second referee Johannes K uchler have been integrated into the manuscript, which resulted in a major revision of the manuscript.

Changes in the manuscript: For the single items of the major revision confer comments and responses listed below and in the separate reply to the comments of Johannes K uchler.

#### A.) General comments

Comment 02: “The paper is grammatically well written but some sections are superfluous, I suggest the authors to remove the section “Synthesis” and potentially relocate any point found relevant on it and absent in other sections.”

Response: Comment adopted.

Changes in the manuscript: The section “Synthesis” has been removed. All those points that summarised results of the previous chapters have been deleted. The last paragraph of the section, analysing the payback period of the afforestation project, has been relocated into chapter “4.5 The perspective of the local economy”.

Comment 03: “The authors spend too much sentences talking about what they could have done with better data or what they have not done because of its lack. This

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive  
Comment

should be totally transformed, the case and information they provide is relevant enough. Please take all this “could” and “do not” and limit them to one (long) paragraph in the discussion section, compiling the most relevant points and relate them to potential uncertainties in the outcome.”

Response: Comment adopted. The respective part of the discussion section has been rewritten according to the indications of the referee.

Changes in the manuscript: Citation from the revised chapter “5. Discussion and outlook”: “The paper describes the historic establishment and present functioning of the Kökyar Protection Forest with regard to its institutional frameworks and financial conditions. While the institutional frameworks of Kökyar I and II are described in satisfactory detail, Kökyar III adopts a differing, more market based approach, which has not been systematically documented yet. Further research must clarify the institutional functioning of Kökyar III, especially in comparison to Kökyar I and II. Concerning the description of the financial conditions, the present financial conditions of Kökyar have formerly not been subject to any publications, and the results of the respective calculations of this paper, being based on a socio-economic household survey comprising 19 leasing households and one additional expert interview with former leading staff of the state-owned organisations, are deemed to be rather rough estimates. Conducting interviews with actual leaders of the governmental organisations of Kökyar I and II and with large private landholders of Kökyar III would have been extremely desirable, however, under the present political tensions in Xinjiang and the resulting scepticism towards any type of social surveys, this seems hard to achieve.”

Comment 04: “There is a general lack of mathematical language for the calculations used; I suggest you use 4-6 equations to complement the text describing how the values in tables are obtained, and especially describing the cost-benefit analysis (sic). This would clarify the paper.”

Response: First part of the comment not adopted. The paper does not use any com-

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

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[Interactive  
Comment](#)

plex mathematical operation which would require to be explained in equations. Therefore, we do not see a lack of mathematical language. Additions of single cost items to total costs, single income items to total income, or single areas to total area, especially if there are many terms of the sum, can most clearly be presented in tables, as is done in the paper. The same is true for subtractions, e.g. of costs from incomes. The single items, of which the tables are composed, are mostly derived directly from the sources, as is explained in the text. As soon as the tables will be placed in the corresponding places in the text body, their readability will be further improved. In some cases, we explain calculations in the continuous text. To give one example, in chapter “4.5 The perspective of the local economy”, we explain that working costs of 51.52 CNY/day multiplied with 180 working days/ha result in working costs of 9289 CNY/ha. We think, the clarity of this multiplication would not profit from the presentation of an equation and the necessary definitions ( $wc/d \cdot wd/ha = wc/ha$ ; where  $wc$  working costs,  $wd$  working days,  $ha$  hectares).

Second part of the comment adopted. In order to further clarify our analysis approach, the section describing cost-benefit analysis in chapter “2. Methods” has been enlarged and made more explicit.

Changes in the manuscript: Regarding first part of the comment: none.

Regarding second part of the comment: citation from chapter “2. Methods”: “The effect of the Kökyar Protection Forest on the local welfare is summarised from the perspective of cost-benefit analysis. Cost-benefit analysis is an assessment method that “quantifies in monetary terms the value of all consequences of a policy to all members of society” (Boardman et al., 2011). In contrast to normal accounting practices applied by profit-oriented corporations to identify the most profitable investment opportunities, cost-benefit analysis is not limited to the monetary costs and benefits of the decision maker himself, but accounts for all marketable and non-marketable costs and benefits experienced by all individuals residing within the area of interest (Mishan and Quah, 2007). In a nutshell: a “benefit” is an increase in human wellbeing, and a “cost” is a

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

reduction in human wellbeing (OECD, 2006). The term “net benefit” (i.e. subtraction of costs from benefits) therefore represents the overall societal welfare gain of a country or region. For the analysis conducted in this paper, the scope will be narrowed down to the local level, which means that downstream ecological costs caused by the Kökyar water consumption, although undoubtedly existent, will not be included. The focus will be set on marketable costs and benefits, while non-marketable effects will be verbally described (for more general information on cost-benefit analysis cf. Boardman et al., 2011).”

Comment 05: “I think an interesting point to add would be a discussion in the decision of the species included in the artificial forest. Poplar consumes so much water, which you know how scarce it is in the area, and I would like to see a comparison with other species with lower water consumptions and similar potential for success, you could use modern academic studies with a biologic focus on transpiration for certain species and also contrast them with studies about traditional gardening in desert areas. The article approaches economically the topic with a superficial cost-benefit analysis, and present results that might be slightly optimistic due to a potential underestimation of what would be the labour and true water costs in a “free” economy. I am aware water prices almost never reflect their costs, but you could improve the paper elaborating on this and its interaction with the current results, could they change sign if these costs were properly accounted?”

Response: Comment not adopted. The raised questions regarding tree species with lower water consumption and the true costs of water are, without any doubt, both interesting and relevant. Yet, they are out of the scope of this paper and should be subject to additional studies. In response to this comment, we clarified the focus of our paper – which actually is on institutional frameworks and financial conditions of the protection forest – by formulating a clear research question at the end of chapter “1. Introduction”. Furthermore, we made more explicit that the water prices stated in our paper do not reflect externalities, and we thematised the true water costs as an important future

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

research field in chapter “5. Discussion and outlook”.

Changes in the manuscript: Citation from chapter “1. Introduction” (research question): “This paper undertakes an exemplary analysis of the Kökyar Protection Forest under the following research question: Under which institutional frameworks and to which financial conditions can peri-urban shelterbelts be established and maintained?” Citation from chapter “2. Methods”: “For the analysis conducted in this paper, the scope will be narrowed down to the local level, which means that downstream ecological costs caused by the Kökyar water consumption, although undoubtedly existent, will not be included.” Citation from chapter “4.3 The perspective of the farmers”: “Irrigation water fees usually fall between 1125 CNY ha<sup>-1</sup> and 1275 CNY ha<sup>-1</sup>. (These prices probably represent the costs of the irrigation infrastructure and operation; they do not reflect externalities.)” Citation from chapter “5. Discussion and outlook”: “[...] the negative consequences of the Kökyar water consumption for downstream ecosystems need to be investigated. Principally, every drop of water diverted from Aksu River for the purpose of irrigating the Kökyar Protection Forest is detracted from its lower reaches and its main stem, the Tarim River. The improvement of the quality of life of Han-Chinese settlers in Aksu is thus bought by the resulting desiccation of downstream ecosystems and the consequent loss of downstream ecosystem services, which deprives local Uyghur farmers and herdsman of their livelihoods. Internalising these downstream effects into the Kökyar water prices may challenge the net-benefit and the positive image of Kökyar Protection Forest.”

#### B.) Particular comments

Comment 06: “Page 1676, line 16: The term pure seems too sensitive, if not inadequate, please change it.”

Response: Comment adopted. “Pure” has been exchanged by “100%”.

Changes in the manuscript: Citation from chapter “1.2 Geographic conditions of Aksu City”: “The composition of the population shifted from a nearly 100% autochthonous

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



Uyghur society to a majority of foreign Han-Chinese settlers [...].”

Comment 07: “Page 1676, line 8: Rumbaer et al. does not appear in the reference list, please check all for consistency.”

Response: The paper by Rumbaer et al. is expected to be published in the same issue of Earth System Dynamics, but is not yet accepted. Therefore, the correct citation is not yet public. Our notification – “Rumbaer et al. (submitted to this issue)” – has been erased by the Copernicus editors.

Changes in the manuscript: None. The citation will be inserted into the reference list as soon as it is known.

Comment 08: “Page 1676, line 26: “there” should be “their”?”

Response: Comment adopted; “their” is correct.

Changes in the manuscript: Citation from chapter “1.3 The Kökyar Protection Forest”: “The four project periods and their corresponding areas were then chronologically labeled [...].”

Comment 09: “Page 1678, line 14: “Other persons” should come with an explanation or rational for their selection, it opens too much the possibilities and it is part of a weak aspect of this contribution, please clarify it.”

Response: Comment adopted. The section about interview partners has been rewritten and explained in more detail. The rational for their selection is self-explaining after we clarified the research question of the paper (cf. above).

Changes in the manuscript: Citation from chapter “2. Methods”: “For information on the institutional processes and economic conditions of the state-owned organisations running the project, a semi-structured interview with the former head of the Forest Management Station was conducted. Other important information on the general circumstances all around the Kökyar Protection Forest were gathered by interviews with

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

random Aksu citizens, a private farming consultant in Aksu, and a seasonal worker in the plantation. All these interviews were conducted between 2011 and 2012 (cf. Appendix A).”

Comment 10: “Page 1678, line 20: See my comment above for could and don’t. It also applies for “but without”.”

Response: Comment adopted. This comment refers to chapter “2. Methods”, which has been rewritten in response to comment 04. In the course of this revision, the queried formulation became obsolete.

Changes in the manuscript: The formulation “but without” has been taken out of the text. For citation cf. above, under comment 04.

Comment 11: “Page 1679, line 14: You seem to use inconsistently spaces for figures, indicating thousands or millions? Please use commas for it, or be consistent with the selected format.”

Response: Comment not adopted. We used to use commas in figures, but they have been replaced by spaces by the editors, according to the standards of Copernicus.

Changes in the manuscript: None.

Comment 12: “Page 1682, line 14: Tremendous and astonishingly are literary words, avoid such terms, your numbers make the point.”

Response: Comment adopted. The words have been exchanged or avoided.

Changes in the manuscript: Citations from chapter “3.5 Obligatory labour”: “Even so, the mobilisation of manpower reached very high levels [...]” “Although the areas of Kökyar III were to be developed and exploited by private investors, the system of calling ordinary citizens to compulsory labour was maintained [...]”

Comment 13: “Page 1683, line 21: I seriously doubt there is a rational for your comment on “inferior work quality”; change it or provide rational and 2 citations of other works

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)



arguing similarly.”

Response: Comment adopted. The queried sentence indeed contained an assumption that was not backed up by the sources. Since the content of the assumption was not vital to the thesis, it has been deleted.

Changes in the manuscript: Citation from chapter “3.6 Initial investment costs”: “The coherence between those numbers can be taken as evidence that the cost calculation of Kökyar I is realistic, and that the costs of the past are transferrable to the present.” [following sentence deleted]

Comment 14: “Page 1684, line 4: What does “apparently satisfactory” means in economic terms? Define or clarify.”

Response: Comment adopted. The comment refers to chapter “4.1 The leasing system”, which gives a brief overview of the farming conditions of the leasers. The meaning of “apparently satisfactory” is repeated and explained in detail in chapter “4.3 The perspective of the farmers”. In response to the comment, we therefore could delete the queried sentence in chapter “4.1 The leasing system” without loss, thus preventing questions and misunderstandings.

Changes in the manuscript: Citation from chapter “4.1 The leasing system”: “[...] regular irrigation water supply and some technical advice in fruit production (socio-economic household survey 2012). [sentence deleted] The leasers, in return, have to pay a substantial lease and an irrigation water fee.”

Comment 15: “Page 1685, line 4: “Presently unknown” by the authors, somebody knows it in NW China, please clarify.”

Response: Comment adopted. The corresponding sentence has been rephrased.

Changes in the manuscript: Citation from chapter “4.1 The leasing system”. “The exact conditions under which the main tenants obtain land from the government have not been researched.”

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



Comment 16: “Page 1688 , last sentence : The words organisation and organisational do not match very well in the same sentence.”

Response: Comment adopted. The sentence has been rephrased.

Changes in the manuscript: Citation from chapter “4.4 The perspective of the governmental organisations”: “The state-owned Water Management Station and Forest Management Station as subsidiary bodies of the Aksu River Drainage Area Management Department and the Aksu Prefectural Forestry Department are the organisational backbone of the system.”

Comment 17: “Pages 1690, line 18: Mentioning an estimation of how much people work on the forest-orchard would help to understand your point about being a “prospering branch”.”

Response: Comment adopted. An estimation of the number of jobs created by the project has been added.

Changes in the manuscript: Citation from chapter “Yet, the invention of the orchard leasing system between the poplar shelterbelts gradually transformed it into a prospering branch of the local economy. The number of leasing households earning their livelihood in the orchards of Kökyar I can be estimated between 324 (Kökyar Annals Compilation Committee, 1996) and 454 (socio-economic household survey 2012). Extrapolated on the orchard area of Kökyar I, II, and III, these figures would allow an estimation of 1341 to 1880 farming households. In addition to these, a substantial number of jobs in the background organisation and in the poplar forests, and a smaller number of jobs for suppliers and commercial consumers can be assumed.”

Comment 18: “Pages 1691, line 1-2: This dangerous assumption does not hold, many developing and transition countries keep farming labour as an additional source of income and in kind income, so you cannot really assume that other activities substitute the labour spent on the farm, rather than complementing it. Please modify and justify

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



it in a proper way.”

Response: Comment not adopted. The comment is based on a misunderstanding of the queried section. From the perspective of cost-benefit analysis, human labour (and every other means of production), no matter if paid or unpaid, involves costs for the society. The reasoning is as follows: if the human labour (or other means of production) had not been deployed to the considered project, it would have been deployed to other sectors of economy, where it would have contributed to societal welfare. But since it has been withdrawn from those other sectors, it reduces the capability of these sectors of increasing societal welfare. This decrease of societal welfare (in other sectors) has to be attributed to the considered project as so-called opportunity costs. Of course, this is an assumption, but it is a valid assumption and a standard assumption in order to define the opportunity costs of a project. By the way, in the case of Kökyar, the farmland was created by the project, which means that the farmers were in fact withdrawn from other sectors of economy when they got settled in Kökyar.

Changes to the manuscript: None.

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