

## Response to RC1 Corinna Gall's comments

The study by Yulei Ma et al. deals with a very interesting topic, namely the influence of different combinations of grass species on runoff formation and soil erosion to derive effective grassland restoration strategies. For this purpose, surface runoff and sediment discharge were measured under natural rainfall over a period of four years for three different mixed-cultivated grasslands and one severely degraded meadow as a control. Furthermore, precipitation, soil and vegetation characteristics were recorded in order to determine the most important factors that additionally influence runoff and soil erosion.

Overall, the manuscript is in good order and comprehensibly written. However, the abstract as well as the results and discussion section should be revised with the following comments.

Response: We thank Corinna Gall for the positive comments about our manuscript and for constructive feedback and suggestions that will help refine our paper.

I would also like to suggest changing the title of the study, as the term "surface water conservation" is not clear and also not explained in the text.

Response: The words "surface water conservation" have been revised to "surface runoff maintenance" in the title.

### Abstract

In the present form of the abstract, the problem of the study is not clear and the presentation of the main results is also difficult for the reader to understand, as runoff reduction ratio and sediment concentration ratio are not common parameters in erosion research. Since these parameters will be explained later, I think it is acceptable to use them in the study, but in the abstract I would recommend presenting the results in a generally understandable way to increase the impact of the abstract.

Response: Thank you for your valuable suggestion. To avoid confusing the reader, we have replaced the words "runoff reduction ratio" with "average runoff depth" and "sediment concentration reduction ratio" with "soil loss per unit area", as shown in lines 29–32: "... the average runoff depth for *DE*, *PE*, *PD* and *SDM* were 0.47, 0.55, 0.45 and 0.27, ...".

Line 20: The term “maintain the stability of the hydrological cycle” is only once used in the abstract and never again in the study itself, which is confusing. Especially at the beginning of the abstract the meaning of this term is not clear.

Response: The words “the hydrological cycle” have been replaced with “the local runoff amount” in line **20**.

Line 22: Please clarify by adding “restoration strategies”.

Response: We have revised the word “restoration strategies” to “mixed-cultivated grasslands” and added the explanation of mixed-cultivated grasslands, as shown in lines **22-25**: “combining two grass species per plot (*Deschampsia cespitosa* and *Elymus nutans* (DE), ...”.

Line 26: What do you mean with “manage runoff” here?

Response: Large-scale vegetation restoration generally reduces local water yield and influences river ecosystem health. The Qinghai-Tibetan Plateau is the headwaters for many of Asia's major rivers. Hence, it is necessary to evaluate whether vegetation restoration maintains or undercuts the gains of downstream water resources. To avoid confusing the reader, the words “manage runoff” have been replaced with “maintain runoff” in line **28**.

## **Introduction**

The introduction is well structured, so that the objective of the study can be derived from the comprehensibly presented problems of alpine grassland ecosystems.

Response: Thank you so much for your kind encouragement.

Line 92: Remove one “the”.

Response: One “the” has been erased as shown in line **112**.

Line 97: Please add “soil characteristics” for clarification.

Response: The words “soil characteristics” have been added in line **117**.

Line 123: Please write out the abbreviations of the three mixed-cultivated grassland types in the introduction again. For example, “SDM” was never explained before in the text.

Response: We have added the explanation of the abbreviations of the three mixed-cultivated grassland types and *SDM*, as shown in lines **167–169**: “... *Deschampsia cespitosa* and *Elymus nutans* (*DE*), *Poa pratensis* *L.cv.* Qinghai and *Elymus nutans* (*PE*) ...”.

## **Materials and methods**

The methods section is very detailed and precisely written so that no questions remain unanswered.

Response: Thank you so much for your kind encouragement.

Line 147: Do you mean “epipedon” here? Also check the caption of Figure 1 (line 626 + 628); please also correct here “SEM”.

Response: This is a typo, the words “mattic epipedom” have been replaced with “mattic epipedon” in lines **195, 756** and **757**, as well as the word “*SEM*” having been replaced with “*SDM*”.

Line 148: Clarify the reference to Fig. 1b and Fig. 1c.

Response: Done. We have clarified the reference to Fig. 1b and Fig. 1c, as shown in lines **195–197**.

Line 150: Why is this value shown as a multiplication?

Response: This is a typo, and the value  $323.58 \times 106$  has been corrected to  $323.58 \times 10^6$  as shown in line **198**.

Line 161: Shouldn't the grass species reduce soil erosion and increase surface runoff? Please clarify.

Response: We have revised the sentence as shown in line **218**: “only be grazing-tolerant and good forage but also prevent soil loss and maintain surface runoff.”.

Line 241: Lower the bracket after “cm<sup>3</sup>”.

Response: We have done, as shown in line **304**.

Line 245: Remove “cohesion” one time.

Response: We have done, as shown in line **308**.

## Results

The presentation of the results in the figures is clear and comprehensible. However, the results in the text are partially generalized in comparison to the information in the figures. Here, attention should be paid to indicating in the text whether differences are significant or non-significant.

Response: Thank you for your valuable suggestion. We have revised the expression of the result section and stated in the text whether differences are significant or non-significant, such as in lines **350–367, 376, 386–388 and 394**.

In my perspective, there is also one important result of the study that has not yet been mentioned. I guess that you selected three different grass mixtures because you originally assumed that there would be differences in runoff and soil erosion due to their different structural properties, which you also described in your study. However, there were no measurable differences between the grass mixtures, which is also an important result that should be mentioned and discussed!

Response: Thank you for your valuable suggestion. We have added a description of differences between the grass mixtures in the **3.1 and 3.2 sections**, as shown in lines **364–365**: “No significant differences ( $P > 0.05$ ) were detected in runoff depth and soil ...”, in lines **386–388**: “The *SRB* values of *DE*, *PE* and *PD* in 2022 were significantly ( $P < 0.05$ ) higher than those of 2019, ...”, and in lines **308–310**: “No significant differences ( $P > 0.05$ ) observed in *RRB*, *SRB*, *CRB* ...”. Also, we have added a discussion about the difference in runoff and soil erosion of the three mixed-cultivated grasslands in the **4.2 section**, as shown in lines **466–479**: “The matching of morphological characteristics of plants can effectively reduce soil loss (Liu et al., 2022). In this study, ...”.

Line 272: Since increased runoff and reduced soil erosion is the desired outcome, a word other than "dramatically" would be more appropriate here.

Response: The word “dramatically” has been erased in line **348**.

Lines 279-281: According to Fig. 3b there is no significant difference between SDM and the grass-mixtures for 2019 regarding soil erosion and also in 2022 the differences in soil erosion are not significant between treatments. However, you can state a lower soil erosion for all treatments in 2022 compared to 2020, and for 2019 for the treatments PE and PD. Please be more precise here.

Response: We have revised the expression, as shown in lines **358–364** “As depicted in Fig. 3b, soil loss in *DE*, *PE* and *PD* (except for *DE* in 2019) was significantly ( $P < 0.05$ ) ...”.

Line 292-294: According to Fig. 4a this statement is true for the treatments DE and PE, but not PD. Please do not generalize the results for all treatments and be more precise.

Response: I am sorry maybe a misunderstanding exists. As shown in **Fig. 4a**, the mean *RRB* values of the cultivated-grassland communities *DE*, *PE*, and *PD* were -79.3%, -130.4% and -48.5% in 2019, -36.9%, -53.5% and -21.5% in 2020, and -115.4%, -156.1% and -87.6% in 2022, respectively. Hence, the increase rate of runoff in 2022 was significantly ( $P < 0.05$ ) higher than that in 2019 and 2020.

Line 301: According to Fig 4d the mean values of *RRSR* are somewhere between 50 and 0. Please make it clear what is meant here.

Response: I am sorry maybe a misunderstanding exists. The unit of the y-axis of **Fig. 4d** is in percentage (%). As shown in **Fig. 4d**, the mean *RRSR* values of the cultivated-grassland communities *DE*, *PE*, and *PD* were 30.3%, 29.5% and 22.8% in 2019, 20.0% 61.6%, and 62.0% in 2020, -26.0% -105.7%, and -132.2%, respectively.

Figure 1: Please correct the typos in the figure caption.

Response: We have corrected the typos in the caption of Figure 1. The words “mattic epipedom” have been replaced with “mattic epipedon” in lines **755** and **756**, as well as the word “*SEM*” has been replaced with “*SDM*”.

Figure 5: Please check that the technical terms in the figure correspond to those in the caption. Why are the median lines are missing in these boxplots? It would be better coordinated if the median values were also shown in this figure.

Response: We have revised the technical terms to match those in the figure and the caption, and added median lines in **Fig. 5**.

## **Discussion**

Consider to include a discussion about the missing difference in runoff and soil erosion of the three selected grassland mixtures. If this part is missing from the discussion, the question arises as to why three different grass mixtures were chosen in the first place.

Response: We have added a discussion about the difference in runoff and soil erosion of the three mixed-cultivated grasslands in the **4.2 section**, as shown in lines **466–479**: “The matching of morphological characteristics of plants can effectively reduce soil loss (Liu et al., 2022). In this study, ...”.

Line 372: What does the "more" refer to?

Response: To avoid confusing the reader, we have removed the word “more” in line **483**.

Lines 374-384: This part is more suitable for section 4.2 where you discuss the effects of grassland community characteristics on runoff and soil loss.

Response: We have moved this part to the 4.2 section, as shown in lines **466–479**.