Dear Authors,

both Referees, that I again thanks warmly for their precious support, are satisfied with your careful revision. Referees #2 has identified some remaining inconsistencies and points to be clarified: once you will have amended and clarified such points, we may proceed with the publication.

Best wishes,

Elena Toth

Response: Thank you for handing our submission and offering us an opportunity to revise it. We have addressed all the comments and provided details of all the changes made to the manuscript. We hope the revised manuscript is now acceptable to you.

The authors have satisfactorily addressed many of my concerns. However, a few areas still require further revision or clarification:

1. The terms “water scarcity” and “water stress” are sometimes used interchangeably, but they have distinct definitions in hydrological contexts. This can cause confusion in sections that discuss water withdrawal, availability, and the Water Stress Index (WSI). Ensure consistent use of these terms throughout the manuscript and provide clear definitions in the introduction or methods sections to avoid confusion.

Response: Thanks for your seriousness again. In the revised version, we provided clear definitions in the method section (see section 2.2). The water stress index (WSI), widely used to assess the water stress intensity, is defined as the ratio of water withdrawal to water availability (Equation 1). **A high WSI value in an area represents high water stress intensity, but not necessarily water scarcity. When the WSI is greater than 1 (WSI>1), water resources cannot sustain environmental or anthropogenic needs and a region is considered to experience water scarcity** (Veldkamp et al., 2017; He et al., 2021). **Water stress is more inclusive and broader concept (see Equations 3 and 4).** In addition to the severity of water stress (WSI), frequency and average duration of water scarcity were also used to describe historical water stress (Veldkamp et al., 2017). Correspondingly, these terms are used consistently throughout the manuscript.

2. In section 3.1, the manuscript discusses the percentage of the population experiencing

water scarcity, moving into or out of scarcity, and facing aggravated or alleviated conditions. The percentages of affected populations vary between sub-sections, and the terms "moving into" and "moving out of" water scarcity could be better defined. It would help to ensure that these terms are consistently used throughout the text to avoid confusion for readers who may struggle to follow the shifts between periods and population dynamics.

Response: Thanks for your comment. We have moved the content of Table 1 from the supporting material (Table S1) into the main text (Table 1), and the specific definitions are as follows.

Table 1. Definitions of different types of population exposed to water scarcity between two periods (WSI_f and WSI_l are WSI values in the former and latter periods, respectively.

WSI value	Classification
WSI_f <1 and WSI_l ≥1	Moving into water scarcity
WSI_f ≥1 and WSI_l <1	Moving out of water scarcity
WSI_f ≥1, WSI_l ≥1, and $WSI_l > WSI_f$	Aggravation of water scarcity
WSI_f ≥1, WSI_l ≥1, and $WSI_l < WSI_f$	Alleviation of water scarcity

3. There appear to be inconsistencies in section 3.3 regarding the projection of irrigation water use and its contribution to total water demand in the 2030s. The authors state that "regional total irrigation is projected to decrease by 13.3% in the 2030s compared to the recent two decades (P3)," indicating a notable reduction in irrigation water use. However, later, they report that "total water use in the 2030s is projected to be 34.2 km^3, with 56.2% (19.2 km^3) contributed by irrigation. These two statements are contradictory. A projected 13.3% decrease in irrigation water use should not result in irrigation contributing more than half of the total water demand. Clarification is needed on how the reduction in irrigation aligns with its large projected share of total water use. Please revise the figures or provide additional explanations to resolve this discrepancy.

Response: The two figures are not contradictory. The irrigation water withdrawal in the P3 is 22.1 km^3, which is projected to decrease by 13.3% to 19.2 km^3 in the 2030s, i.e., 22.1× (100-13.3)/100=19.2. However, due to the increase in industrial, urban, and domestic water use, the total mean annual water demand of different SSP is projected to be 34.2 km³ in 2030. The proportion of irrigation is 56.2%, i.e., 19.2/34.2×100%=56.2%.

4. In lines 470–480, the authors state that the future surface water deficit is projected to be 0.6–8.36 km³. However, when discussing irrigation efficiency improvements, they mentioned that the reduction in the surface water deficit would be 6.3 km³. It is unclear whether the 6.3 km³ represents the maximum possible reduction or if it is part of the 0.6–8.36 km³ range. Please clarify the relationship between these figures to ensure consistency in the results.

Response: The 6.3 km³ represents the net surface water deficit in the 2030s after accounting for improvements in irrigation water efficiency, assuming that the water needs of all sectors are fully met. To improve clarity, we have revised the sentence as follows. **When all sectoral water usages need to be fulfilled (8.36 km³), the possible improvement of irrigation efficiency in the future could solve 25% of the water deficit (2.06 km³), leading to a net surface water deficit of 6.3 km³.**

5. The study highlights the effects of vegetation restoration on water availability but does not sufficiently explain how this restoration interacts with other water management practices. In some places, the text suggests that vegetation restoration exacerbates water scarcity, while in others, it appears to be part of broader water-saving efforts. Clarifying the overall impact of restoration efforts in relation to other water-saving measures would enhance the consistency of the discussion.

Response: Previous studies have shown that the impact of vegetation restoration on water availability exhibits significant spatial heterogeneity. It decreases water resources in arid areas (measured as precipitation minus evapotranspiration) but increases water resources in humid regions (Feng et al., 2017; Zan et al., 2024). By scenario simulation, we estimated that vegetation restoration led to a 7.9% reduction in runoff in the YRB between 2001 and 2020, thereby exacerbating water stress. This result is expected, given that most of the YRB is classified as arid or semi-arid. Similar findings have been reported for this basin (Zhang et al., 2018), suggesting that local vegetation restoration efforts in some regions should be approached with caution to avoid increasing water stress in the YRB. In our future water stress assessment, we considered two aspects: reducing water demand (improvements in irrigation efficiency) and increasing water supply (water transfer projects). These measures have mitigated water stress to a certain extent, counteracting the effects of vegetation restoration.

References:

Feng, H., Zou, B., and Luo, J.: Coverage-dependent amplifiers of vegetation change on global water cycle dynamics, J. Hydrol., 550, 220-229, https://doi.org/10.1016/j.jhydrol.2017.04.056, 2017.

Zan, B., Ge, J., Mu, M., Sun, Q., Luo, X., and Wei, J.: Spatiotemporal inequality in land water availability amplified by global tree restoration, Nature Water, 2, 863-874, 10.1038/s44221-024-00296-5, 2024.

Zhang, S., Yang, Y., McVicar, T., and Yang, D.: An analytical solution for the impact of vegetation changes on hydrological partitioning within the Budyko framework, Water Resour. Res., 54, 10.1002/2017WR022028, 2018.