The following is the point-to-point response to all the comments. The page and line numbers in the following response refer to the revised manuscript with changes marked.

Response to Editor:

The manuscript has been improved after the revision. However, several points still require further revision, particularly concerning the equations and the interpretation of certain results.

Reply: Thank you very much for the positive evaluation. We have carefully addressed all the comments raised by the reviewers and revised the manuscript accordingly, especially the equations and interpretation of certain results.

Response to Anonymous Referee #2:

1. Comment:

Line 181: What is SOM? Soil Organic Matter?

Reply: Yes, SOM refers to soil organic matter. We have clarified this abbreviation in the revised manuscript (see Line 187).

2. Comment:

Lines 183-188: Which equations were used for the calculation of LS-factor? Usually, the LS - factor (in USLE or RUSLE) is calculated by means of equations.

Reply: We have added the equations used for the calculation of LS-factor (see Lines 191-194).

"The LS factor was calculated using the method developed by Böhner and Selige (2006) in SAGA-Analyses and modelling applications. The calculation is based on specific catchment area and slope angle:

$$LS = \begin{cases} \left(\frac{CA^{0.5}}{22.13}\right)^{0.5} \cdot (65.14\, sin^2 \beta_{CA} + 4.56\, sin\, \beta_{CA} + 0.065)\; for\; \beta_{CA} > 0.0505 \\ \left(\frac{CA^{0.5}}{22.13}\right)^{3 \cdot \beta_{CA}^{0.6}} \cdot (65.14\, sin^2 \beta_{CA} + 4.56\, sin\, \beta_{CA} + 0.065) \end{cases} \quad (4)$$

where CA (m^2) defined as the discharge contributing upslope area of each grid cell; β_{CA} ($m\ m^{-1}$) is the weighted mean slope angle of the upslope area."

3. Comment:

Equation (1): Is E the soil erosion rate per year? How was the erosion rate per month calculated?

Reply: We have revised Eq. (1) to explicitly distinguish monthly soil erosion from annual soil erosion (see Lines 169-174). Monthly erosion was calculated using monthly rainfall erosivity and monthly NDVI-derived *C* factor. Annual erosion was then obtained by summing the monthly values (see Line 174).

4. Comment:

Equation (2): Rday is the daily rainfall erosivity. However, according to Equation (2), Rday is expressed per year.

Reply: Thank you for pointing this out. We have corrected the unit of daily rainfall erosivity and clarified that monthly rainfall erosivity were obtained by summing daily erosivity values (see Lines 179-180).

5. Comment:

General question: The basic spatial unit for the application of RUSLE and the concept of Sediment Delivery Ratio (SDR) was the grid cell. Which is the difference between grid cell and Hydrologic Response Unit (HRU)?

Reply: In our model, a grid cell is a spatially explicit raster unit with a fixed geographic location and flow-path relationship, whereas an HRU is usually a lumped or semi-distributed unit that groups areas with similar land use, soil, and slope characteristics. The grid-cell-based framework is therefore more suitable for representing sediment connectivity, dam-controlled areas, and the upstream-to-downstream routing of cascading check dams (see Lines 259-262).

6. Comment:

See annotated manuscript for two secondary "editorial" errors!

Reply: Thank you for your careful check. We have corrected the two annotated editorial errors in the revised manuscript.

"Line 186: TOC (%) is the soil Total Organic Carbon content;
Lines 195-196: Total Catchment Area (TCA) in ASGA
Lines 198-199: the LS factor was calculated at 30-m DEM and then aggregated to the 100-m grid using average resampling for subsequent RUSLE calculations."

Response to Anonymous Referee #3:

General comments:

I have read both the original and the revised manuscript. The authors have responded carefully to the reviewers' comments and have substantially improved the manuscript. The revised version provides clearer descriptions of the RUSLE factors, NDVI harmonization, and uncertainty associated with sediment trapping efficiency. The revised figures and captions are also more informative. The main concerns raised in the previous round have been adequately addressed. I have only a few minor comments that should be considered before publication:

Reply: Thank you very much for the positive comments. We have carefully considered all remaining points and made further revisions, particularly regarding the definition of SRC_{dam}, the interpretation of model performance, the independence of NDVI evaluation, and the interpretation of Fig. 11. Please refer to the replies to the following comments.

1. Comment:

Equation (9) should be double checked. The current definition allows SRCdam to exceed 100%, as occurs in the Jialu River basin, and makes the term "sediment reduction contribution" difficult to interpret.

Reply: We thank you for this important comment. The original definition was intended to reflect the importance of sediment trapping by check dams relative to the actual sediment yield exported from the basin under real check-dam-regulated conditions.

However, we agree that this definition allows SRC_{dam} to exceed 100%, which makes the term "sediment reduction contribution" difficult to interpret. To make the index more intuitive and consistent with the term "sediment reduction contribution", we have revised its definition as the ratio of sediment trapped by check dams to the hypothetical SY without check-dam trapping (see Lines 313-316):

$$SRC_{dam} = \frac{SY_{noTrap} - SY_{Trap}}{SY_{noTrap}} \times 100\% \quad (9)$$

We have updated the relevant text (see Lines 24-27, 379-384, 435-436, and 519) and figures (Figures 8, 10, 11, and S10) in the revised manuscript.

2. The model-performance assessment does not appear to be independent. IC0 and KIC were optimized separately for each of the 17 sub-basins using the observed sediment-yield records, after which the same observations were used to report NSE and R2. These values therefore describe goodness of fit rather than predictive validation.

Reply: We have revised the wording in the manuscript and changed "model validation" to "goodness-of-fit" where appropriate (see Lines 290, 303, 330, and 343).

To provide an additional and more independent evaluation of the sediment trapping module, we further used field-surveyed sediment accumulation data for check dams from Fang et al. (2023) (see Lines 303-305 and 333-334).

"In addition, to independently assess the sediment trapping module, the simulated sediment accumulation was compared with field-surveyed sediment accumulation data from 61 check dams reported by Fang et al. (2023)."
"In addition, the simulated sediment trapping by check dams agreed well with the observations from field survey (NSE = 0.651, R2 = 0.75) (Fig. S3)."

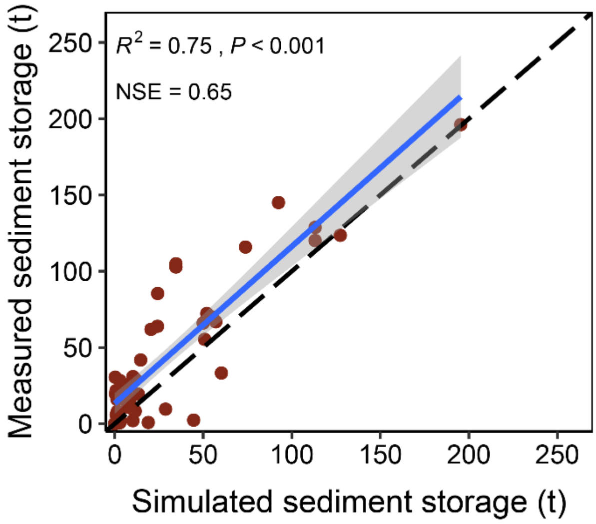

Figure S3. Comparison between simulated and measured sediment storage in check dams reported by Fang et al. (2023) (n=61). The dashed line indicates the 1:1 line, and the shaded area represents the 95% confidence interval of the fitted regression."

3. The newly added NDVI evaluation does not fully establish the reliability of the reconstructed pre-MODIS record. The correction was developed from the 2000–2015 overlap and appears to have been evaluated over the same period; the manuscript should state whether the reported r2, RMSE, and MAE are based on independent validation data.

Reply: We agree that the reported R^2, *RMSE*, and *MAE* should not be interpreted as independent validation statistics. The purpose of the NDVI correction in this study was to harmonize GIMMS-NDVI-3g with MOD13Q1 and construct a temporally consistent NDVI record for deriving the C factor. Therefore, the full overlapping period from February 2000 to December 2015 was used for correction to make full use of the available seasonal, interannual, and spatial variability (see Lines 133-136).

4. The interpretation of Figure 11 remains stronger than the analysis supports. A high SARdam combined with a low SRCdam does not by itself demonstrate that a basin has “insufficient” dams; it may also reflect dam age, reduced remaining capacity, high upstream sediment supply, construction history, maintenance, or spatial placement. Likewise, low SARdam relative to SRCdam is not sufficient evidence of excessive construction.

Reply: This is a good comment. We have therefore revised the relevant text and figure labels to avoid the terms “insufficient” and “overmuch” (see Lines 450-480, Figure 11). In the revised manuscript, the trade-off between SRC_{dam} and SAR_{dam} is interpreted as a diagnostic indicator of sediment reduction effectiveness and storage occupation, rather than direct evidence for the adequacy of check-dam numbers (see Lines 28-30, 450-480, and 524-527).

"We used the trade-off between SRC_{dam} and SAR_{dam} as a diagnostic indicator to compare sediment reduction effectiveness and storage occupation among sub-basins (Text S2). This comparison can provide useful information for the management of check dams. A

relatively high SAR_{dam} combined with a low SRC_{dam}, as observed in the Kuye River, Huangfuchuan River, and Jing River basins, indicates high storage pressure and limited current sediment reduction effectiveness (Fig. 11). This pattern may be associated with dam age, reduced remaining capacity, high upstream sediment supply, construction history, maintenance conditions, or spatial placement. Therefore, these sub-basins should be prioritized for further field assessment, capacity restoration, desilting, maintenance, or optimized dam placement. In contrast, the Fenchuan River basin showed relatively high SRC_{dam} but low SAR_{dam}, suggesting that check dams still have available storage capacity and maintain effective sediment reduction under current sediment supply conditions (Fig. 11). For these basins, future efforts may no longer need to focus on check dam construction. Instead, great emphasis should be placed on hillslope soil and water conservation measures, such as vegetation restoration.

Sub-basins with both high SRC_{dam} and high SAR_{dam}, such as the Jialu River basin (Fig. 11), indicate that check dams have contributed substantially to sediment reduction but have also consumed a large proportion of storage capacity, suggesting a need for maintenance and capacity restoration. In contrast, sub-basins with both low SRC_{dam} and low SAR_{dam}, such as the Fen River basin (Fig. 11), show limited sediment reduction effectiveness and low storage occupation, which may reflect low sediment supply, limited dam-controlled area, spatial mismatch between check dams and sediment source areas, or suboptimal dam placement. These patterns should therefore be used as diagnostic indicators for further field assessment and management optimization."