Quantitative assessment of check dam system impacts on catchment flood characteristics – a case in the Loess Plateau, China

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1. Introduction

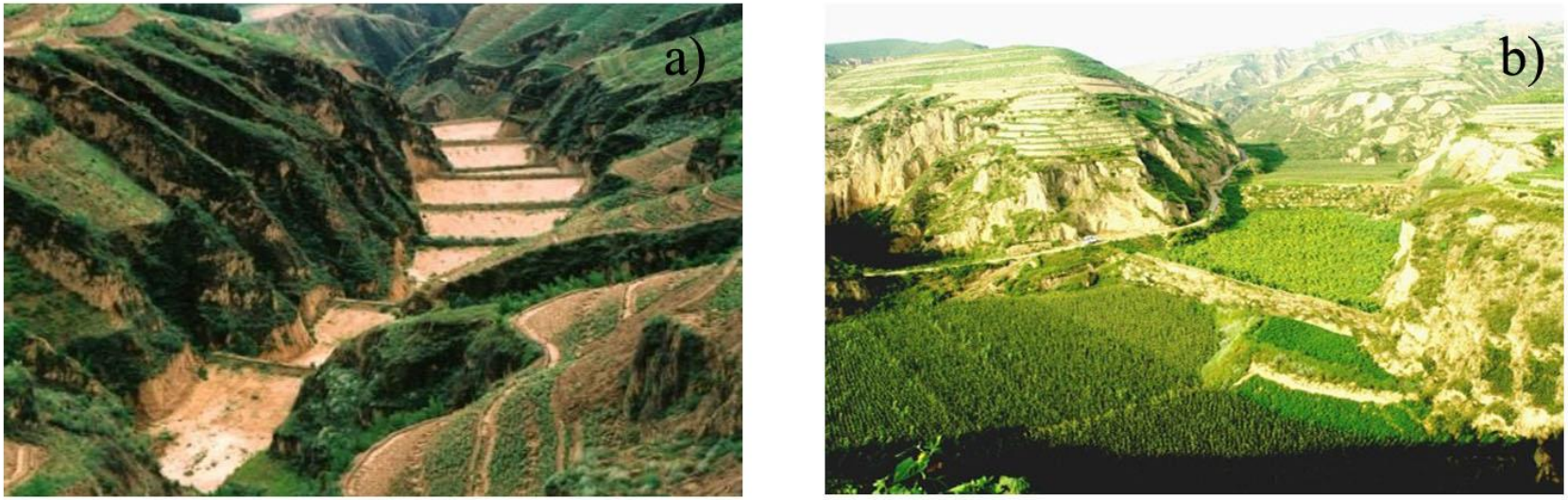

Figure.1 Water body storage (a) and formed check dam farmland (b) in front of check dams

Soil and water conservation (SWC) practices affect the water balance of a catchment by altering the major hydrological components. Check dams built across channels to reduce stream speed and trap sediment are considered to be one of the most effective engineering approaches toward sediment retention. Despite its extensive practices and environmental importance, particularly in arid and semi-arid regions, its effects on runoff characteristics are poorly understood in this region. Check dams may also impact the transfer of runoff from uplands to lower areas.

2. Flood simulation

Wangmaogou catchment

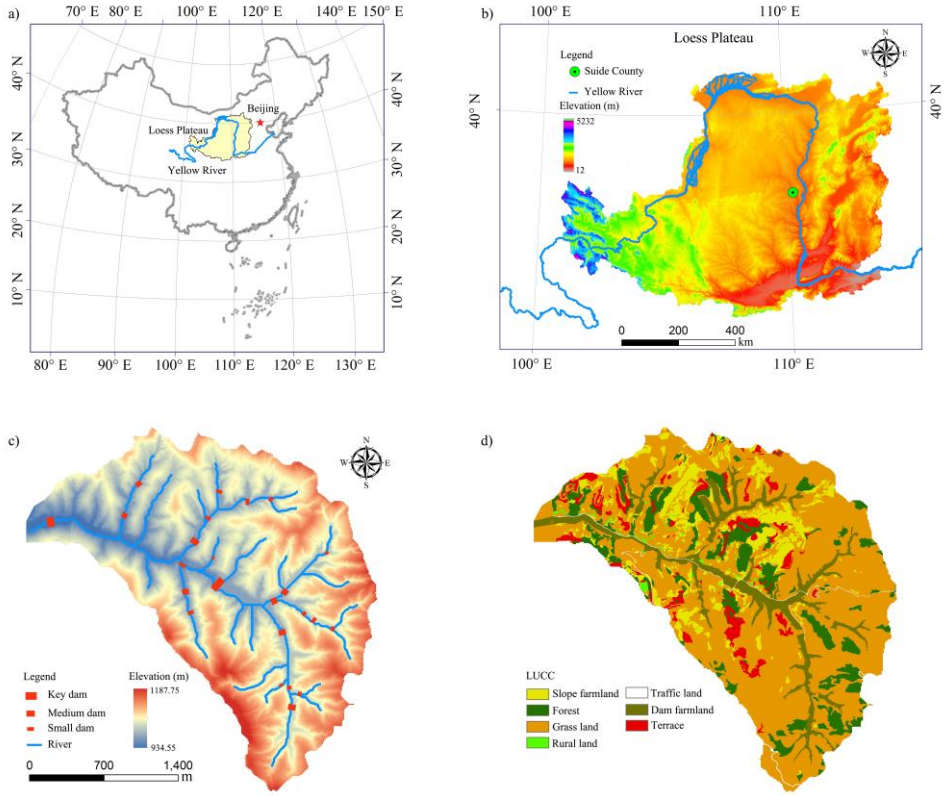

Figure 2: a) Loess Plateau of China; b) Location of Wangmaogou catchment; c) Distribution and elevation of check dams; d) Distribution of the seven lands use/cover types

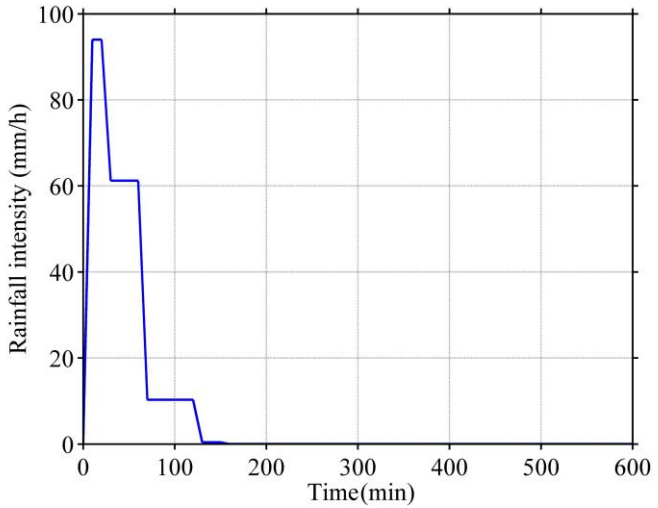

Figure 3: Hyetograph under consideration in the study area

Performance evaluation:

- Nash-Sutcliffe efficiency (NSE)
- Root mean square error (RMSE)
- Coefficient of determination R^2

2. Flood simulation

Model calibration

Sensitive parameters :

- **Infiltration rate**
- **Manning coefficient**

Reference

Range proposed by Li et al. (2007) and Engman (1986) under different LUCC

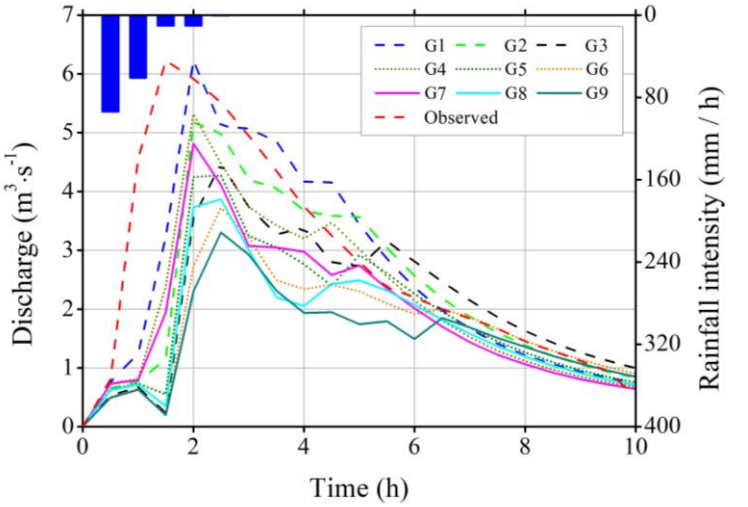

Figure.4 Hydrograph of observed and simulations

Parameters	Infiltration (mm/h)	Manning ($s/m^{1/3}$)
G1	Min.	Min.
G2	Min.	Med.
G3	Min.	Max.
G4	Med.	Min.
G5	Med.	Med.
G6	Med.	Max.
G7	Max.	Min.
G8	Max.	Med.
G9	Max.	Max.

Evaluation	*NSE*	R^2	*RMSE*
G1	0.68	0.7	1.03
G2	0.36	0.44	1.47
G3	0.09	0.24	1.75
G4	0.51	0.63	1.28
G5	0.16	0.38	1.68
G6	0.08	0.23	1.91
G7	0.38	0.6	1.45
G8	0.22	0.35	1.82
G9	0.02	0.23	2.03

3. Peak discharge and runoff volume

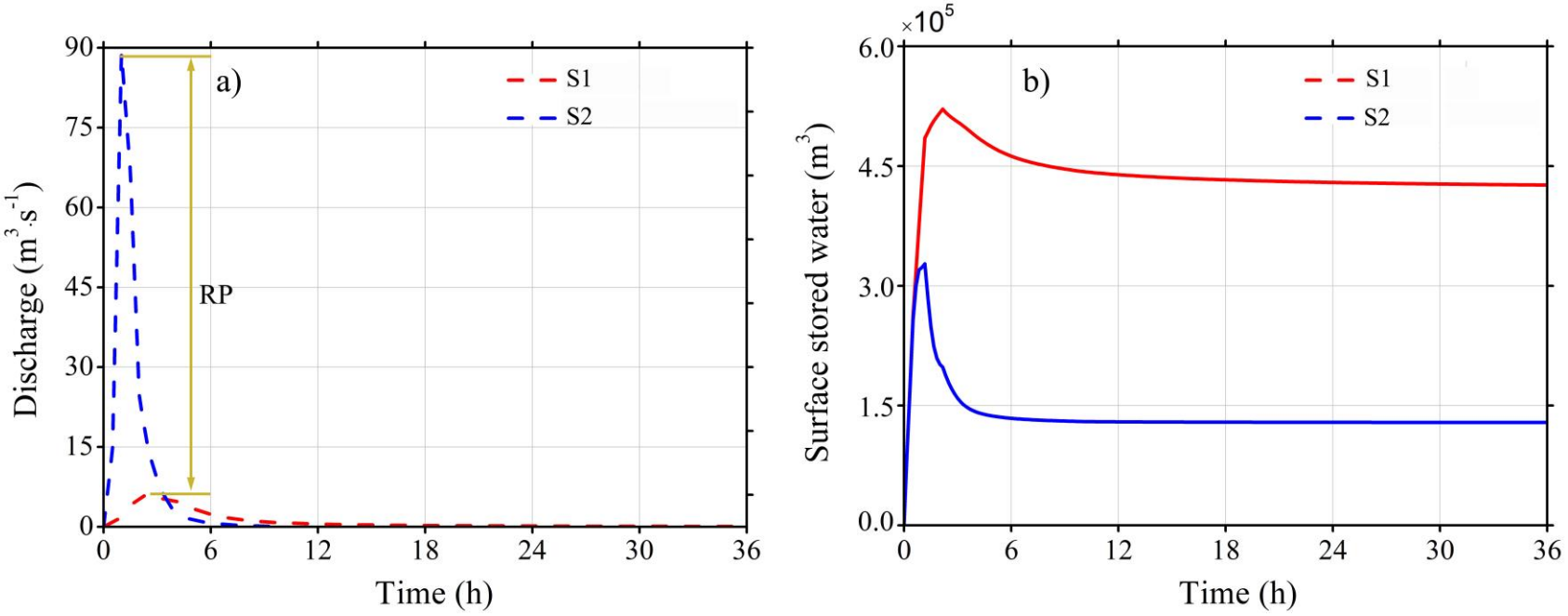

Figure 5: Comparison of peak discharge (a), and volume of surface stored water (b) between the catchments with (S1) and without (S2) check dams. Note: reduction peak discharge (RP)

- The peak runoff discharge at the catchment outlet without check dams decreased by 93.0% compared to with check dams.
- Installation of check dams also altered the spatial water distribution

4. Runoff lag times

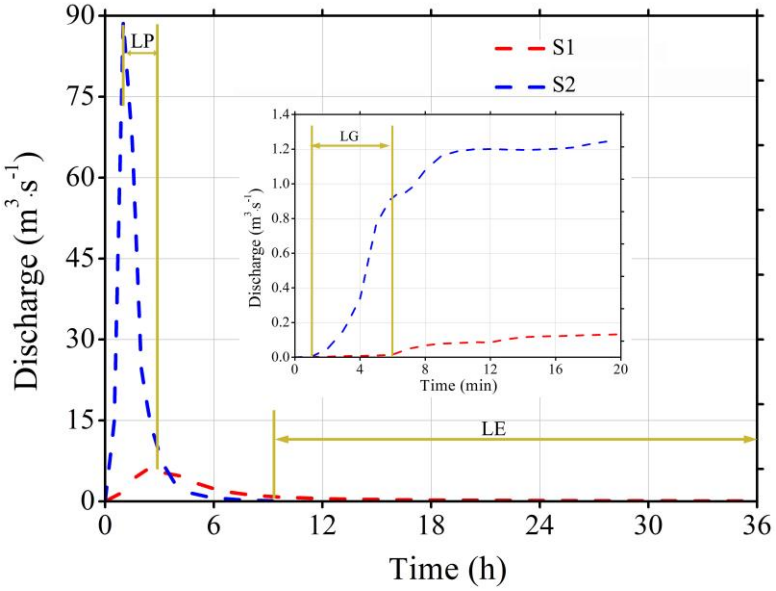

Figure 6: Comparison of outlet runoff times with and without check dams: the generation lag (LG), peak lag (LP) and end lag (LE)

Check dams significantly increase the so-called runoff lag times (lag to generation, lag to peak and lag to end of runoff) at the channel outlet compared to catchments without check dams.

5. Maximum discharge and location

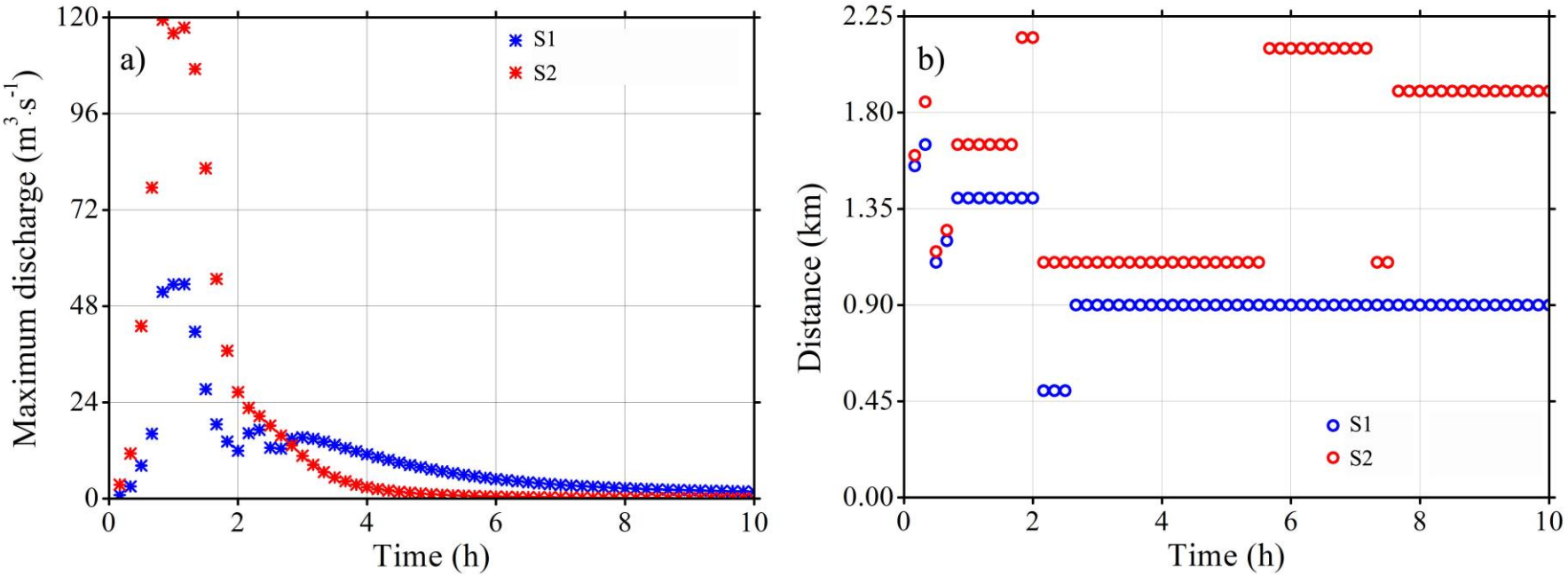

Figure 7: Distribution of maximum discharges (a) and the corresponding distance of occurrence (b) in catchments with and without check dams

The installation of the check dams changed the spatial distribution of peak flow locations as well, moving them considerably upstream and, thus, enabling higher safety downstream.

Thanks for your attention