water

Supplementary Materials

S1: The Erosion Rate, Sediment and Flow Rate of Shejiagou Catchment

Figure S1 was derived from Debasish et al. (2018). The erosion rate, sediment inflow to each gully, and the surface water flow were modelled by WATEM/SEDEM in Debasish et al. (2018). According to the simulation results, the headwater areas of the catchment and the gullies on the right side of the main channel contributed the largest amount of sediment and water discharge. The deployment strategies of check dams in our study referred to this simulation results.

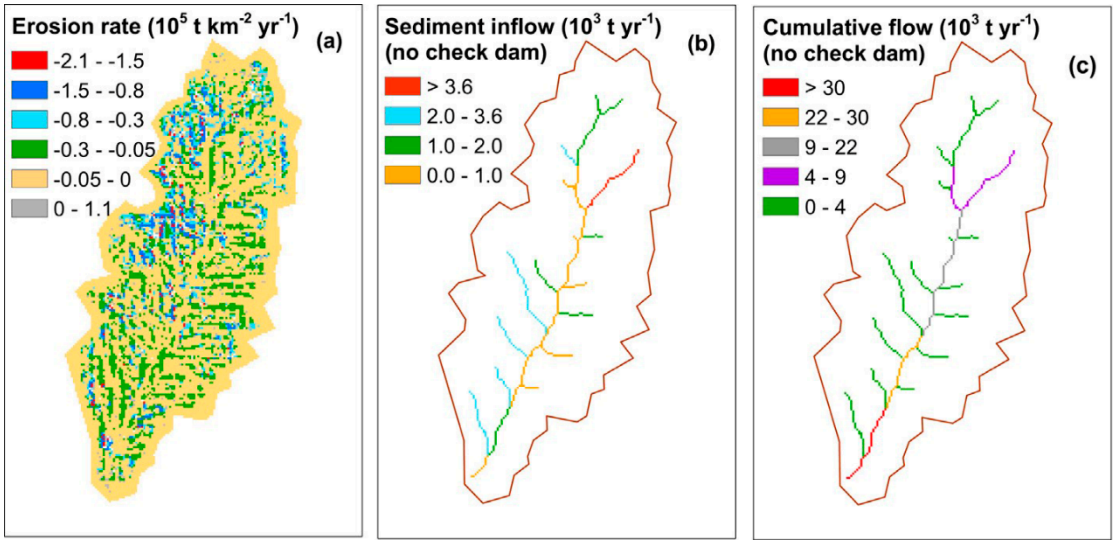

Figure S1. (**a**) Sediment erosion (negative value) and deposition (positive value) rates for Shejiagou catchment; (**b**) Sediment inflow to stream segments; (**c**) Cumulative flow without check dams (Debasish et al., 2018).

S2: Comparison of Open Check Dams and The Check Dams Studied in This Study

Open check dams (Figure S2) are widely used for flood attenuation in mountainous streams that experience torrents. They are mainly used as torrential barrier to trap bed-load and mitigate debris flow which could cause disaster to downstream areas (Figure S3). Therefore, the main purpose of open check dam is attenuate flood and trap large cobblestones carried by the debris flow. Sediment silting behind the open check dam is the result but not purpose.

Differently, check dams (Figure S4) in the Loess Plateau are constructed to trap eroded sediment carried by the floods and to use the sedimentary land as farm land, replacing the farmlands on the hillslopes. Many studies have reported that the farmlands on the hillslope cause serious soil erosion. Therefore, the main purpose of check dams in the Loess Plateau is to trap sediments.

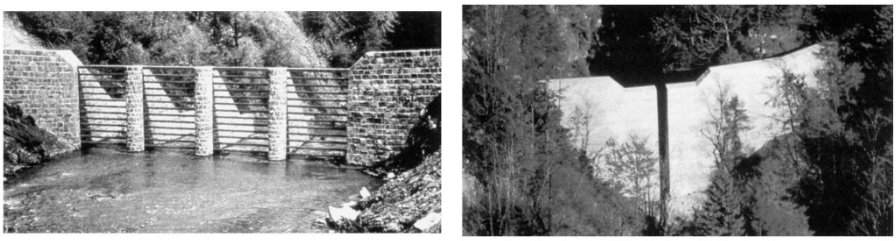

Figure S2. Open check dams. Beam dam (left), silt dam (right). Derived from Armanini and Larcher (2001).

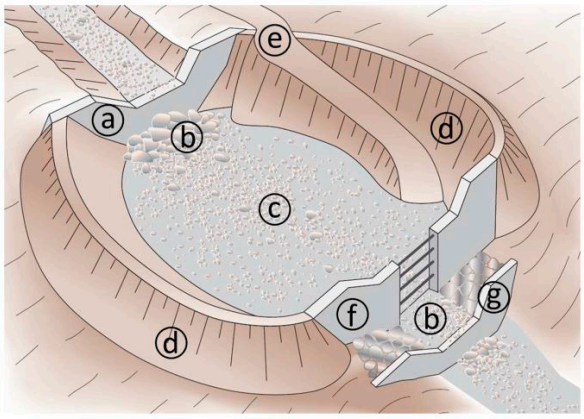

Figure S3. Characteristic components of a sediment trap with an open check dam: (a) inlet structure: solid body dam; (b) scour protection; (c) basin; (d) lateral dikes; (e) maintenance access; (f) open check dam; (g) counter dam. Derived from Piton and Recking (2015).

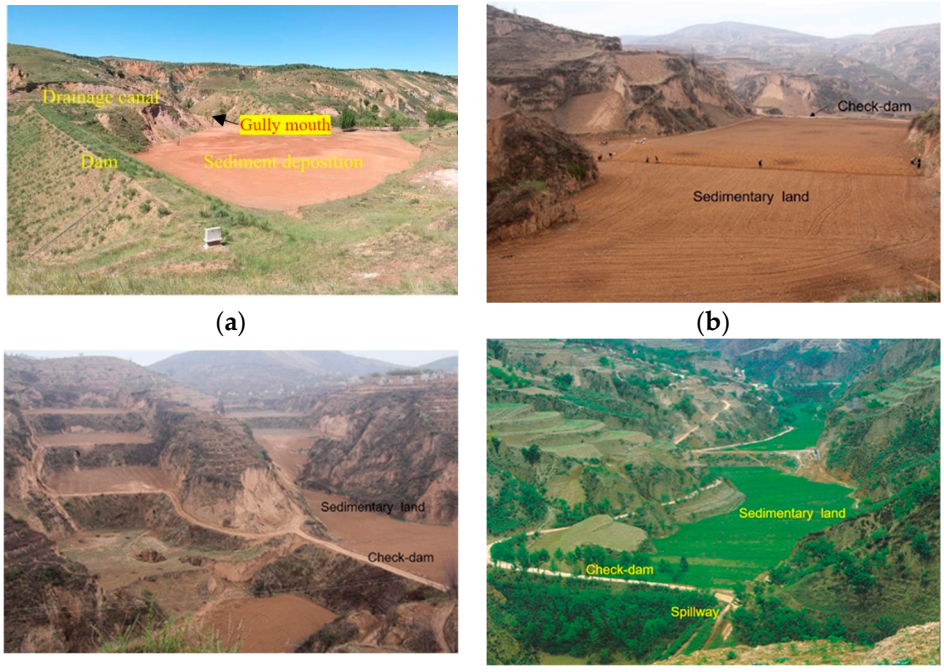

Figure S4. Examples of check dams in the Loess Plateau. (**a**) check dam LDG-1 in Liudaogou catchment; (**b**) check dam MDZ-1 in Wangmaogou catchment; (**c**) check dam NYG-2 in Nianyangou catchment; (**d**) check dams system in Shejiagou catchment.

There are mainly three limitations to applying open check dams in the Loess Plateau catchment to reduce sediment output:

(1) The sediment reduction rate is low for open check dam, compared to the check dam (without open outlet) because the sediment carried by floods (usually defined as hyperconcentrated flow) in the Loess Plateau is suspended load with high sediment concentration.

(2) The construction materials of the dam body for open check dams are usually stone or concrete, which increase the construction expense in the hilly-gullied Loess Plateau

catchment. Instead, check dams in the Loess Plateau catchment are usually gravity dam constructed by the local earth using materials from the nearby hillslopes, which largely reduces the construction expense.

(3) As mentioned above, open check dams require more frequent maintenance to make sure the outlet is not blocked.

In the Loess Plateau there are also some large check dams slightly similar to the open check dams. These large check dams are constructed by concrete and have complete discharge structures such as spillway, vertical shaft and lying pipe. However, these discharge structures are mainly functioning when the water depth behind the check dam above a threshold to prevent flood overtopping.