**Supplemental file 4 (SF 4):**

**Table S2** Key parameters used in the current study

|  |  |  |
| --- | --- | --- |
| Parameters | Description | Computation |
| $$ω\_{i}$$ | A non-physical parameter that characterizes the natural climatic-soil properties | $ω\_{i}=Z\frac{AWC\_{i}}{P\_{i}}+1.25$, $Z$ is an seasonality constant that captures the local precipitation pattern and hydrogeological characteristics, ranging from 1 to 30;$ AWC\_{i}$ (mm) is the volumetric plant available water content; the 1.25 term is the minimum value of $ω\_{i}$ ; $P\_{i}$ (mm/yr) is the annual precipitation for pixel $i$ |
| $$Z$$ | An empirical constant that captures the local precipitation pattern and hydrogeological characteristics | Estimated as $0.2×N$, $N$ where is the average number of rain days (>1mm) per year over the study period (Donohue et al., 2012) |
| $$AWC\_{i}$$ | The volumetric plant available water content | $AWC\_{i}=min(rest\\_layer\\_depth, root\\_depth)×PAWC$,$PAWC$ (mm) is the plant available water capacity; root restricting layer depth is the soil depth at which root penetration is inhibited because of physical or chemical characteristics; vegetation rooting depth is given as the depth at which 95% of a vegetation type’s root biomass occurs |
| $$k\_{ij}$$ | Evapotranspiration coefficient for each pixel | Defined according to literatures (Wang et al. 2016) and the InVEST user’s guide (Sharp et al. 2016) |
| $$RPI\_{i}$$ | The runoff potential index for each pixel | $RPI\_{i}=\frac{RP\_{i}}{RP\_{a}}$ ,$RP\_{i}$ is the nutrient runoff proxy for runoff on pixel $i$ , and $RP\_{a}$ is the average $RP$ over the raster |
| $$eff\\_n$$$$eff\\_p$$ | The maximum retention efficiency of nitrogen and phosphorus for each LULC, varying between 0 and 1. | Defined according to the literature data and the InVEST user’s guide (Sharp et al. 2016) |
| $IC$ for NDR model | The index of connectivity | $IC=log\_{10}( \frac{D\_{up}}{D\_{dn}} )$,$D\_{up}=\overbar{S}\sqrt{A}, D\_{dn}=\sum\_{i}^{}\frac{d\_{i}}{S\_{i}}$,$\overbar{S}$ (m/m) is the average slope gradient of the upslope contributing area and $A$ (m2) is the upslope contributing area, $d\_{i}$ (m) is the length of the flow path along the pixel $i$ |
| $$usle\_{i}$$ | The amount of annual soil loss on each pixel | $usle\_{i}=R\_{i}×K\_{i}×LS\_{i}×C\_{i}×P\_{i}$ ,where,$R\_{i}$(MJ·mm·(ha·hr)-1) is the rainfall erosivity, $K\_{i}$(ton·ha·hr·(MJ·ha·mm)-1) is the soil erodibility, $LS\_{i}$ is the slope length-gradient factor, $C\_{i}$ is the crop-management factor, and $P\_{i}$ is the support practice factor |
| $IC$ for SDR model | The index of connectivity | $IC=log\_{10}( \frac{D\_{up}}{D\_{dn}} )$ , $D\_{up}$ is the upslope component defined as: $D\_{up}=\overbar{C}\overbar{S}\sqrt{A}$ ,where, $ \overbar{C}$ is the average $C$ factor of the upslope contributing area, $\overbar{S}$(m/m) is the average slope gradient of the upslope contributing area and $A$ (m2) is the upslope contributing areaand, $D\_{dn}$ is the downslope component defined as: $D\_{dn}=\sum\_{i}^{}\frac{d\_{i}}{C\_{i}S\_{i}}$ , where $C\_{i}$ and $S\_{i}$ are the $C$ factor and the slope gradient on pixel $i$, $d\_{i}$(m) is the length of the flow path along the pixel $i$ |
| $$SDR\_{max}$$ | The maximum theoretical *SDR* | Defined as 0.8 according to the InVEST user’s guide |