FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: SOIL EROSION

Reference 9

Chen J., Xiao H., Li Z., Liu C., Ning K., Tang C. 2020 How effective are soil and water conservation measures (SWCMs) in reducing soil and water losses in the red soil hilly region of China? A meta-analysis of field plot data Science of The Total Environment 735, 139517 10.1016/j.scitotenv.2020.139517

Background and objective

Anthropogenic pressure coupled with high rainfall and diverse heterogeneous landscapes (e.g., land use and topography) has resulted in severe water erosion in the red soil hilly region (RSHR) of China. Soil and water conservation measures (SWCMs) have been extensively implemented, and their effects on runoff and sediment control have been widely tested at plot scales. However, it is difficult to gain an overview of the efficiency of SWCMs due to the difficulty of directly upscaling field observations to regional scales. The specific objectives of the present study are as follows: (i) to quantify the effects of different types of SWCMs and the combined effects of these measures in reducing runoff and sediment; (ii) to identify the most effective SWCMs in the RSHR; and (iii) to explore the benefit tradeoffs relationship between runoff reduction and soil conservation.

Search strategy and selection criteria

We conducted a review of studies, including journal articles and academic dissertations, obtained through Web of Science (WOS) and the Chinese National Knowledge Infrastructure (CNKI) conducted at plot scales in the RSHR of China for all years, up to December 2018. The search terms were as follows: "soil and water conservation" or "soil retention" or "soil and water loss" or "runoff" or "erosion" or "sediment" and "China". We refined our search results using the keywords "red soil" or "subtropical" or "granite". Additionally, references cited in searched studies were considered as well. (i) plots were observed under natural rainfall conditions and located in the RSHR of China; (ii) the same response variables, including at least one soil loss or erosion rate or runoff depth or runoff coefficient, were compared between plots with SWCMs and plots without SWCMs; (iii) one of the factors was recorded associated with plots, such as location, precipitation, field area, slope length, slope gradient, land use, soil properties and monitoring period; (iv) the number of replications, mean values, standard deviations or standard errors of plots with SWCMs and plots without SWCMs were reported; (v) at least two data pairs were contained in each group (a plot with SWCMs and a plot without SWCMs); (vi) identical plot data reported in different articles were included only once. The duration of observations of study plots ranged from 1 to 15 years, but most studies were conducted for <5 years (approximately 82%). Slope gradients varied from 2.7° (4.7%) to 30° (57.7%), with the largest number within a range of 10° (17.6%) to 15° (26.8%) (Fig. 2c). These field plots investigations were conducted on relatively steep slopes (mean = 14.26° (25.4%), SD = 5.48° (9.6%), N = 431) compared to the standard RUSLE plot gradient of 5.1° (9%).

Data and analysis

The mean effect sizes were calculated using a random-effects model with restricted maximum likelihood method (Chen et al., 2017). The 95% confidential intervals (CI) were calculated with a bootstrapping approach (a method for estimating population by re-sampling samples) and presented for forest plots. A negative effect size (LRR < 0) indicates a reduction in runoff or sediment as a result of SWCMs implementation. When the CI crosses the Y-axis (an invalid line including zero), the effectiveness of SWCMs was regarded as not significant. To further analyze the efficiency of different SWCMs, the LRR and CI were transformed to percentage decline using (1 – exp (LRR)) × 100

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
106	Plots distributed across 53 sites in seven provinces and one autonomous region, covering most areas of the red soil hilly region (RSHR), located in a subtropical monsoon climate. It is the most important strategic agricultural and economic region in China.	cover crop (Cc), grass cover (Gr)	no cover	Metric: 1) Runoff; 2) Soil loss; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- Cover crop had significant ($p < 0.05$) reduction effect on runoff, approximately 29%. Grass cover had significant ($p < 0.05$) reduction effect on runoff.
- Cover crops (49% reduction of soil loss) and grass cover had a significant reduction effect with respect to soil loss ($p < 0.05$).
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Cover crops and grass cover had significant reduction effect with respect to both runoff and soil loss ($p < 0.05$).