



Scale effects on post-fire runoff and soil erosion and their mitigation with forest residue mulching

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Wildfires can have striking direct and indirect impacts on soils, including extreme runoff-erosion responses with serious negative consequences for land-use sustainability and downstream values-at-risk. Arguably, the best manner to reduce post-fire soil erosion consists of rapid application of a protective layer of “mulch”, comprising straw, needles or wood-based materials.

In this study, we assessed the efficacy of forest residue mulching for reducing runoff and soil erosion across two spatial scales, i.e. micro-plots of approximately 0.25 m² vs. slope-scale plots of roughly 100 m². We did so for a eucalypt plantation in north-central Portugal during the first two years following a moderate severity fire. We also tried to analyse which were the key factors underlying the erosive observed at untreated plots, with a special focus on soil moisture content and soil water repellency frequency.

Forest residue mulch reduced post-fire runoff by around 50% and post-fire soil losses by about 90% at both plot scales. However, runoff was 10 times higher at the scale of the micro- than slope-scale plots. By contrast, soil erosion was “only” two times higher at the micro- than slope-scale plots. The main factor explaining runoff was rainfall intensity, while the main factor accounting for soil erosion was ground cover. Both soil moisture and soil water repellency played a secondary role in explaining the post-fire hydrologic response. This reflected the fact that neither of both factors differed markedly between the mulched and control conditions. Our results indicated that forest residue mulch was first and foremost an effective method due to the fact that it substantially increased ground cover.