Using tracer-based sediment budgets to quantify erosion and deposition within harvested forests in south-east NSW, Australia

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The total impact of forest operations on the store of soil material within harvested coupes can be difficult to quantify. A study was recently undertaken in a small (~12 ha) basin near Bombala, south-east NSW to measure both the net amount of soil erosion from the basin, and the redistribution of eroded soils and sediments within it. The dry sclerophyll study area was divided into several distinct elements: log landings, snig tacks, general harvest area (GHA), cross banks, and the filter strip of native vegetation left adjacent to the major streamline. Measurements of two radionuclide tracers (^{137}Cs and ^{210}Pb-excess) in each of these locations were then integrated into budgets describing the movement of soil within and between the various landscape elements. The ^{137}Cs budget showed that no net loss of soil material had occurred from within the study area, with retention of 109 ± 14 %. Conversely, the ^{210}Pb-excess budget showed a total retention of 78 ± 12 %. The deficit of ^{210}Pb compared to that of ^{137}Cs was explained by a combination of analytical and sampling uncertainties, losses of ^{210}Pb associated with combustion and/or transport of litter and organic matter from the site, and some small loss of surface soil (to a depth of 2 mm). However, no evidence of surface-derived topsoil material was found in sediments currently being transported from the site. Both tracer budgets showed that a net loss of soil from the snig tracks and log landings had occurred. This was quantified to be 28 ± 13 mm and 48 ± 29 mm depth from these land forms respectively. Up to 30 % of this loss could be directly attributable to the creation of the cross banks by bulldozer blading. The remainder was associated with mechanical losses due to export on truck tyres and bark, dust during the dry summer harvesting phase, and losses associated with sheet and rill erosion during storm events over the intervening years. Soil material eroded from the log landings was accounted for within the cross banks, GHA, and buffer strip. Similarly the soil material eroded from the snig tracks was accounted for within the cross banks, GHA, and the buffer strip. The GHA was found to be a net trap of soil and sediment from the ^{137}Cs budget, although the ^{210}Pb budget suggested that this may be offset by a loss of organics and litter. The tracer values also suggested that the filter strip had preferentially trapped fine-grained material in preference to coarser grains. Of the total activity of ^{137}Cs removed from the snig tracks, about 20 ± 10 % was incorporated within the cross banks, 32 ± 4 % within the filter strips, and the remainder, 48 ± 7 %, within the GHA. This suggests that the current system of spreading flow from high-compaction areas (such as the snig tracks and log landings) onto the low-compaction area of the GHA, was effective in retaining soil and sediment within the study area. In this regard it is clear that careful placement of the cross banks and the maintenance of high soil infiltrability and surface roughness within the GHA and filter strip areas remains critical.