Sediment dynamics assessed at catchment scale using nuclear techniques with the support of Geographical Information Systems

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The Rainbow Smelt (*Osmerus mordax*) population of the 217 km^2 Boyer River watershed located on the right bank of the St. Lawrence River (Canada, Quebec), gradually declined and completely disappeared in the beginning of the 1980's due to water eutrophication and excessive siltation in the spawning area. Water erosion, is the principal vector of non-point source pollution and constitute the main way of conveying sediments and agricultural nutrients towards hydrosystems, leading to water quality degradation.

The study's objectives were to quantify the soil and sediment loss from agricultural fields, to map and identify the areas at risk in the watershed using the ^{137}Cs technique with the support of Geographical Information Systems (GIS).

Using GIS, the Boyer River watershed was divided into 6 isosectors presenting specific soil/slope/land use combinations. A minimum of three representative agricultural fields were sampled for ^{137}Cs determination in each isosector. A total of 412 points were sampled in 24 representative cultivated fields. For each field, based on the ^{137}Cs results, a sediment budget (eroded, stable and deposition areas) was produced using the SURFER 8 package and the data of the individual fields were extrapolated to isosectors and to the whole cultivated area of the watershed.

The initial ^{137}Cs fallout of fourteen forested sites ranged from 1622 to 3697 Bq m^{-2} with an average value of 2780 $\pm$ 300 Bq m^{-2} with a coefficient of variation of 21 %.

Data from the 24 sampled fields revealed that net sediment output of fields under short crop rotation is almost three times higher than that of fields under long crop rotation.

The net sediment production for the Boyer River catchment was estimated at 2.8 t ha^{-1} yr^{-1}. This represents an annual export of around 60 000 tons of material from the watershed towards the St. Lawrence River. 28% of the cultivated lands of the Boyer River watershed experienced an erosion rate higher than 6 t ha^{-1} yr^{-1}, the suggested soil loss tolerance level for most Canadian soils. Another 45% of the cultivated area was near this limit. The isosectors loams with slopes higher than 2% generated the highest sediment rate (6.9 t ha^{-1} yr^{-1}) and nearly 40% of the global sediment production, and sandy loams with slopes lower or higher than 2% are the most vulnerable and degraded area.

The quantitative and qualitative degradation of the soil and water resources of the Boyer River watershed are directly linked with intensive and specialized agricultural developments. This study shows that it is possible, through a sampling strategy using GIS, to use ^{137}Cs measurements to estimate sediment budget at the scale of a 217 km^2 watershed.

Keywords: Boyer River watershed (Canada), water erosion, nuclear techniques, GIS, isosectors, net sediment production.Please fill in your abstract text.