Assessment of Soil Erosion Using Caesium –137 on Cultivated Fields Following Natural Forest Conversion in the Kefa Zone of Southwest Ethiopia

MEKURIA ARGAW1, PAUL L. G. VLEK1, SOOJIN PARK2

1Centre for Development Research (ZEF), University of Bonn, Ecology and Natural Resource Management, Germany
2Seoul National University, Department of Geography, Shilim-dong, Kwanak - Gu, The Republic of Korea

Abstract

Soil erosion is a prime cause of loss of productivity of land. Decline in land productivity in most cases triggers the conversion of natural forests into agricultural land. The severe soil erosion in the highlands of Ethiopia is believed to be a result of agricultural conversion. The process of natural forest conversion is a growing phenomenon in the southwest region of Ethiopia. This study was aimed at assessing the magnitude and rate of soil erosion in a 24 km² sub-catchment in the Kefa zone of southwest Ethiopia, using the 137Cs technique. A chronosequence of continuously cultivated fields of 2, 6, 12, 16, 20, 24 and 58 years after conversion were studied. A reference inventory of 2026 ± 176 Bq m⁻² with a coefficient of variation of 24.6 % was recorded indicating the applicability of the technique in the region. Although weak, the distribution of the 137Cs inventories in the studied fields showed a declining trend (R²=0.2) with increasing years of continuous cultivation after conversion. The values of the younger and older fields were 1994 Bq m⁻² and 1164 Bq m⁻² respectively, indicating the greater extent of soil erosion in the older fields than in the younger fields. Estimated erosion rates using the Proportional Model (PM) and Mass Balance Model 1 (MBM1) also showed an increasing trend (R²=0.41) with increasing years of cultivation. Soil erosion rates in the cultivated fields ranged between 1 t ha⁻¹ yr⁻¹ in the younger field and 24.7 t ha⁻¹ yr⁻¹ in the older field. Erosion rate estimates for the sub-catchment were 11.6 t ha⁻¹ yr⁻¹ and 17.3 t ha⁻¹ yr⁻¹ by the PM and MBM1, respectively. An estimate made by using the Universal Soil Loss Equation (USLE) yielded 12.3 t ha⁻¹ yr⁻¹ validating the results by the prediction models and the applicability of the technique for soil erosion studies in Ethiopia. The results of this study showed that soil erosion in Kefa zone is on the verge of surpassing the tolerable level and it should of an immediate concern by conservationists and development planners at all levels.

Keywords: Caesium-137, Ethiopia, forest conversion, Mass Balance Model 1, Proportional Model, soil erosion

Contact Address: Mekuria Argaw, Centre for Development Research (ZEF), University of Bonn, Ecology and Natural Resource Management, Walter-Flex-Straße 3, D53113 Bonn, Germany, e-mail: margawd@uni-bonn.de