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Costs of Nutrient Losses in Priceless Soils Eroded From the Highlands of Northwestern Ethiopia

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Soils formation is a geomorphic process that takes place through the interaction of soil forming factors in several hundreds and thousands of years. However, land degradation and soil erosion is consistently taking place in the horn of Africa washing away this priceless product in short period of time. The scale of the problem dramatically increased due to the increase in deforestation, overgrazing, over-cultivation, inappropriate farming practices, and increasing human population. Several research results were published in the region showing the extent of land degradation and soil loss. However, little attempt has been done to estimate the nutrient loss in monitory terms which made it difficult for policy makers to properly understand the extent of the problem. A study was, therefore, conducted in 2011 to estimate soil and nutrient losses caused by water erosion and predict nutrient replacement costs on different land use types and slope classes at Harfetay watershed, Northwestern Ethiopia. The revised soil loss equation (RUSLE) was used to estimate the soil loss from the different land uses and slope classes in watershed. Moreover, nutrient loss from similar units was calculated by multiplying the in situ nutrient concentration of soil samples by the estimated soil loss using RUSLE. The replacement costs of nutrient losses were calculated by multiplying the nutrient loss with the price of available nutrients in urea and diammonium phosphate. The estimate of the RUSLE indicated that the average soil losses in the study watershed were 119 tons ha-1 year-1 for non-conserved crop land, 23 tons for conserved farmlands, 23 tons for forest and shrub lands, 19 tons for grazing lands, and 6 tons for plantation forest. The mean soil loss for lower slope classes (<15%), middle slope classes (15-30%) and upper slope classes (>30%) were 30.11, 48.09 and 57.22 tons ha-1 year-1, respectively. The highest losses of total nitrogen (154.7 kg ha-1 year-1), available phosphorus (1.84 kg ha-1 year-1), and organic matter (1677.9 kg ha-1 year-1) were obtained from non-conserved cropland. Conversely, the lowest values of the same parameters were registered from the land covered with plantation forest. Comparing slope classes for non conserved cropland, organic matter and nutrient losses were higher in upper slope classes followed by middle and lower ones. The replacement cost of available N and available P for non-conserved cropland, conserved cropland, forest/shrub lands, grazing lands and plantations were 121, 36, 27, 32 and 13 Birr ha-1 year-1, respectively (1USD = 19 Birr); and the weighted mean replacement cost in the watershed was estimated to be 98 Birr ha-1 year-1 which is about 20% of the cost of fertilizer applied per individual farmers in the watershed. From the study it was possible to conclude that conversion of forest lands and plantation forests to cropland causes serious soil and nutrient losses. Construction of conservation structures on cropland, however, will reduce soil and nutrient losses. To halt soil and nutrient loss and ensure sustainable land management and agricultural development in the Harfetay watershed and similar watersheds, policy and development interventions including increasing awareness of farmers on of soil and nutrient losses, enforcing land use policies and expanding bio-physical soil conservation practices are required.