Modeling agricultural interventions from farm-scale to landscape: The case for the Agricultural Policy/Environmental eXtender (APEX) tool in Northern Tanzania

F. Kizito[1]*; J. Kihara[1]; G. Sikumba[2]; M. Bekunda[3]; B. Lukuyu[2]; Lyimo S.D[4]; L. Yangole[4].

[1]International Center for Tropical Agriculture (CIAT);
[2]International Livestock Research Institute (ILRI);
[3]International Institute of Tropical Agriculture (IITA).
[4]Selian Agricultural Research Institute (SARI)

* Corresponding author: F. Kizito, F.Kizito@cgiar.org

Abstract

Evaluation of agricultural interventions at the farm level is important in order to scale viable interventions that benefit smallholder farmers within the landscape. It also allows for more effective agricultural policies that can be applied at scale. The Agricultural Policy/Environmental eXtender (APEX) model was applied to two farms in Seloto Village of Tanzania and subsequently to the watershed level. Using a calibrated and validated APEX model, the simulation of two conservation practices, specifically contours on sloping farm fields and forages grasses in farming systems (single and combined), was conducted at the field scale on two farms. Four variables [runoff, sediment, soil moisture storage and crop yield], were compared between field data collected over three years and the simulated practices. The field-scale outputs were then extrapolated to the areas encompassed by the different conservation practices at the watershed scale. In addition, we simulated how the field interventions would perform if they were hypothetically scaled within the landscape. The speculative estimations are presented as percentage reductions compared to the baseline scenario. When single conservation practices were implemented, reductions were 25% for runoff, 35% for sediment and 20% increment for soil moisture storage. In contrast, runoff losses increased by 20% at the watershed level while crop yields registered a 15% increment. The increase in runoff appears to be associated with patches in the watershed with no vegetation cover and interventions that increase the runoff loads at the watershed scale. When the conservation practices were combined, percentage reductions increased for all variables. The total reductions for the combined two practices were 55% for runoff, 60% for sediment, with 58% increase for soil moisture storage and 30% increases in crop yields. Model performances in simulating runoff, sediment load, soil moisture storage and crop biomass were generally satisfactory. APEX was an efficient tool for simulating the variables examined. Overall, the cumulative and combined effects of field conservation practices are scalable and can help address excess nutrient and sediment concerns and improve water quality at the landscape level while allowing smallholder farmers to reap the benefits associated with sustainable intensification through improved yields with a lower environmental footprint.

Keywords: Farm-scale, interventions, landscape, APEX, smallholder farmers, sustainable intensification