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Intensification Options and Associated Greenhouse Gas (GHG) Emissions in Smallholder Crop-Livestock Systems in Kenya

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Abstract

Population pressure on land has positioned food security and increasing production as top priorities for East African agriculture, over decreasing greenhouse gas (GHG) emissions. While some agricultural practices are faced with the trade-off of production versus climate change mitigation, others become a synergy by meeting the double win. In our study we reviewed intensification options for smallholder's mixed crop-livestock systems in Kenyan Central Province and their corresponding impact on the climate. We analysed both farm production and GHG balance using agricultural activity data, IPCC equations and NUANCES-FARMSIM, the farm scale dynamic model which integrates the interactions between crop-soil, livestock and manure management. We combined data collected from 150 farms to develop different scenarios of intensification: Fertiliser rise (FERT); improved livestock feeding (FEED); improved manure handling (MAN); and combinations of them. The fertiliser rise scenario (FERT) increased maize production by 5-8 % on average, showing an increment of 16-30 % in total farm emissions from the baseline. Increments of dry matter intake by cattle increased emissions by 20-25 %, while improving the nutrient content in fodder and feed showed a 135-170 % increase in milk production per cow with lower GHG intensity. Better manure handling (MAN) reduced emissions in the manure management system but increased emissions in soils in proportion to the nitrogen cycled in the system and therefore the size of the N-pool. Yields significantly increased due to more manure available through better manure handling (MAN), with higher nutrient content coming to the system in the form of concentrates or enriched fodder (FEED) for the cattle. Emissions per unit of product were reduced as the production increased for the cases of improved feeding (FEED) and its combination with improved manure handling (FEED + MAN), but not for the fertiliser rise (FERT) or its combinations (FERT + FEED; FERT + MAN). Finally we discussed the inclusion of agroforestry practices to the farm balance, by analysing their potential to offset farm emissions while improving livelihoods.

Keywords: East Africa, greenhouse gas emissions, livelihoods , mixed crop-livestock systems, smallholders