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Organic manure drive farming system transitions through soil fertility gradients and crop suitability ranges in mid-hills of Himalayan range

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Abstract

Farmyard manure (FYM)- mixture of animal dung, crop residues, urine, bedding material, fodder residues, household waste and other components - links crop, livestock, and forests to support livelihoods in mid-hills of Nepal. The practice was efficient under low intensity cropping systems for decades but, since 2000s, studies show deficiencies leading to decline in soil quality affecting land suitability for a range of crops. Farmers are aware of soil quality (field fitness), which guides crop choice. As farmers allocate resources towards improving crop and animal production, closing the nutrient cycle through improved utilisation of FYM is the most critical entry point in mixed farming system. Yet, in many parts of mid-hills, existing practices affect manure quality, which range from materials included, composting method, soil quality, landscape suitability, and method of application. FYM preparation and application are labour intensive. Most farmers keep FYM on an open pile or heap, some in an open half heap/pit, and a few in either an open or covered pit. Farmers use doko (approximately 25 kg) to transport to the field when considerable amount is accumulated weeks or months in advance and incorporate during land preparation after rainfall onset. This traditional practice expose manure to sunlight and rain resulting in volatilisation of nitrogen and runoff. Agent-based modelling is used to evaluate farmers' agency decisions to distribute FYM and choice of crops based on resulting soil suitability gradients to steer farms towards sustainable organic pathway. FYM improve soil fertility, soil structure, soil moisture, and tillage operations but to improve crop yields, farmers increasingly apply inorganic fertilisers at the expense of soil quality with significant environmental, economic, and social synergies and trade-offs.

Keywords: Agent-based modelling, farm productivity, farmyard manure, Himalayan Range, resource recovery