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Energy budgeting and emergy synthesis of rainfed maize–wheat rotation system with different soil amendment applications

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ABSTRACT

Soil is a non-renewable resource and its preservation is essential for food security, ecosystem services and our sustainable future. Simultaneously, it is a major challenge to substitute non-renewable fossil based resources with renewable resources to reduce environmental load. In order to check soil erosion *vis-a-vis* degradation of sloppy lands of rainfed maize–wheat rotation system, fertilization with organic manure supplemented with inorganic fertilizers is required. In order to address these issues, substitution of 50% NPK through four organic manures *viz.* farmyard manure (FYM), vermicompost (VC), poultry manure (PM) and *in situ* green manuring (GM) of sunnhemp (*Crotalaria juncea* L.) were evaluated against 100% NPK through inorganic fertilizers and through FYM for energy budgeting and emergy synthesis during 2009–2014. Integrated use of FYM along with 50% NPK fertilizers could maintain the highest energy ratio (7.3), human energy profitability (142.4), energy productivity (0.22 kg MJ^{-1}), and energy profitability (6.3 MJ ha^{-1}) over other treatments. However, GM and inorganic fertilizers on equal NPK basis maintained the highest energy intensiveness (24.61 MJ US $\$^{-1}$) and exhibited higher emergy yield ratio (2.66) and lower emergy investment ratio (0.60) and environmental loading ratio (3.74) which resulted into higher environmental sustainability index (0.71) over other treatments. Fertilization with organic manure (FYM) alone could not compete with other fertilized options to energy budgeting and emergy synthesis except specific energy. The study demonstrated that innovative integrated nutrient management of chemical fertilizers and organic manures particularly FYM for energy budgeting and GM for emergy synthesis may be considered as feasible and environment-friendly options for soil conservation, thereby benefiting a 50% saving on costly chemical fertilizers in non-OPEC countries which import most of its phosphorus and potassium fertilizers.