Refining Soil Conservation and Regenerative Practices to Enhance Carbon Sequestration and Reduce Greenhouse Gas Emissions

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Modern agricultural technology, in all its aspects, has enabled increased agricultural production to meet the growing demand for food and fulfill the Sustainable Development Goals of the UN Agenda 2030. Yet the impact of these achievements on soil degradation and greenhouse gas (GHG) emissions is considerable. Agricultural practices that increase soil carbon stocks and reduce greenhouse gas emissions, as outlined under the international 4per1000 initiative, constitute valuable strategies for mitigating global warming while increasing soil carbon stocks and ensuring soil health. The objective of this proposal is to evaluate the influence of conservationist and regenerative agricultural practices on carbon (C), nitrogen (N) and phosphorus (P) cycling, soil biodiversity and GHG emissions with a particular emphasis on long-term SOC stocks, and processes governing C persistence. This project represents an exploratory effort to couple the stoichiometric drivers to microbial populations related to C, N, and P cycling and stocks, and GHG emission under diverse agricultural practices. To this end, we set up a long-term consortium of field experiments that assess the impact of different cropping systems and agricultural practices on soil properties. The participants from twelve different countries represent a total of 37 field sites with different time sequences and/or contrasting agricultural management. Twenty-six sites have been established for at least ten years. At each site, estimates and modelling scenarios of possible N_2O, CO_2 and CH_4 emissions from crop/pasture/forestry systems will be carried out using best available IPCC or local emission factors and GHG emissions will be measured at a subset of sites. To compare the impact of different climatic and edaphic conditions among sites, we propose a standard soil organic matter (OM) physical fractionation procedure resulting in two contrasting soil fractions including particulate organic matter (POM), which consists mainly of partially decomposed plant residues, and the mineral-associated OM (MAOM), principally of microbial origin. This project will build a worldwide database of C and N stocks, bulk density, soil fertility and GHG emissions across different ecosystems and under differential agricultural management. Moreover, the project will determine the extent to which climatic conditions, net primary production of cropping systems and soil type affect carbon and nitrogen stocks, nutrient dynamics and greenhouse gas

emissions. The final product of the project will be to recommend best management practices for production of food crops which would promote soil C accumulation, especially MAOM, without increasing GHG emissions thus contributing to the sustainability and resilience of agriculture.

Keywords: soil carbon persistence, sustainable development, nutrients cycling, carbon storage GHG emissions.