AG 19 Assessment of Soil Quality of Different Practices for Rain-fed Lowland Rice Farming in Cambodia-Using Biofunctool Approach

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Abstract:
Conservation Agriculture (CA) cropping systems have been tested to restore soil fertility, increase productivity and profits. Biofunctool approach assessed changes in soil health under contrasted practices covering three main soil functions: C transformation, nutrient cycling and soil structure. The results revealed positive impacts of CA on the main soil functions. SOC, N, SOC stock, and N stocks were significantly higher under CA when compared with CT. Higher values of labile-C (POXC) and SituResp were observed under CA at 0-5 and 5-10 cm depths. Significant difference was observed at 0-5 cm soil depth ($p<0.05$) under CA when compared with GM and CT, representing higher labile-C inputs and soil biological activity of the mesofauna and microflora. Higher values of Ca, Mg and K contents were recorded under CA and GM for all soil layers.

Introduction:

Rice is the first staple crop and among the main agricultural products in Cambodia; however, the productivity is still low due to low level of soil nutrients. A series of CA practices were tested and promoted over the past 10 years in the rain-fed lowland rice agroecosystem around the Tonle Sap Lake region of Cambodia to restore the soil fertility and to increase the availability of fodder resources.

Methodology:

This study assessed changes in soil health under contrasted practices of rain-fed lowland rice farming including (i) conventional tillage (CT), (ii) CA cropping systems (CA) and (iii) green manure management (GM), which represents different stages of an agroecological transition. The assessment was done by a multi-functional approach integrating a set of twelve soil quality indicators related to three main soil functions (i.e., C transformation, nutrient cycling and soil structure) including soil physical-chemical analyses.

Result:

Findings portrayed a positive impact of soil indicators (soil organic carbon (SOC), Nitrogen (N), labile-C, basal soil respiration, water stable aggregates) at CA7 comparing to CT on 0-5 and 5-10 cm depths. Labile-C (POXC) and soil basal respiration were two to three times higher at CA7 comparing to CT at 0-5 cm depth. At 0-40 cm depth, CA7 exhibited a difference amount of SOC and N stocks of +8.38 Mg C.ha-1 and +1.14 Mg N.ha-1 respectively when comparing with other practices. A trend of SOC stabilization was observed under CA soils (0-5 and 5-10 cm depths). Principal component analysis (PCA) was conducted. CA7 differed from the other land uses (Fig. 2). The first axis separates CA7 and CGM2 from CGM1 and CT, while the second axis separates CA7 from CGM2. The main variables that separate CA7 and CGM2 from the other managements are those that define the 1st principal component (e.g., TOC, TNK, TNC, K, Ca). The main variables that separate CA7 from CGM2 are those that comprise the 2nd discriminant function (e.g., P, POXC, SituResp, lamina, Mg, clay, silt).

Discussion:

Main soil indicators are positively impacted by long-term CA practices (CA7) with an increase of soil organic C and N contents, an increase in labile-C (POXC), an improvement of soil aggregation that can protect SOC from microbial oxidation along with a no-till management when compared with CT (Palm et al., 2014; Peregrina et al., 2010).

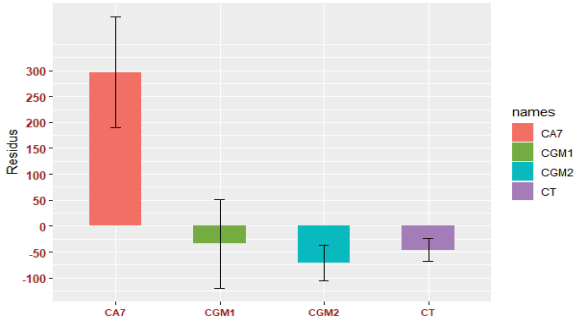

Fig. 1:Mean values of regression residuals between POXC and SituResp® per treatment at 0-5cm depth.

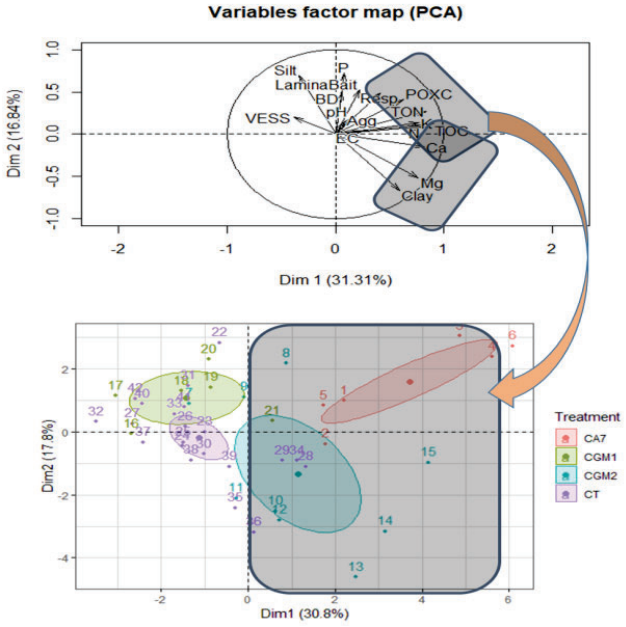

Fig. 2: Principal component analysis for the impacts of contrasted cropping systems on soil functions and soil chemical properties at 0-10 cm.

Conclusions:

Biofunctool® approach was applied under contrasted annual rice cropping systems. Long term CA (CA7) and CGM2 exhibited a positive impact on main soil functions when compared with green manure management (CGM1) and CT. Additional studies are however needed to follow the changes between contrasted practices and to be able to conclude on the differential impacts of CA vs. CGM vs. CT