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LETTER TO THE EDITOR

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Production (via N-fertilization) and correction (by liming) of acidity in soils contribute a huge efflux of CO_2 to atmosphere: Real or arbitrary?

In a recent article, Zamanian, Zarebanadkouki, and Kuzyakov (2018) made an interesting assessment for CO_2 efflux to atmosphere from inorganic carbon in soils on N-fertilization-induced acidity (7.48×10^{12} g CO_2 C/year) and also from liming of acid soils (273×10^{12} g CO_2 C/year) using global database of soil $CaCO_3$ stock, acid soil coverage, N-fertilizer use, associated quantity of protons produced, etc. We have the following few nonconvergent points of views on the issues.

Firstly, stoichiometry of protonation (H^+) in soils out of N-fertilization through urea, and other sources is known and the resultant annual changes in soil pH are also reported by many even using long-term experiments (Ghimire, Machado, & Bista, 2017; Stewart et al., 2015). Most of them found the changes innocuous in soils rich in clays and organic carbon that impart high-buffering capacity. Even, if the amount is significant, such drop in pH is localized at the point of its (N) application and is restricted mostly to the surface layer, excepting when applied in depth, like anhydrous NH_3. As rightly indicated by the authors, most of the calcic layer in soils exists in subsurface horizon, and thus, the possibility for its coming into contact (physical availability) with the protons generated out of N-fertilization is less. Again, N with other fertilizers increases crop yield and ensures a net C-sequestration in soils (Dalal, Allen, Wang, Reeves, & Gibson, 2011; Mandal et al., 2007) that mitigates the severity of the problem. Moreover, of late, conservation agriculture is becoming popular across the continents. Such practices may increase SOC (Powlson et al., 2014) that further improves buffering capacity making soil less responsive to the above phenomenon. The reported huge amount of CO_2 efflux out of decomposition of $CaCO_3$ on N-fertilization-induced acidity, without a direct evidence of field-level measurement, may thus be unlikely.

Secondly, the authors indicated a huge amount of CO_2 efflux (273×10^{12} g CO_2 C/year) from acidic soils due to liming ($CaCO_3$) @1.0 t/ha annually over an estimated area of 3.79×10^9 ha. It is said that soil acidity and poverty go hand in hand. Application of such an amount of $CaCO_3$ annually by farmers particularly of developing nations where acid soils concentrate is thus untenable. Besides, reclamation of soil acidity is done not only by $CaCO_3$ but also by CaO, basic slag etc. wherein little CO_3 exists for producing the reported flux (Bhat, Kundu, Hazra, Santra, & Mandal, 2010; Fageria & Nascente, 2014). Moreover, liming significantly increases crop productivity and biomass yield withdrawing a huge amount of CO_2 from atmosphere; a part (~1/3rd) of which is stored as SOC in the hidden half offsetting again the amount of the flux (Kuzyakov & Domanski, 2000). This is corroborated by large number of studies including those of Fornara et al. (2011) who observed ~20% higher SOC stock in limed than unlimed soils under long-term experiments. Liming further improves soil structure and stability of clay assemblages and clay-organic matter bonds that protect SOC by physical as well as physicochemical mechanisms (Paradelo, Virto, & Chenu, 2015). Inclusion of all these important issues would have made the discussion comprehensive and real; while the present form is a one-sided, straight forward relationship yielding a huge CO_2 efflux that may hardly be the case in nature.

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