



Opinion

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It's Time for a New Agriculture System



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Opinion

This summer when we look at the mouth of the mighty Mississippi River, we might see a vast dead zone which surpasses the area of the state of New Jersey. Around the world, dead zones have been shown a consistently associated with crop fertilizer losses and soil erosion. Hypoxic and anoxic zones are caused by excessive nutrient pollution, primarily from crop agriculture. In the corn belt state of Illinois, for example, mean nitrogen N, phosphorus P and potassium K rates are about 150, 50 and 50 for the respective nutrients on kg/ha application rate. When we look at the cost of the conventional maize production system we look not only to the dead zone and the over 50% reduction in brown shrimp catch. But other concerns are soil effects on economic, environmental, and health concerns and consequences.

In North America, the biggest nutrient input in the maize dominated cropping system is ammoniated nitrogen. Ammoniated fertilizer comprises the bulk of the fertilizer input and has the largest carbon foot print. In areas where rain as precipitation seasonally exceeds the crop evaporation, washing of nutrients are associated with soil acidification, soil aging, soil organic matter loss and soil erosion [1] (Figure 1).

The grand father of the long term farming trials the University of Illinois Morrow Plots has shown the maize production methods with full fertilizer recommendation applied result in substantial losses of soil organic matter and will contribute to accelerated soil acidification and aging [2].

The conventional maize monoculture not only has a large carbon footprint related to use of fertilizer inputs principally N then P and K but also from herbicide, insecticide, and lime. Agrichemical inputs have side effects not restricted to their direct cost and environmental effects but can lead to long term soil deterioration of the soil system itself. The energy cost of agriculture inputs can be dwarfed by their potential to compromise soil quality by reducing the levels of soil organic matter and acidify the soil which represents a type of double edged sword [3].

The Rodale Institute Farming Systems Trial has taken a different approach than conventional N fertilization dependence. By their design, they demonstrated that N fertilization by ammoniated sources are not essential but rather it can be eliminated. In addition other agrichemical inputs are not necessary when the soil can be improved. In biologically based systems using legume based rotation of crops, cover cropping and organic amendment weans the plants from a chemical dependence to a dependence on the soil itself [4-6].

While the conventional maize and soybean rotation did not lose organic matter unlike the results of maize monoculture in Illinois and elsewhere in the Midwest. The biologically based farming systems was found not only to reduce the carbon footprint of the production practices but additionally and more importantly substantially increased soil organic matter [7].

At the Ohio State University a long term maize no till experiment started in the early 1960s has shown that converting from fully tillage to no till can lead to 330 kg/ha/yr C sequestration [8]. In relation to these encouraging results, we must consider the fertilizer and pesticide inputs are equal or greater under

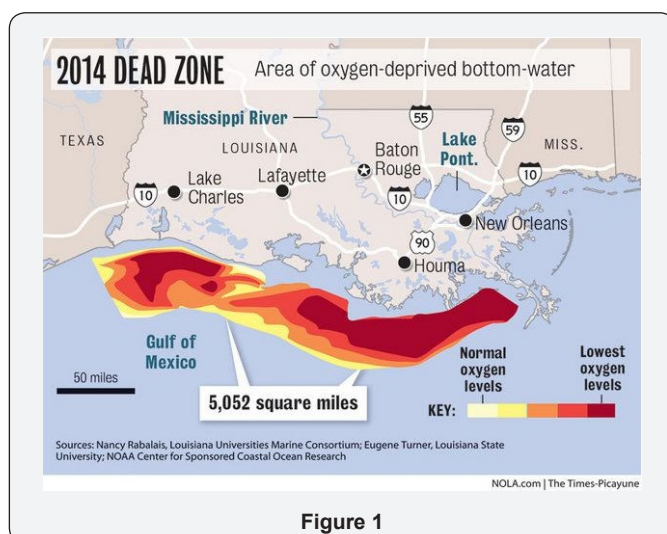


Figure 1

these no till systems run conventionally. The Rodale approach experienced lower carbon foot print and substantially higher carbon sequestration from cover cropping, crop rotation, and organic amendment in Rodale Farming Systems Trial and Compost Utilization Trial.

Rattan Lal, a noted expert in Carbon sequestration, suggested that if no till systems were extended on global tillable acreage up to 10% of current greenhouse gas emissions could be neutralized. While OSU results put the potential C sequestration at 330kg to neutralize 10% The Rodale work suggest the range of a crop cover contribution can be from 600 to 1,200kg C per ha per year. While compost amendment could provide sequestration rates 1,100 to 2,200kg C per ha per year. Work should now concentrate and the potential for additive and synergistic interactions of practice combinations and systems.

If we depart from no till effect of 10% at 330 the use of cover cropping could result in about 18 to 36% mitigation potential and compost about 34 to 68%. These numbers do not include the acreages of pastures which are well known to have extremely high Carbon sequestration potential when managed properly and the acreage of pasture system can exceed the tillable acreage by 2 times nor does it consider the potential for forests.

Until recently most of the energetics and greenhouse gas work has focused on carbon footprint of individual practices or technological packages and protocols for individual crop production such as monoculture maize.

The potential of using our soil as carbon sink may not be fully appreciated and represents much more profound opportunity than the traditional focus on just carbon foot print from a practice or practices.

Beside the tradition practice of using a production foot print approach alone, we suggest the bigger goal of improving the soil base condition by soil sequestration while reducing and eliminating agrichemical inputs be combined in calculating a net result. When input footprint costs are subtracted from positive carbon sequestration a net bottomline carbon sequestration can be calculated which would be an improvement on current calculation of input footprint alone and give quantitative estimate of net effect.

The use of biological inputs in cropping systems can eliminate the majority of carbon footprint from maize. The biological input provide necessary nitrogen from the soil by including soybean legume forages and winter covers in the cropping scheme. While conventional systems need the same of increasing inputs

over time the biologically based system depends rather on the improved soil conditions and get the nitrogen from biological nitrogen fixation from the vast atmospheric reservoir.

With increasing consensus on the challenge of changing climate, soil organic matter works to stabilize crop yields from the principal constraint of periodic drought. Since improved soil condition increases soil percolation and soil water retention and use the Rodale Farming Systems study clearly shows superior yield of biologically based systems compared to conventional maize and soybean cropping with agrichemicals in drought years.

In terms of the environment, energy use economics, sustainability and the addressing of global issues of greenhouse gases and mitigation of negative effects of climate change, we need to focus our production systems on the soil and substitute biological for agrichemical inputs. In developing these new generation practices net carbon sequestration uses the soil sequestration value and subtracts the carbon foot print of practices. Concentrating on net sequestration is highly recommended to better estimate the impact of our system on the soil, energy and environment.

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