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CARBON FOOT PRINTING- PROSPECTS AND IMPORTANCE IN AGRICULTURE

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Present modern-day environment issue is all about to reduce concentrations of carbon dioxide (CO_2) and other greenhouse gases (GHG) in Earth's atmosphere (IPCC 2007). The fact cannot be ignored that Agriculture has always been counted as one of the biggest emitters of GHGs globally. It covers 35% of the land area and accounts for nearly 13.5% of the total global anthropogenic GHG emissions which contributes about 25, 50, and 70 % of CO_2, CH_4, and N_2O, respectively (Montzka*et al., 2011).* The goal of modern agriculture is striving towards higher-energy and higher carbon-input systems (diesel, chemical fertilizers, pesticides etc). One of the key indicators of indicators in assessing the environmental sustainability of farming system Greenhouse gas emissions is one of the keys (Gómez-Limón and Sanchez-Fernandez,2010). The term carbon footprint in agriculture is getting popularity to quantify such impacts which function is based on (a) Emissions of greenhouse gas emissions per unit of farmland—quantifying the total amount of emissions in crop production that focuses more on environmental health and (b)to produce per kilogram of grain the quantity of greenhouse gas emissions associated with— which is emphasizing both emissions while production of a crop as well as the products (i.e., grain yield) involved with per unit of emission. Carbon footprint is considered as one of the most recent terms for global warming potential that defines the total greenhouse gas emissions associated with a product or service. This carbon footprint (CF) assessment of products especially in agricultural has recently gained much attention and popularity in international society in context with climate change. It is highly essential to choose such crops and management practices as well that have low CF to maintain a win-win situation between food production and greenhouse gas emissions (GHG). Thus, information which is pertained with carbon footprinting (CF) for crops production under conservation agriculture definitely would be of immense importance and relevance in order to adopt technologies wisely which would mitigate the GHG emission and improve the environmental footprint of the agricultural systems.

The direct energy under farm operations is termed as the energy which is directly required for various operations to carry out whereas indirect energy is involved for the production of several farm inputs, such as commercial fertilizers, pesticides, herbicides etc. The amount and type of energy engaged in agricultural operations have a vast impact on the emissions of CO_2. CO_2 emitted either directly from soil respiration or indirectly due to fuel or electricity consumption can be curtailed by practices like changing agronomy package, management of nutrient, tillage/residue management and water management etc. Improved agronomic practices increase yields and also generate inputs of carbon residue and lead to an increase in soil carbon storage (Follett, 2001). Although reports of minimum or no-till effects on soil carbon are mixed (West and Post, 2002; Ogle et al., 2005; Gregorich et al., 2005), but conservation agriculture with crop residue retention and cropping system management as key components can conserve energy in crop production. This paper will deal with the factors or agricultural practice contributing towards maximum carbon footprinting along with some mitigation strategies that can be a better option to think for adaptation.

Farm Operations Contributing Maximum Carbon Foot Printing

There are many factors in crop production that responds to greenhouse gas emissions as. The most popular method to analyze this is LCA (life cycle assessment) analysis, it includes CO_2 emissions from off-farm manufacture, transportation and delivery of various input products to the farm gate as well as those emissions during the cultivation of a crop. Emissions of CO_2 from field crop production are mostly obtained from (1) decomposition of crop residues; (2) application of inorganic fertilizers to the crop; (3) manufacture, storage, and transportation of inorganic fertilizers, herbicides and pesticides to the farm gate; (4) various other farming operations such as spraying of pesticides, planting and harvesting the crop and tillage operations; (5) soil carbon gains or losses from various cropping systems; and (6) emissions of N_2O from summer fallow areas where the land is kept for the crop to be grown the following years (Chang Liu et al,2016).

Few Mitigation Strategies to Lower Co_2 Emission from Farm Operations

As a signatory country to the United Nations Framework Convention on Climate Change (UNFCCC), the United States is actively engaged in a critical international effort to combat the problems posed by climate change and presented few farming strategies to increase grain production in order to lower carbon footprint. (1) using diversified cropping systems that can reduce the system's carbon footprint by 32 to 315 % compared with conventional monoculture systems (2) improvement of N fertilizer use efficiency can decrease the carbon footprints of field crops as N fertilizer applied to these crops contributed 36 to 52 % of the total N_2O emissions; (Walter et al. 2015). (3)Intensified rotation with less summer fallow that can lower the carbon footprint by as much as 150 % compared to system with high frequency of summer fallow; (Harker et al. 2009; Menalled et al. 2001) (4) soil carbon sequestration enhancement which will reduce carbon footprint as the emissions from farm inputs can be helpful to offset partly by conversion from atmospheric CO_2 into plant biomass and gradually sequestered into the soil; (5) reduced tillage along with crop residue retention to raise soil organic carbon and reduce carbon footprints; (6) integration of all key cropping practices can increase crop yield by 15 to 59 %, can reduce emissions by 25 to 50 % and lower the carbon footprint of cereal crops by 25 to 34 %; (Yang et al. 2013) (7) addition of N_2- fixing pulses in rotations that reduces the use of inorganic fertilizer, and lower carbon footprints. Adoption of these improved farming tactics can lead to new possibilities to optimize the system performance to reduce the carbon footprint of crop cultivation.

Conclusion

Sustainable agricultural systems are aimed to produce better quality and affordable food in sufficient quantity to meet the growing global population demand of food, feed, and fuel, and at the same time ensures farming systems that must have a low impact on the environment. The key agronomical tactics include not only to diversify the cropping systems or improving N fertilizer use efficiency but also it involves overall integration of all improved farming practices together enables to reduce the use of inorganic fertilizers, increase the system productivity, and lower the carbon footprint. High time already it is to make aware even the farmers too that not only increase crop production should be a major focus but the way the crops are produced and marketed will also have significant environmental consequences. Sooner by following relevant agro-environmental policies with the adoption of improved agronomical tactics to increase food production will lead to no cost to the environment can be achieved that will be sustainable in true sense effectively, efficiently, and economically.

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