Vol. 3 Issue-2, October 2022 (e-ISSN: 2582-8223)

Carbon Sequestration and Agriculture

Dr Monika Banotra and Dr B.C Sharma
Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences & Technology Jammu, J&K, 180009, India

ARTICLE ID: 50

Carbon sequestration is the practice of capturing and storing atmospheric carbon dioxide. It is the process of sinking the amount of carbon dioxide in the atmosphere with the aim of reducing global climate change. In Agriculture, Carbon sequestration refers to the ability of agriculture lands and forests to remove carbon dioxide from the atmosphere. In crops, trees and plants carbon dioxide is used in the process of photosynthesis and it is stored as carbon biomass in tree trunks, branches, foliage, roots and soils. The amount of carbon stored in soil as soil organic matter is influenced by the addition of carbon from plant debris and carbon losses from respiration, the decomposition process and both natural and human disturbances to the soil. By adopting farming practices that involve least disturbance to the soil and encourage carbon sequestration, farmers may be able to slow or even reverse the loss of carbon from their fields. The ability of agriculture lands to sequester carbon depends on several factors, including climate, soil type, crop and vegetation. Forests and grasslands are considered as good carbon sinks because they can store large amount of carbon in their foliage and root systems for longer periods of time. Soils are the largest terrestrial sink for carbon on the planet.

Agriculture's role in mitigating climate change by Carbon sequestration

Several farming practices and technologies can reduce greenhouse gas emissions and prevent climate change by enhancing carbon storage in soil by preserving existing soil carbon and reducing carbon dioxide, methane and nitrous oxide emissions.

- **Conservation tillage and cover crops:-** Conservation tillage refers to a number of strategies and techniques for establishing crops in the residue of previous crops, which are purposely left on the soil surface. Reducing tillage reduces soil disturbance and helps to mitigate the release of soil carbon into the atmosphere. Conservation tillage also improves the carbon sequestration capacity of the soil. Additional benefits of conservation tillage include improved water conservation, reduced soil erosion, reduced fuel consumption, reduced compaction, increased planting and harvesting flexibility, reduced labor requirements and improved soil tilth.

- **Improved cropping and organic systems:-** Organic systems of production increase soil organic matter levels through the use of composted animal manures and cover crops. Cover crops like legumes increases soil organic matter by (8 to 114 %) whereas cover crops like grasses and brassicas increase soil organic carbon up to (4 to 62 %). On the other hand, Organic cropping systems also eliminate the emissions from the production and transportation of synthetic fertilizers. Components of organic agriculture could be implemented with other sustainable farming systems, such as conservation tillage, to further increase climate change mitigation potential. Generally, conservation farming practices that conserve moisture improve yield potential, reduce erosion and fuel costs also increase soil carbon. Some of the practices including direct seeding, field windbreaks, rotational grazing, perennial forage crops, reduced summer fallow and proper straw management, using higher-yielding crops or varieties and maximizing yield potential can reduce carbon dioxide emissions and also increase soil carbon.
- **Land restoration and land use changes:-** Land restoration and land use changes that encourage the conservation and improvement of soil, water and air quality typically reduce greenhouse gas emissions. Modifications to grazing practices, such as implementing sustainable stocking rates, rotational grazing and seasonal use of rangeland, can lead to greenhouse gas reductions. Converting marginal cropland to trees or grass maximizes carbon storage on land that is less suitable for crops.
- **Irrigation and water management:-** Improvements in water use efficiency, through measures such as irrigation system mechanical improvements coupled with a reduction in operating hours, drip irrigation technologies, and center-pivot irrigation systems, can significantly reduce the amount of water and nitrogen applied to the cropping system. This reduces greenhouse emissions of nitrous oxide and water withdrawals.
- **Nitrogen use efficiency:-** Improving nitrogen use efficiency through practices like precision farming using GPS tracking can reduce nitrous oxide emissions. Other strategies include the use of cover crops, green manures, animal manures, nitrogen-fixing crop rotations, composting and integrated pest management.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- **Methane capture from livestock:-** Large emissions of methane and nitrous oxide are attributable to livestock waste treatment, especially in dairies. Agriculture methane collection and combustion systems include covered lagoon and complete mix and plug flow digesters. Anaerobic digestion converts animal waste to energy by capturing methane and preventing it from being released into the atmosphere. The captured methane can be used to fuel a variety of on-farm applications, as well as to generate electricity. Additional benefits include reducing odors from livestock manure and reducing labor costs associated with manure removal.
- **Bio fuels:-** Bio fuels particularly those derived from oilseeds (biodiesel), feed corn (ethanol) or even from cellulosic sources are carbon neutral. Further, research needs to be done on the global land use change implications if farmers grow more of a specific bio fuel feedstock.
- **Other renewable energy options:-** Renewable energy such as wind and solar energy also momentous opportunities for the agriculture sector to reduce greenhouse gas emissions.

Potential benefits of the value soil carbon for agriculture

'Developing Farms and Agro-forestry systems' with strong incentive for budding soil carbon will be the midpoint of climate stabilization. Thus, the new crop that farmers may grow in the future is carbon but as the issue related with other crops, farmers need market, as well as price that will make it economical to grow. The value of carbon from the individual farmer as well as society at large, is the heart of understanding the role agriculture, can play in carbon sequestration and climate stabilization. Thus, the two systems are created for the assessment of offsetting greenhouse gas emissions and are known as carbon taxation and cap and trade.

Charge systems: Carbon tax

By taxing every ton of carbon in fossil fuels or every ton of greenhouse gas industries emit, entities that emit greenhouse gases or use carbon based fuels will have an incentive to switch to alternative renewable fuels, invest in technology changes to use carbon based fuels more efficiently and in general adopt practices that would lower their level of greenhouse gas emissions. Thus a carbon or greenhouse gas emission tax values carbon in negative terms of tax avoidance. Those agriculture farms and industries that emit or use less carbon-intensive fuels pay a smaller tax. From the view point of farmers, a carbon tax would increase the direct and indirect costs of agricultural production. Farmers used carbon based fuels directly in the forms of petroleum and natural gas and indirectly in the forms of carbon based fertilizers and pesticides and fuel intensive inputs. Thus, a carbon tax could move farmers to shift to systems of production that either eliminate the use of fossil fuels and inputs or at least improve the efficiency of their use. The policy makers generally think to prohibit the agriculture sector from such taxation. For the most part, carbon tax proponents have been more interested in placing greenhouse gas emission taxes on upstream producers of the original source products. This includes coal, petroleum and natural gas producers and major emitters such as large electric utilities. Nonetheless, as people work to reduce greenhouse gas

Benefits of a carbon tax for farmers

A major benefit of a carbon or greenhouse gas emission tax would be the creation of a stream of tax revenue that the government could use to further induce the practice and technology changes necessary to lower greenhouse gas emissions. For example, many of the current agriculture conservation programs, such as the National Mission for sustainable Agriculture (NMSA), National Mission on Sustainable Habitat and Carbon foot print policy, support improvements in soil quality and could be funded in part from emission or carbon taxes, thereby providing a revenue source to subsidize those who adopt or maintain emission reduction practices or carbon sequestration activities. Tax revenues could also assist in the support of conservation programs like the Drought Prone Areas Programme (DPAP), Desert Development Programme (DDP) and Integrated Wastelands Development Programme (IWDP) by the Department of Land Resources, which works to keep sensitive and highly erodible lands out of production since these lands sequester soil carbon. Another benefit of this approach is that a tax provides a clear and stable cost to current practices. A tax also makes it easier to determine changes that will be more profitable in a new cost environment. For instance, if a concentrated animal feeding operation understood the cost of their emissions as expressed by their emission tax, it would be easier for the operation to determine alternatives to current practices that would be cost efficient. At a high enough tax rate, installing methane digesters to lower greenhouse gas emission would become economically feasible. Finally, it has been argued that a carbon tax approach is cost effective in implementation, at least when compared to other method of achieving greenhouse gas emissions reductions.

Cap and trade: A private market for greenhouse gas emissions

A government-sponsored cap and-trade system would create a new market for greenhouse gas emissions by creating a new property right-the right to emit. The market is created by a government that sets a limit or cap on total greenhouse gas emissions allowed. Industries that emit greenhouse gases are issued emission permits that allow a certain amount of emissions. Industries that exceed their allowed emissions must purchase offsets from other entities that pollute less than their allowance or from entities that sequester carbon. These exchangeable emission permits, often called allowances, are measured in tons of carbon dioxide equivalents per year. Carbon dioxide equivalents provide a common measure for all greenhouse gas emissions and are calculated by converting greenhouse gases into carbon dioxide equivalents according to their global warming potential. Over time, the government will continually lower the total level of allowances to meet an established level of acceptable total emissions. As the supply of allowances decreases, the value of the allowances will rise or fall depending on demand and on the ability of emitters to make necessary changes to reduce emissions or

Benefits for farmers

Depending on the practices adopted, farmers could be a source of inexpensive carbon reduction and capture the value of these allowances as offsets. In short, the value of offsets would become the market price of carbon equivalents. This would become the value of the new crop carbon that farmers could grow. If a farmer shifted to an organic system of production, measurable improvements in the ability of the farmer to sequester carbon could be verified and the farmer could sell this sequestered carbon at the current carbon market price set in the new emissions market .

Subsidies to the farmers for carbon crop

There is an immediate benefit to farmers willing to make changes that meet the challenges of climate stabilization. If sufficiently funded with outreach and technical assistance, efforts can be made to assure that all farmer regardless of their situation take advantage of these programs. Finally, resources can be prioritized to different regions of the country or to specific practices or systems of production .So that this program can be cost-effective in reaching climate change goals.