

Organic farming on solving Climate Change

The increasing prevalence of ecologically sustainable products in consumer markets are generally assumed to curtail anthropogenic impacts on the environment. One of the most sustainable approaches to food production is Organic agriculture. A one percent increase in its acreage could reduce emissions by 0.049%. It revolves around recycling techniques and low external input with high harvest strategies. The main principle is based on enhancing soil fertility and diversity at all levels and makes soils less susceptible to erosion. These practices generally have positive impacts on the environment per unit of area, but not necessarily per product unit. Our food system has substantial impact on climate change and organic agriculture helps to mitigate the burning issues at a social and environmental front as well.



According to the Intergovernmental Panel on Climate Change (IPCC), the annual amount of greenhouse gases emitted by the agricultural sector is estimated at between 5.1 and 6.1 gigatonnes of CO₂ equivalents in 2005. This represents approximately 10–12% of total greenhouse gas emissions. Of these emissions, methane emission is the highest and nitrous oxide comes next, while net emissions of CO₂ are relatively minute. Agriculture is the main emitter of nitrous oxides and methane according to current practice and knowledge. This could be due to our narrow approach to get high production and productivity without giving importance to environmental and social issues. It is high time to harvest natural resources like sunlight and rainwater including recycling of biomass produced in the farm itself. Every blade of grass helps to sink atmospheric carbon in addition to harvesting sunlight to produce food/feed to the living beings in the ecosystem.



Compared to conventional or integrated systems, global warming potential of organic farming systems is considerably small when calculated per land area. However, when the same is calculated for per product unit, the difference declines as conventional yields are higher initially than organic yields. Under stress conditions like dry conditions or water constraints, organic agriculture may outperform conventional agriculture, both per crop area and per harvested crop unit.



The use of synthetic nitrogen fertilizers increases the global warming potential of conventional agriculture. Global nitrogen fertilizer consumption (produced by fossil energy) in 2005 was 90.86 million tonnes. This is about 1% of global fossil energy consumption.

On the other hand, Organic agriculture is self-sufficient in nitrogen. Mixed organic farms practice highly efficient recycling of manures from livestock and of crop residues by composting. Leguminous crops deliver additional nitrogen in enough quantities (this is the main source on stockless organic farms). A legume helps to fix atmospheric nitrogen in the soil. On calculating the potential nitrogen production by leguminous plants via intercropping and off-season cropping to be 154 million tonnes, a potential which exceeds the nitrogen production from fossil fuel by far and which is not fully exploited by conventional farming techniques.



Diversified crop rotations with green manure crops improve soil structure and diminish emissions of nitrous oxide. Soils managed organically are more aerated and have significantly lower mobile nitrogen concentrations. Both factors reduce emissions of nitrous oxides. To further reduce any environmental impacts, it is advised to improve crop varieties, feature perennials in crop rotations, use cover crops (between successive crops or between rows of plantations) and avoid bare fallows, enhance plant and animal productivity and efficiency, reduce unnecessary tillage using minimum to no-till strategies.

The on-farm use of farmyard manure – a practice increasingly abandoned in conventional production – needs to be reconsidered in the light of climate change. While conventional stockless arable farms use synthetic nitrogen fertilizers, manure and slurry from livestock production or from non-ruminant farms have become an environmental problem. In these livestock operations, nutrients are available in excess and overfertilization

occurs. However, only 17% of the 100 Mt N produced in 2005 was taken up by crops. The remainder was somehow lost to the environment. Between 1960 and 2000, the efficiency of nitrogen uses for cereal production decreased from 80 to 30 percent. High levels of reactive nitrogen (NH_4 , NO_3) in soils may contribute to the emission of nitrous oxides and are main drivers of agricultural emissions. The efficiency of fertilizer use decreases with increasing fertilization, because a great part of the fertilizer is not taken up by the plant but instead emitted into the water bodies and the atmosphere. The emission of GHG in CO_2 equivalents from the production and application of nitrogen fertilizers from fossil fuel amounted to 750 to 1080 million tonnes (1 to 2 percent of total global GHG emissions) in 2007. In 1960, 47 years earlier, it was less than 100 million tonnes. Recycling nitrogen on the farm by using manure and nitrogen fixing plants enhances soil quality and provides nutrients. This is the predominant technique of organic and low external input agriculture. However, timing and management of its use are essential. Soil mineralization processes should deliver the elements to the plant at times of peak demand. Organic and green manures as well as nitrogen from legumes can be managed very precisely due to the design of the crop rotations including cover and catch crops. In addition, improved distribution systems, such as decomposed desi cattle manure (dung & urine) application into soils, reduce nutrients losses considerably. All these techniques might be knowledge intensive for farmers and require site specific adaptations. As nitrogen on organic farms is far more costly than industrial nitrogen, there is a strong incentive to avoid losses and to learn and implement recycling techniques.



Methane accounts for about 14% of the greenhouse gas emissions. Two thirds of this are of anthropogenic origin and mainly from agriculture. Methane emissions stem to a large extent from enteric fermentation and manure management and in consequence are directly proportional to livestock numbers. A reduction of the Global Warming Potential (GWP) has also been found on organic dairy as compared to conventional.

Organic cattle husbandry contributes positively to reducing methane emissions by aiming towards animal longevity. Cattle naturally prefer to graze and move freely under open atmospheric condition. By doing so, cattle help to improve the soil water holding capacity. While moving, cattle do nibbling, mobbing, mowing, mulching, dunging, urinating etc, which helps to improve soil fertility. It is important to manage the cattle movement to avoid over grazing of grasses so that regeneration of soil surface vegetation is not affected. If we consider milk as only the economic product, the ratio between the unproductive phase of young cattle and the productive phase of dairy cows is favourable in organic systems because, calculated on the basis of the total lifespan of organic dairy cows, less methane is emitted. On the other hand, lower milk yields of organic cows caused by a higher proportion of roughage in the diet, might increase methane emissions per yield unit. A model calculation of the best yield-methane emission rate at different diets (roughage versus concentrates) is missing. The slightly reduced yields of organic farms might be nearer the optimum than conventional dairy production. Composting and biogas production are often suggested as measures for mitigating climate change. Storage and composting of manure and organic waste have been strongly improved on organic farms in recent years. Using the modern techniques, such as covering, processing compost and steering the compost process, prevents leaching and reduces N_2O emissions. Composting manure may reduce CH_4 but enhance N_2O emission from heaps. Compost use can greatly enhance carbon sequestration in the soil compared to raw manure use. The benefits of aerobic fermentation of manure by means of composting is ambiguous, as a shift from anaerobic to aerobic storage of manure can reduce methane emissions. A very promising option, however, is controlled anaerobic digestion of manure and waste combined with biogas production. Biogas production from liquid slurry makes use of the evolving CH_4 for energy and is applied by many sustainable farmers.



While this option is not restricted to organic production methods, organic agriculture has been at the forefront of biogas production systems for decades.

In the Rodale Farming Systems trial in the mid-Atlantic region of the continental USA, the manure-based organic system sequestered 1,218 kg carbon per ha and year, the legume-based stockless organic system sequestered 857 kg, and the conventional system sequestered 217 kg

18 organic and 10 conventional farms in Bavaria, Germany, were compared to calculate the organic farms' annual sequestration at 402 kg carbon, while the conventional farms had losses of 202 kg. It was estimated that compost application and cover crops in the rotation were particularly adept at increasing soil organic matter.



Agriculture can help mitigate climate change by either reducing GHG emissions or by sequestering CO₂ from the atmosphere in the soil. The application of improved agricultural techniques (e.g., organic agriculture, conservation tillage, agroforestry with native tree species) reduces or stops soil erosion and converts carbon losses into gains. Consequently, considerable amounts of CO₂ are removed from the atmosphere. Organic agriculture already provides effective methods to reach both of these goals. If agricultural practices remain unchanged, the loss of organic carbon in typical arable soils will continue and eventually reach a new steady state at a low level. Agriculture can help mitigate climate change by either reducing GHG emissions or by sequestering CO₂ from the atmosphere in the soil. The application of improved agricultural techniques (e.g., organic agriculture, conservation tillage, agroforestry with native tree species) reduces or stops soil erosion and converts carbon losses into gains. Consequently, considerable amounts of CO₂ are removed from the atmosphere. Organic agriculture already provides effective methods to reach both of these goals. If agricultural practices remain unchanged, the loss of organic carbon in typical arable soils will continue and eventually reach a new steady state at a low level.

