IFOAM EU GROUP

IFOAM INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

The CONTRIBUTION *of* ORGANIC AGRICULTURE *to* CLIMATE CHANGE MITIGATION

Organic Agriculture

- *affordably captures carbon from the air and effectively stores it in the soil in high levels for long-periods*
- *integrates trees, hedgerows and pastures into farming systems to increase carbon capture and biodiversity*
- *reduces greenhouse gas emissions and fossil fuel use through an appropriate combination of organic fertilizers, cover crops and less intensive tillage*
- *puts people at the center of the farming system to increase resilience, income, and food security*

Prepared by

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Introduction

According to the Inter-governmental Panel on Climate Change (IPCC) agriculture currently accounts for 10-12% of global greenhouse gas (GHG) emissions and this figure is expected to rise further. GHGs attributed to agriculture by the IPCC include emissions from soils, enteric fermentation (GHG emissions from the digestion process of ruminant animals), rice production, biomass burning and manure management[1]. There are other 'indirect' sources of GHG emissions that are not accounted for by the IPCC under agriculture such as those generated from land-use changes, use of fossil fuels for mechanization, transport and agro-chemical and fertilizer production. The most significant indirect emissions are changes in natural vegetation and traditional land use, including deforestation and soil degradation. Soil carbon losses caused by agriculture account for one tenth of total CO2 emissions attributable to human activity since 1850. Deforestation is a common land-preparation practice in many agricultural regions that leads to massive loss of carbon stocks and massive CO_2 emissions. The IFOAM Basic Standards for Organic Production and Processing prohibit the clearing of primary eco-systems. The world's soil is however a major store of carbon – approximately three times the amount in the air and five times as much in forests[2].

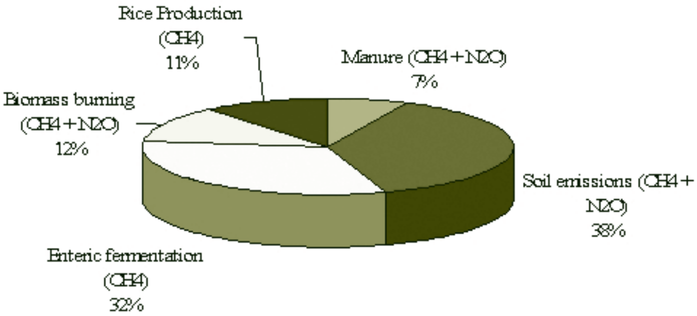


Figure 1: Main sources of 'direct' GHG emissions in the agricultural sector in 2005 [1]

Benefits of Organic Agriculture in relation to climate change mitigation

With the right type of agriculture, emissions leading to climate change can be minimized and the capacity of nature to mitigate climate change can be harnessed to sequestrate significant quantities of atmospheric carbon dioxide – especially in the soil. Global adoption of Organic Agriculture has the potential to sequester up to the equivalent of 32% of all current man-made GHG emissions[3]. Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It utilises ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. It combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved[4].

Table 1: Overview of key the case studies

Case study	Country	System	Organic practices used	Mitigation benefits
Farming Systems Trial	USA	Arable crops	organic fertilization crop rotation cover crops	2.3 ton Carbon/hectare/year
Pure Graze	The Netherlands	Pasture-based diary system	use of natural reproductive cycles locally produced fodder and feed reduced use of concentrate feed	0.4 ton Carbon/hectare/year 10% (per kg produce) and 40% (per hectare) less GHG emissions than conventional farming
Composting in Egypt's desert	Egypt	Vegetable crops	composting	0.85 ton Carbon/hectare/year
DOK trial	Switzerland	Arable crops	organic fertilization crop rotation including grass clover cover crops	0.25 ton Carbon/hectare/year
Agroforestry	Indonesia	Cocoa/forest	intercropping with trees and shrubs	11 ton Carbon/hectare/year

The Food and Agriculture Organisation of the United Nations (FAO) regards Organic Agricultural as an effective strategy for mitigating climate change and building robust soils that are better adapted to extreme weather conditions associated with climate change[5]. The IPCC's Fourth Assessment Report also recommends the use of practices which are standard in Organic Agriculture for mitigating climate change. Organic Agriculture optimally combines these different practices in a systematic manner and sustains agricultural production in resource-limited regions.

As illustrated in the five case studies the potential for soil sequestration depends greatly on a number of variables including the soil type, climate, land-use history, and the farming system adopted – especially the availability and quantity of carbon rich components used in the system such as compost, manure, perennial plants, pastures and trees. Carbon sequestration is also affected by the saturation level of the soil – and therefore its capacity to sequester additional carbon. Soils which are inherently low in carbon and those which have been degraded through poor agricultural practice for example generally have a greater potential to sequester carbon.

The studies differ in terms of climatic conditions (hot and dry climate versus temperate), soil type (fertile loamy soil versus sandy infertile soil) as well as with regard to cropping system (intensely managed arable crops versus agro-forestry systems versus extensive livestock systems).

The Egyptian case study features the use of Organic Agriculture practices applied to arid soils of very low fertility. The Farming System Trial and the Egyptian case studies both utilized high levels of organic fertilizer inputs to regenerate degraded soils – including the use of organic waste streams from beyond the farm. The DOK trial was designed to limit organic inputs to what is generally available at the farm level and despite this limitation maintained soil carbon levels better than conventional systems. The agro-forestry case study illustrates the role of Organic Agriculture in maintaining high carbon sequestration levels in, and avoiding emissions from, cocoa agro-forestry systems by reversing the trend of shade tree removal evident in conventional agro-forestry.

Recommendations and strategies for further application and scaling-up of benefits

The case studies illustrate the high sequestration and low GHG emission potential of Organic Agriculture across different climates, soil types and under different production systems. Given the extent of the threat that global temperature rise poses to the world's population and environment, it is of utmost importance to integrate Organic Agriculture into both national and international climate change agreements, mitigation mechanisms and action plans. It is also recommended that just as there are simplified IPCC guidelines for the conversion of land from one use to the other, a simplified set of guidelines should be developed for the conversion of conventional to organic land use.

1 Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko, 2007: Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer, Eds., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

2 Bellarby, J., Foereid, B., Hastings, A., Smith, P. (2008): Cool Farming: Climate impacts of agriculture and mitigation potential, Greenpeace International, Amsterdam (NL). 44 p.

3 Robert Jordan, Adrian Müller and Anne Oudes (2009): High Sequestration, Low Emission, Food Secure Farming. Organic Agriculture - a Guide to Climate Change & Food Security, IFOAM

4 www.ifoam.org

5 Niggli, U., A. Fliessbach, P. Hepperly and N. Scialabba. 2009. Low Greenhouse Gas Agriculture: Mitigation and Adaptation Potential of Sustainable Farming Systems. FAO, April 2009, Rev. 2 – 2009.

The Farming Systems Trial in the USA

Case Study by Eliav Bitan[a]

A cost-effective, market-ready way to remove carbon dioxide from the atmosphere

Organic Agriculture sequesters carbon dioxide quickly and affordably, while conventional agriculture produces greater emissions. The Farming Systems Trial, an ongoing thirty year study at the Rodale Institute demonstrates the potential of Organic Agriculture to sequester an equivalent of up to 30% of all annual world greenhouse gas emissions. Organic Agriculture with cover crops, crop rotation, and biological nutrition sources pulls carbon out of the atmosphere and stores it in soils. In addition to affordable carbon sequestration, Organic Agriculture provides increased food security through more reliable yields, and decreased needs for external inputs.

The Farming Systems Trial is North America's oldest comparative scientific study of Organic Agriculture. Since 1981, an organic system using legumes - plants that fix nitrogen in soil - and an organic manure system have been compared to a non-organic system. The synthetic chemical system follows a 5-year rotation typical of many farms across the American Midwest - corn, soybeans, corn, corn, soybeans - and receives fertilizer and pesticide applications according to the standard recommendations provided by Pennsylvania State University. The organic legume system is structured around a 3-year rotation of hairy vetch/corn, rye/soybeans, and wheat. The organic legume system depends on cover crops, intense rotation, and tillage to manage pests and nutrition. The organic manure system follows a 5-year rotation of corn, soybeans, corn silage, wheat, red clover and alfalfa hay, with aged cattle manure applied in the two corn years. The organic manure system receives composted manure and cover crops for nutrients, and uses tillage for weed control. The two organic systems receive no chemical inputs for fertility, weed or pest control.

Low Emission

The synthetically managed chemical system in the trial (conventional farming) used 30% more energy than the organic systems, despite being based on best practices.

High Sequestration

In the Farming Systems Trial, during the transition to organic and the first decade of organic production, the legume system added an average of 744 kilograms of carbon to the soil per hectare, and the manure system added an average of 1,217 kilograms of carbon per hectare. These rates translate to 2.73 metric tons of carbon dioxide per hectare and 4.47 metric tons of carbon dioxide per hectare.[1] Since then, Rodale's experiment combining composted manure and cover crops sequestered carbon at average annual rates exceeding 2,300 kilograms of carbon per hectare, or 8.44 metric tons of carbon dioxide per hectare.[2] Further research has the potential to demonstrate even higher soil carbon sequestration rates.[3]

Food Secure

After the initial three year transition period, the organic systems in the Farming Systems Trial have achieved yields comparable to the conventional systems. Organic yields have been 28- 34% higher than conventional yields in especially dry and wet years.

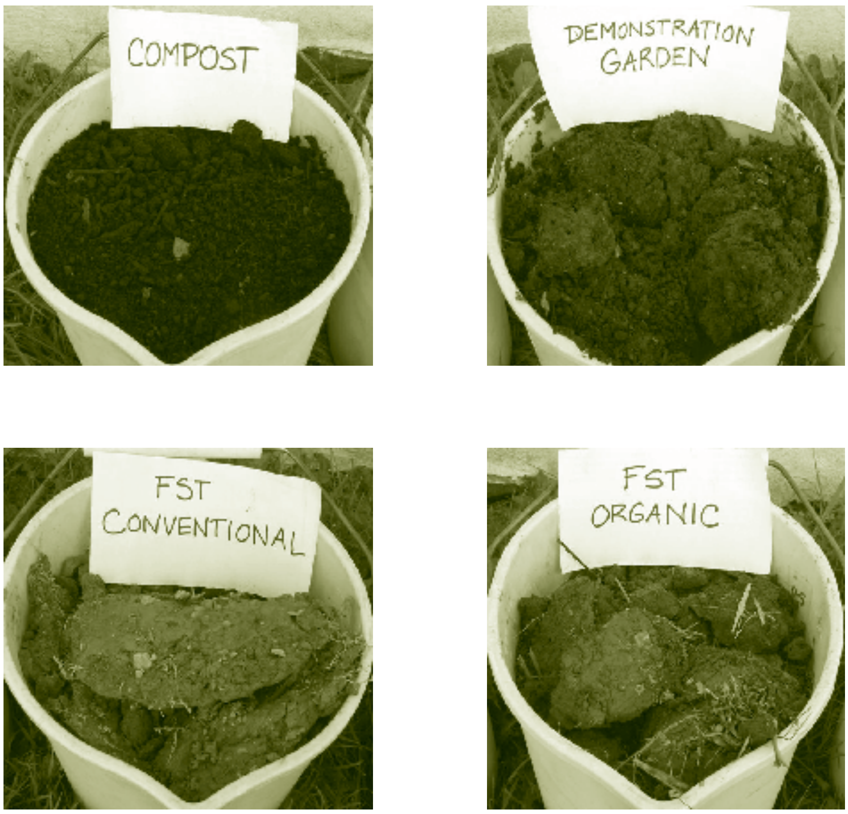
a Rodale Institute, USA, eliav.bitan@rodaleinst.org

Conclusion

Agriculture is currently the most cost-effective, market-ready way to remove carbon dioxide from the atmosphere. Scientific research is needed to determine which agricultural techniques, practices, and systems will achieve actual climate mitigation.

The Farming Systems Trial offers an opportunity to examine the climate mitigation potentials of different existing agricultural systems. The results suggest the huge possibilities for agriculture. The trial showed that only the organic systems have sequestered significant amounts of carbon: up to 4.47 metric tons of carbon dioxide per hectare per year.

The Farming Systems Trial provides a scientific hope for agriculture's potential to mitigate climate change. Organic Agriculture can sequester significant levels of carbon dioxide from the atmosphere while providing ecosystem benefits and high crop yields. These results suggest that farmers who set out to increase soil organic carbon could achieve far greater success in sequestering carbon dioxide, if they were given incentives to achieve this goal.



Comparison of the different soils structures

1 Pimentel, D. P. Hepperly, J. Hanson, D. Douds, and R. Seidel. 2005. Environmental, energetic and economic comparisons of organic and conventional farming systems. BioScience 55(7): 573-582

2 Hepperly, P., D. Lotter, C. Ziegler Ulsh, R. Seidel, and C. Reider. 2009 (in press). Compost, manure and synthetic fertilizer influences crop yields, soil properties, nitrate leaching and crop nutrient content. Compost Science and Utilization

3 Pimentel, D. P. Hepperly, J. Hanson, D. Douds, and R. Seidel. 2005. Environmental, energetic and economic comparisons of organic and conventional farming systems. BioScience 55(7): 573-582

Pure Graze

Case Study by Kees van Veluw[a]

Natural rhythms and intensive grazing

Organic dairy farming in the Netherlands emits 40% less green house gasses (GHG) per hectare of land than conventional agriculture. This can be further improved by using the Pure Graze system in which farms are adapted to align with natural animal and plant cycles. Pure Graze increases the efficient use of fodder and decreases the need for concentrate feed, further reducing the GHG emissions of the dairy farm.

Low Emissions

Dairy farming contributes significantly to greenhouse gasses. On average, the production of 1 litre of milk in the Netherlands releases one to two kilograms of carbon dioxide-equivalent GHG emissions[1]. The largest sources of emissions are the production and transport of concentrate feed and rumen fermentation. Further sources of GHG emissions are the use of fossil fuel and manure storage and application. Research has shown significantly different emissions between organic and conventional milk production. A meta-analysis conducted at Wageningen University in the Netherlands collected and integrated all relevant research concerning energy use and GHG emissions by dairy farming systems during the last decade. They found organic dairy farms emit 40% less greenhouse gas per hectare of land and 10% less per kilogram milk, compared to conventional dairy farming (table 1).

Table 1: Emission of greenhouse gasses on organic and conventional dairy farms in the Netherlands[1]

	Emissions in kilograms per hectare		**Emissions in kilograms per 1,000 kilograms milk**	
	conventional	organic	conventional	organic
CO_2	4,250 - 11,630	2,650 - 4,950	420 - 550	320 - 410
N_2O	15.3 - 37.1	12.4 - 18.8	1.5 -1.9	1.5 - 2.0
CH_4	250 - 520	180 - 300	25 - 26	22 - 26
CO_2 equivalents	14,470 - 34,160	10,990 - 17,010	1,450 - 1,650	1,310 - 1,460

Pure Graze

Reasons for the lower greenhouse gas emissions of organic dairy farms are as follows:

- Avoidance of chemical fertilizers, resulting in a reduction of approximately 50 kilograms of carbon dioxide equivalent per 1,000 kilograms of milk.
- Organic dairy farms use 30% less concentrate feed. Concentrate feed is responsible for over 30% of greenhouse gas emission of dairy farms.
- Replacing imported concentrate with locally produced concentrates reduces about 100 kilograms of carbon dioxide per 1000 kilograms of replaced concentrates[2].
- Increased grazing. Grazing reduces methane emissions from manure storage. While nitrous oxide emissions may be increased, the methane decrease is greater.

a Agro Eco – Louis Bolk Institute, Driebergen, the Netherlands k.vanveluw@louisbolk.nl

High Sequestration

Pure Graze dairy farmers in the Netherlands adapt their farm management to natural cycles by allowing springtime calving. This means the increased fodder requirement of a lactating cow and the natural growing pattern of the grass clover pasture go hand in hand. In late autumn and wintertime, when the quality of grass is low, the requirement of non-lactating cows is low too. Pure Graze farmers have an intensive grazing scheme that moves cows to a fresh high quality pasture four to five times a day. Following this natural rhythm has a number of advantages:

- Better health of cows and calves
- Lower expenditure on fodder conservation
- High omega acid content in the milk from the consumption of fresh grass and clover tops
- A reduced rate of expensive concentrate feed.

Most importantly: Pure Graze farmers optimize grass clover lands for longer grazing periods (up to ten months a year) and high yields of grass clover. They use permanent pastures which continuously increase organic matter in the soil which leads to carbon sequestration. Practice shows that the organic matter content increases by 0.1% per year. This means a sequestration in the top 10 centimeters of soil of at least 1.5 metric tons of carbon dioxide per hectare per year. Further soil carbon sequestration can be expected in the deeper portions of the soil.

Conclusion

This case study shows that organic dairy farms in the Netherlands are low emission, high sequestration methods of food production. They have a 10% (per kg produce) and 40% (per hectare) lower emission of GHGs compared to conventional dairy farming, due to a lower level of concentrate use, the absence of chemical fertilizers and replacing imported concentrates with local animal feed. Pure Graze farming uses natural rhythms and intensive grazing to build natural efficiency in the existing production system. This system increases soil carbon sequestration, storing at least 1.5 metric tons of carbon dioxide per hectare per year[3] (equivalent to 0.4 metric tons of carbon per hectare per year).

Pure Graze farmers let their animals graze on turnips in late autumn.

Pure Graze farmers apply an intensive use of grassland. Cows get a small piece of land to graze 4 to 5 times a day.

1 Bos, J.F.F.P.; Haan, J.J. de; Sukkel, W. (2007)
Energieverbruik, broeikasgasemissies en koolstofopslag: de biologische en gangbare landbouw vergeleken. Volledig rapport (Energy use, emission of greenhouse gasses and carbon sequestration; comparing biological and conventional agriculture)
Wageningen : Plant Research International, (Rapport / Plant Research International 140)

2 Sukkel, W. (2009) Broeikasgasemissies bij de productie van veevoer (Emission of greenhouse gasses in the production of animal feed)
[Wageningen] : [Wageningen UR],

3 Elferink, E; Well, E. van; Hees, E; Schans, F. van der (2008)
Klimaatlat Melkveehouderij, gebruikershandleiding. (Climate Scan Dairy Farming, User's Manual)
CLM, www.klimaatlat.nl

Composting in Egypt's desert

Case Study by Boki Luske[a]

Composting in the Egyptian desert has been demonstrated to be a high sequestration, method of producing food by sequestering over 3 metric tons of carbon dioxide per hectare per year. Composting is a low emission practice because it reduces methane emissions from landfills[1]. The use of compost to produce food also avoids emissions of nitrous oxide from the production and application of chemical fertilizers. The application of compost not only promotes high rates of soil carbon sequestration but also increases soil fertility which enhances food security.

Egypt contains very few fertile areas (less than 5% of the country) and given that the human population is increasing very rapidly, more and more desert is being reclaimed for food production. Among those new farms the number of organic farms is also increasing. As soil conditions are initially very poor, the farms face a challenge, namely to improve the fertility of the soil. Soil fertility can be enhanced organically by increasing organic matter levels for instance by the application of compost. Compost can be produced by combining organic waste streams in windrows, adding the right microorganisms and creating aerobic conditions. Worldwide the soil contains a major carbon stock that degrades due to unsustainable land use practices. On the other hand agricultural soils are a major potential carbon sink that may be used to mitigate climate change[2]. Recently the mitigation potential of organic farming practices in Egyptian desert soils was studied.

Low Emission

The first organic farm in the Arabic region was founded 30 years ago in the Egyptian desert. This farm, called Sekem, mainly used compost, green manures such as clover and irrigation water to turn the desert into a fertile agricultural area. Over the years the farm slowly but steadily expanded in size and created a mosaic of fields with different ages. Due to organic farming practices, soil conditions at the farm improved and soils became more productive. This is in contrast with many conventional systems in Egypt that need to use increasing amounts of chemical fertilizers to maintain their production levels. In addition as conventional farmers in the region noticed the benefit of compost for increasing soil fertility, the demand for compost increased.

To meet this increasing demand a major composting facility was developed which now processes 120,000 metric tons of organic waste per year into 60,000 metric tons of high quality compost. The waste consists of chicken and cow manure, rice straw and green waste originating from Sekem itself, nearby farms and irrigation canals.

Windrow composting is an effective method to recycle organic waste and it reduces emissions of methane that would have been emitted due to rotting organic waste in landfills. Composting one ton of Egyptian organic waste mitigates the greenhouse effect of 0.44 metric tons of carbon dioxide equivalents. The UNFCCC has included composting as an official method for emission reduction projects. Apart from compost there are also emission rights or carbon credits generated at the composting facility. The carbon credits generate an additional income for the farm and are mostly sold to stakeholders in the organic sector who want to promote sustainable farming in developing countries.

High Sequestration

To investigate the mitigation effect of organic farming in the desert due to soil carbon sequestration, soil properties of several fields were measured and compared with the surrounding desert areas[3]. The results of the study indicate that the soil carbon stock increases very rapidly in the first few years after land reclamation (figure 1). In the long term, the rate of carbon sequestration slows down until a new equilibrium is reached, unless new practices are added. Initially the desert contains hardly any soil

a Agro Eco – Louis Bolk Institute, Driebergen, the Netherlands b.luske@louisbolk.nl

carbon and soil properties are not suitable for agriculture. In an initial 5 year time period soil carbon stocks increased from 3.9 metric tons of carbon per hectare to 18.9 metric tons carbon per hectare. Over the 30 year time period soil carbon stocks increased from 3.9 to about 30.3 metric tons carbon per hectare in the upper 50 cm of the soil. This means on average, every year, for thirty years this agricultural system sequestered 0.85 metric tons of carbon per hectare per year (3 metric tons of carbon dioxide per hectare per year).

Conclusion

Compost trials in the Egyptian desert show that organic farming practices - recycling of organic waste to compost and adding to the soil in dryland regions have the potential to mitigate climate change by avoiding emissions and sequestrating high levels of carbon. Furthermore, these systems improve soil fertility and increase food security in the area.

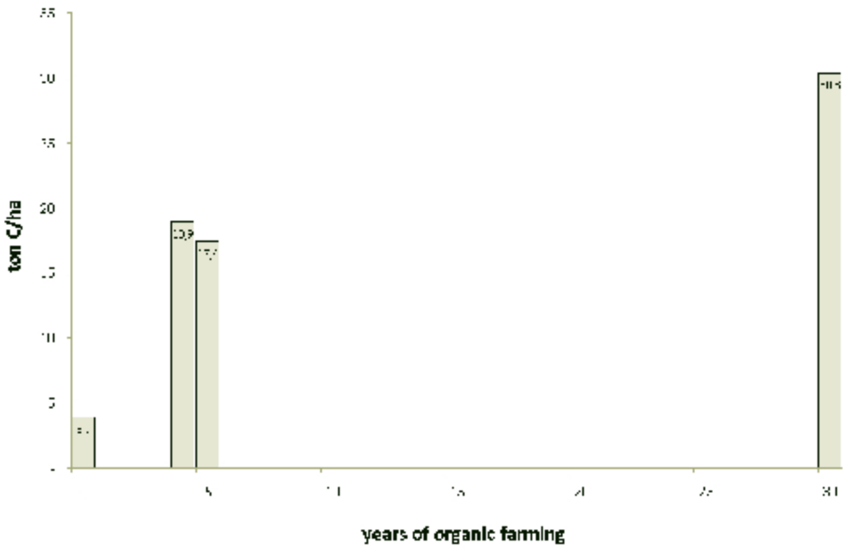


Figure 1. Soil carbon stock development through organic farming in Egyptian desert soils.

1 UNFCCC/CCNUCC. 2007. Approved baseline and monitoring methodology AM0039. "Methane emissions reduction from organic waste water and bioorganic solid waste using co-composting". AM0039 / Version 02, Sectoral Scope 13, EB 35.

2 Lal, E., 2004. Soil Carbon Sequestration Impacts on Global Climate Change and Food Security. Science, Vol. 304, no. 5677, pp. 1623 – 1627

3 B. Luske & J. van der Kamp. Carbon sequestration potential of reclaimed desert soils in Egypt. In press. Louis Bolk Institute & Soil and More International, The Netherlands.

Soil carbon sequestration in Switzerland - the DOK trial

Case Study by Johannes Scholberg[a] and Adrian Muller[b]

Organic systems, by closing nutrient cycles and making more efficient use of local (on-farm) resources, can contribute to mitigating climate change[1]. This is due to the fact that certain farming practices result in storage of carbon (C) in the soil (sequestration), thereby effectively reducing the amount of CO2 in the atmosphere. The DOK trial, a research project on the mitigation potential of Organic Agriculture has demonstrated this.

DOK trial

The DOK trial was initiated in 1978 to investigate the effect of different organic versus conventional farming practices with different fertilizer, pesticide and energy use, on crop yield, biodiversity, and soil quality[2]. The crop rotation, tillage practices, residue management and manure application rates used were based on the same number of livestock so that the effect of different farming systems - except for the stockless conventional system - on soil C sequestration could be determined. The study was conducted at Therwil in the vicinity of Basel in Switzerland using a 7-year crop rotation. Results for this study were described in detail in a number of scientific papers (2, 3, 4). Some of the main results as related to climate change mitigation are outlined below. It should be noted that the differences between conventional and organic management practices used in these studies are not so pronounced as for example the same stocking rates are used in both systems. In regions where these differences are more pronounced, it would be expected that the benefits of C sequestration in Organic Agriculture would be much greater.

High Sequestration

The storage of CO_2 in the soil between 1977 and 2004 was calculated for the different systems in the study[3,4]. At the onset of the study the soil carbon content was fairly high. This was probably due to high previous applications of manure and the incorporation of grass-clover pasture before the start of the study. The upper 20 cm of the soil contained about 1.5% C which translates to an initial carbon stock of around 45,000 kg C per hectare. Using computer models it was calculated that annual inputs of 3,000 to 3,500 kg C per hectare would be required to maintain the original (high) soil C level at this study site[3].

Averaged across the entire period, plant residues added between 1,360 and 1,640 kg C per hectare annually. Additions from manure ranged from zero (stockless conventional system with only chemical fertilizers) to 890 to 1,170 kg C per hectare (for the other systems) annually. Total C addition from crops and soil amendments ranged from 1,410 (stockless conventional system) to 2,280 to 2,400 (organic systems) and 2,810 (conventional systems with manure). Inputs were thus lower than required to maintain the initially high C stock according to the model calculations. During a period of twenty-seven years, the biodynamic system maintained the original soil C level. In the other manure-based systems soil C dropped by 0.3% per year. Soil organic C dropped by 0.5 to 1% per year when no organic fertilizers were used[3]. In terms of C sequestration benefits, use of organic amendments resulted in the soil retaining up to 0.25 ton C per hectare per year more (in the biodynamic system) compared to the exclusive use of inorganic fertilizers and pesticides.

a Agro Eco - Louis Bolk Institute, The Netherlands, j.scholberg@louisbolk.nl

b FiBL, Switzerland, adrian.mueller@fibl.org

Low Emission

In addition to C sequestration, Mader et al, 2002 found decreased GHG emissions from organic systems due to:[2]

- Nutrient inputs in organic systems were 34 to 51% lower per hectare than conventional managed systems.
- The amount of energy required per kg product was 20 to 56% lower in organic systems.

Food Secure

The results of this thirty–two-year study demonstrate that organic food production is more secure in periods of high or low rainfall. This was directly associated with more efficient use of nitrogen and greater biodiversity.

- The capacity of organic soils to withstand soil disturbances associated with intense rainfall events (soil stability) was enhanced by 10 to 60% compared to conventional soils. Soils also had a 30 to 40% higher capacity to conduct water, which renders them less prone to erosion and/or flooding[2]
- Organically managed soils showed more efficient nutrient cycling, due to higher biological activity. Therefore less nitrogen occurred in a form that is prone to leaching losses and that can contribute to emissions of GHG[2]
- The number of earthworms and beneficial soil organisms favoring inherent soil structure and fertility, where also two to three times higher in organic soils[2]

Conclusion

The DOK trial showed Organic Agriculture, relative to conventional agriculture, enhances C sequestration and reduces GHG emissions, thereby mitigating climate change. In addition, relative to conventional farming, Organic Agriculture can also improve inherent soil quality and soil fertility. The enhanced biodiversity of the organic system was one of the key factors favoring more efficient use of water, nutrients and energy for crop production. This also renders organically managed systems more able to sustain production under adverse climatic conditions associated with climate change.[1]

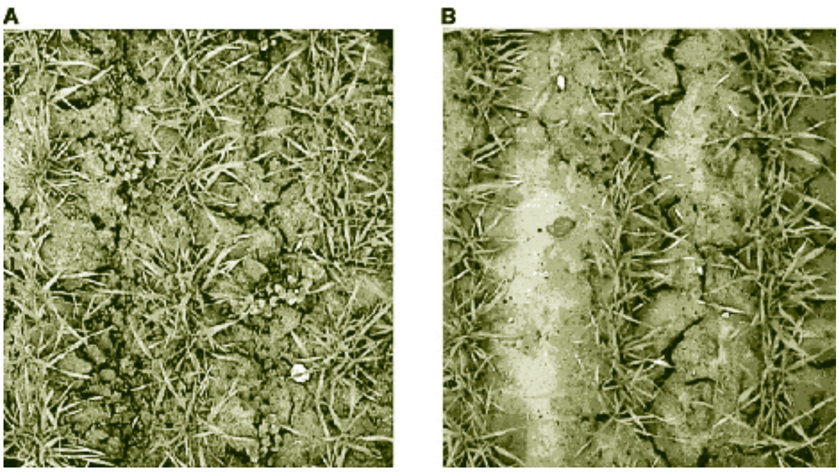


Figure 1: Organic soil management practices (a) result in resilient soils, store more carbon, water and nutrients, and have a better structure compared to conventionally managed soils (b) that sequester less carbon and are prone to soil degradation

1 International Trade Centre UNCTAD/WTO. 2007 Organic farming and climate change. ICT, Geneva, Switzerland, 31 pp.

2 Mäder P., A. Fließbach, D. Dubois, L. Gunst, P. Fried, U. Niggli. 2002. Soil fertility and biodiversity in organic farming. Science 296: 1694-1697.

3 Leifeld J., R. Reiser, H. Oberholzer. 2009. Consequences of conventional versus organic farming on soil carbon: Results from a 27-year field experiment. Agronomy Journal 101: 1204-1218.

4 Fließbach, A., H.R. Oberholzer, L. Gunst, P. Mäder. 2007. Soil organic matter and biological soil quality indicators after 21 years of organic and conventional farming. Agriculture, Ecosystems, and Environment 118: 273-284.

Carbon sequestration in organic cocoa agro-forestry

Case Study by Merijn Bos[a]

Throughout the humid tropics, millions of smallholder farmers grow crops in combination with trees (agroforestry systems). Cocoa is among the most important tree crops grown in this way. Agro-forestry systems are already recognized by the Kyoto Protocol as a means of mitigating climate change. Organic agro-forestry is a high sequestration, low emission method of producing food. Cocoa agro-forests range from mono-cropped, poorly shaded plantations to densely shaded, heterogeneous forestry systems that consist of cocoa trees intercropped with secondary crops and shade trees. The latter, complex types of agro-forests provide habitat to high levels of biodiversity, even approaching those of pristine rainforests[1]. Moreover, such systems diversify the sources of income in that more than 20% of revenues can come from spices, medicinal herbs, and fruit and timber trees[2].

High Sequestration

In extensive agro-forestry, heterogeneous plantations often have old shade tree stands that consist of forest remnants and secondarily grown trees that make up multilayered canopy structures, and thereby resemble pristine rainforests in height and density. In such plantations the carbon stock can reach up to 228 metric tons of carbon per hectare[3], which is almost as much as that known from natural rainforests (300 metric tons of carbon per hectare). Organic agro-forestry aims at maintaining and even replanting shade tree stands that include local tree species.

In Indonesia, newly planted cocoa agro-forestry systems sequestered about 1.5 metric tons carbon per hectare per year (5.5 metric tons of carbon dioxide per hectare per year) during the first fifteen years. Including the below ground carbon stock and carbon in simultaneously planted shade trees, carbon sequestration during the first five years reached over 11 metric tons of carbon per hectare per year.

Low Emission

There is a trend however for conventional agro-forestry management to increase carbon dioxide emissions by removing shade trees to increase short-term productivity. In Indonesia, the thinning of planted shade tree stands led to a 56 % reduction of carbon stored in the above and below ground biomass.[3] Such management intensification has been reported from all major cocoa producing countries and causes an additional threat to plants, birds and insects, and makes the system more sensitive to land erosion, drought and flooding. Organic systems avoid this reduction by maintaining a bio-diverse system including shade trees and crops.

Food Secure

Besides the increased carbon storage and sequestration in shaded agro-forests, such systems maintain ecosystem sustainability and secure important ecosystem services such as clean drinking water, natural control of pests and diseases, and habitat for local biodiversity. Access to organic markets generates financial incentives to farmers, which contributes to the economic viability of shaded agro-forests compared to that of poorly shaded systems.

Most of the certified organic cocoa originates from West Africa where thousands of smallholder farmers have certified their extensively grown cocoa. In a project on organic cocoa production, carried out in the Democratic Republic of Congo, about 3,000 smallholder farmers are involved. The extra revenues from organic farming encourages these farmers to protect and plant shade tree stands in their cocoa

a Louis Bolk Institute, Driebergen, the Netherlands, M.Bos@louisbolk.nl

plantations. To assess the effects on carbon stocks, a baseline study on tree carbon stocks was carried out. The project is developing a monitoring system for tree carbon stocks in organic cocoa agro-forests, that will be linked to the annual internal control system used for organic group certification.

Conclusion

The case of carbon sequestration in cocoa agro-forestry is a powerful example of a recognized methodology for climate change mitigation. Organic Agriculture generates financial incentives to maintain and even re-plant shade tree stands. The high carbon sequestration in such shaded cocoa agro-forests is a clear win-win with global and local benefits as it is paralleled by increased sustainability of income through diversified revenues, increased sustenance of profitable ecosystem services, and better adaptation of land use to the effects of climate change, such as drought, floods and land-erosion.

Two women harvesting cocoa in a densely shaded cocoa plantation in Indonesia

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Dense shade cacao agroforest

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1 Bos MM, Steffan-Dewenter I, Tscharntke T. 2007. The contribution of cocoa agroforests to the conservation of lower canopy ant and beetle diversity in Indonesia. Biodiversity and Conservation 16: 2429-2444.

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IFOAM position on the full diversity of Organic Agriculture

Any system using the methods of Organic Agriculture and being based on the Principles of Organic Agriculture is regarded by IFOAM as 'Organic Agriculture' and any farmer practicing such a system can be called an 'organic farmer'. Organic Agriculture brings valuable contributions to the farmer and to society outside the market place. IFOAM supports the adoption of Organic Agriculture regardless of whether the products are marketed as organic or not.

IFOAM regards third party certification as a reliable tool for guaranteeing the organic status of a product, and one that appears to be most relevant in an anonymous market. But IFOAM does not see this as 'universal' and not the only tool to describe Organic Agriculture.

Apart from third party certification there are other methods of organic quality assurance for the market place. These can be in the form of self-declarations or participatory guarantee systems. There are also situations where the relation between the consumer and the producers are strong enough to serve as a sufficient trust building mechanism, and no other verification is needed.

IFOAM definition of Organic Agriculture

Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

IFOAM principles of Organic Agriculture

Health

Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

Ecology

Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

Fairness

Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities

Care

Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

IFOAM'S MISSION IS LEADING, UNITING AND ASSISTING THE ORGANIC MOVEMENT IN ITS FULL DIVERSITY. OUR GOAL IS THE WORLDWIDE ADOPTION OF ECOLOGICALLY, SOCIALLY AND ECONOMICALLY SOUND SYSTEMS THAT ARE BASED ON THE PRINCIPLES OF ORGANIC AGRICULTURE.

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