

# Organic Agriculture and Climate Change Mitigation

A Report of The Round Table on Organic  
Agriculture and Climate Change

**URS Niggli | Nadia El-Hage Scialabba**

---

**Food and Agriculture Organization of the United Nations (FAO)  
Natural Resources Management and Environment Department  
Rome, December 2011**

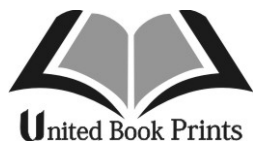
---



# **Organic Agriculture and Climate Change Mitigation**

**A Report of the Round Table on Organic  
Agriculture and Climate Change**

**Urs Niggli  
Nadia El-Hage Scialabha**



*1st Reprint in India, 2015*

*Published by:*

United Book Prints  
4806/24, Ansari Road,  
Daryaganj,  
New Delhi - 110 002  
Tel.: 011-41511055

© *FAO, 2011*

ISBN: 978-93-83692-06-4

eISBN: 978-93-88148-52-8

Printed in India

# CONTENTS

xiii	ABBREVIATIONS AND ACRONYMS
xv	PREFACE
1	<b>CHAPTER 1</b>
	Round Table on Organic Agriculture and Climate Change
1	<b>RTOACC mandate</b>
7	<b>Work of RTOACC in 2010</b>
12	<b>CHAPTER 2</b>
	Soil carbon sequestration of organic crop and livestock systems and potential for accreditation by carbon markets
13	<b>Existing gaps in data required to quantify the mitigation potential of organic agriculture</b>
17	<b>Potential of soil carbon sequestration of organic crop and livestock systems</b>
17	Introduction
18	Material and methods
20	Results
23	Methodological difficulties of the meta-study
28	Summary and conclusions
28	Next steps
29	<b>Potential for accreditation of an organic farming system methodology for the carbon market</b>
30	Carbon market context
33	Material and methods
34	Results

<i>iv</i>	<i>Organic Agriculture and Climate Change Mitigation</i>
36	Summary and conclusions
38	Next steps
<b>40</b>	<b>CHAPTER 3</b>
	<b>Life cycle assessment of organic food and farming systems: methodological challenges related to greenhouse gas emissions and carbon sequestration</b>
<b>41</b>	<b>Introduction</b>
<b>42</b>	<b>Life cycle assessment methodology</b>
44	Goal and scope definition
47	Inventory analysis
49	Impact assessment
50	Interpretation
<b>55</b>	<b>Greenhouse gas emissions of organic versus conventional products</b>
55	Assessing differences in greenhouse gas emissions between farming systems and agricultural products
59	Major greenhouse gas contributions and mitigation options in organic food chains
<b>62</b>	<b>How to perform life cycle assessment in complex agricultural systems</b>
62	How to allocate and account for interactions in the farming systems
66	How to account for carbon sequestration in life cycle assessment
68	Recommendations and research needs
<b>70</b>	<b>Status on initiatives and data requirements of life cycle assessment</b>
70	Existing initiatives to assess life cycle assessment of products
72	Data requirements and greenhouse gas emission estimates for LCA-based certification

73	Existing databases of organic products evaluated with LCA methodology
74	<b>Summary and next steps</b>
76	<b>ANNEX</b> <b>Literature review of greenhouse gas emissions per kilogram organic versus conventional agricultural product at farmgate</b>
78	<b>REFERENCES</b>





# LIST OF FIGURES

- 21 **Figure 1**  
Monitoring length of different management practices (organic and conventional) considered in the farming system comparison (N=2477)
- 21 **Figure 2**  
Geographical distribution of the sample of soil carbon studies used in the pair-wise comparisons of organic and non-organic management
- 22 **Figure 3**  
Variation in sampling soil depth of different analyzed soil carbon studies (N=2477)
- 23 **Figure 4**  
Soil organic carbon (SOC) contents (expressed in %) are significantly higher in organically managed soils
- 23 **Figure 5**  
Soil organic carbon (SOC) stocks (expressed in tonne of carbon ha<sup>-1</sup>) are significantly higher in organically managed soils
- 24 **Figure 6**  
Five different scenarios of carbon change induced by two management treatments (A—blue arrows and B—grey arrows) after a set amount of time
- 25 **Figure 7**  
Hypothetical field trial simulation comparing conventional and improved management practices initiated at three different times (A, B and C) after converting a natural ecosystem to agricultural production in year zero

- 27 **Figure 8**  
Scheme and equation used to calculate soil organic carbon (SOC) stock
- 31 **Figure 9**  
Certified Emissions Reduction (CERs) expected until 2012 from a number of different projects carried out in different sectors under the Clean Development Mechanism (CDM)
- 32 **Figure 10**  
Percentage of market share achieved by different project type for Carbon Emission Reductions (CERs) in the Voluntary Carbon Market (VCM)
- 35 **Figure 11**  
Rough and preliminary estimates of the potential of emission reductions achieved with mitigation practices applicable within organic agriculture
- 36 **Figure 12**  
The interplay of the revisions of existing CDM methodology AMS.III-F and the new methodology based on AMS.III-A
- 43 **Figure 13**  
The four phases in the life cycle assessment methodology
- 48 **Figure 14**  
Illustration of the basic data requirements and emission estimates used for the LCA of agricultural products
- 54 **Figure 15**  
Greenhouse gas emissions from organic soybeans produced in Jilin Province, China, and transported to the harbour of Aarhus, Denmark: a hotspot analysis
- 54 **Figure 16**  
Environmental impacts from organic and conventional soybean produced in Jilin Province, China
- 57 **Figure 17**  
Literature review of greenhouse gas emissions per kilogram of organic and conventional products.
- 59 **Figure 18**  
Greenhouse gas emissions from UK food consumption

- 63    **Figure 19**  
Illustration of the interactions in organic farming systems that needs to be accounted for in LCA of organic wheat
- 66    **Figure 20**  
Greenhouse gas emissions (g CO<sub>2</sub> eq/kg wheat) of organic wheat relative to how the imported resource “manure” has been accounted for
- 67    **Figure 21**  
Illustration of the impact of the chosen time perspective when estimating soil carbon changes



# LIST OF TABLES AND BOXES

	<b>Table 1</b>
50	Example of environmental impact categories used in LCA and the contributions from the main emissions
	<b>Box 1</b>
51	LCA of organic soybeans exported from China to Denmark
	<b>Box 2</b>
60	Climatic mitigation options in organic food chains



# ABBREVIATIONS AND ACRONYMS

<b>ANOVA</b>	Analysis of variance
<b>BSI</b>	British Standards Institution
<b>CDM</b>	Clean Development mechanism
<b>CEDECO</b>	Educative Cooperation for the Development of Costa Rica
<b>CERS</b>	Certified Emission Reductions
<b>CMA</b>	Comprehensive meta-Analysis
<b>DEFRA</b>	Department for Environment, Food and Rural Affairs
<b>DOK</b>	Biologisch-dynamisch, Organisch-biologisch and Konventionell
<b>EF</b>	Emission Factors
<b>EU</b>	European Union
<b>FADN</b>	Farm Accountancy Data Network
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FIBL</b>	Research Institute of Organic Agriculture
<b>GHG</b>	Greenhouse Gas
<b>ICEA</b>	Environmental and Ethical Certification Institute
<b>ICROFS</b>	International Centre for Research in Organic Food Systems (Denmark)
<b>IFA</b>	International Fertilizer Association
<b>IFOAM</b>	International Federation of Organic Agriculture movements
<b>IGO</b>	Intergovernmental organizations
<b>ILCD</b>	International Reference Life Cycle Data System

<b>ISO</b>	International Organization for Standards
<b>LCA</b>	Life Cycle Assessment
<b>MRV</b>	Monitoring Reporting and Verification
<b>NAMA</b>	Nationally Appropriate mitigation Actions
<b>NAPA</b>	National Adaptation Programmes of Action
<b>OFA</b>	Organic Federation of Australia
<b>OTC</b>	Over-the-Counter (Carbon market)
<b>PAS</b>	Publicly Available Specification
<b>PLFA</b>	Phospholipid Fatty Acids
<b>REDD</b>	Reducing Emissions from Deforestation and Forest Degradation in developing countries
<b>RTOACC</b>	Roundtable on Organic Agriculture and Climate Change
<b>SALM</b>	Sustainable Agricultural Land management
<b>SEAE</b>	Spanish Society for Organic Farming
<b>SOC</b>	Soil Organic Carbon
<b>SPC</b>	South Pole Carbon Asset management Ltd
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>VCM</b>	Voluntary Carbon market



# PREFACE

During the next decades, billions of people, particularly those in developing countries, will face changes in climate patterns that will contribute to severe water shortages or flooding, and rising temperatures that will cause shifts in crop growing seasons. This will increase food shortages and distribution of disease vectors, putting populations at greater health and life risks. The predicted temperature rise of 1 to 2.5°C by 2030 will have serious effects, especially in terms of reduced crop yield. The productivity of farms is likely to diminish because of climate change, especially in the 40 poorest countries in Africa and Asia. Increased drought periods in many parts of the world and erratic rainfalls will endanger yield stability and put global food production at risk.

As the world seeks solutions for facing the reality of changing climates, the importance of mitigating the effects of greenhouse gas (GHG) emissions becomes increasingly significant, especially in the agriculture sector which both emits and sequesters GHGs. Agriculture causes approximately one-third of global GHGs when direct energy use, emissions from livestock, the production of fertilizers, pesticides, machinery and equipment as well as soil degradation and land-use change for feed production are taken into account.

yet, agriculture and, in particular, organic agriculture can be part of the solution to mitigate GHG gases through farming practices that build soil fertility, avoid use of synthetic fertilizer and improve carbon sequestration. The report of the Intergovernmental Panel on Climate Change (IPCC) on the role of agriculture considers many techniques packed into organic management as relevant mitigation and adaption actions, such as the integration of leguminous plants into the

crop rotations, excellent soil cover, mixed farming systems and the longevity of ruminants. The Round Table on Organic Agriculture and Climate Change (RTOACC) is a newly launched initiative dedicated to increasing understanding and quantifying the role that organic agriculture can play in climate change mitigation and adaptation – in addition to its already understood contribution in areas such as reducing use of chemical pesticides and biodiversity conservation. Established at the United Nations Climate Change Conference in Copenhagen in December 2009 and supported by the United Nations Food and Agriculture Organization (FAO), RTOACC participants spent their first year engaged in activities such as quantifying the climate benefits of organic farming which can be used for building up carbon-offset methodologies approved for international emission, and developing and improving life cycle assessment (LCA) tools for a better integration of organic farming techniques.

This is not to say that there is a dearth of knowledge on the role of organic agriculture in mitigating climate change. The fact that organic farmers replace synthetic fertilizers with biomass management results not only in enhanced soil fertility, but also increased soil carbon sequestration.

What RTOACC can contribute, through its multi-stakeholder platform, is setting base values so that all future investigation, methodology development and quantification work moves ahead from the same point. RTOACC participants use these base values as a point from which to identify what data is available and what data is missing, to identify current or develop new methodologies that can fill the data gaps, and then to use the new complete data to quantify the mitigation potential of organic agriculture. It is well known that there have been no relevant studies on soil carbon stocks in Africa or South America so further investigation will be required in order to access and incorporate reliable data from those areas. This information not only can enhance climate change mitigation activities which will have broad benefits, it also can provide the data to verify the mitigation benefits of organic agriculture which will allow organic farmers to increase their participation in carbon markets.

Looking to the future, RTOACC is committed to making a concerted effort to disseminate its findings to and through a variety of communication networks. For example, results will be sent to scientific publications to build a broad peer-reviewed knowledge stock that can be taken into account by the IPCC and other relevant scientific institutions; to national GHG inventories to develop management-specific information for their agricultural segments; and to data bases to share the knowledge of specific inputs and techniques of organic agriculture. In addition, RTOACC can share its newly improved or developed methodologies to appropriate entities to facilitate approval of organic practices for the regulated and non-regulated carbon markets.

Looking at the progress made in its first months of operation, RTOACC can look back at a time of fruitful activities and be proud of what its participants have achieved.



**Urs Niggli**  
Research Institute of  
Organic Agriculture



**Nadia El-Hage Scialabba**  
Food and Agriculture  
Organization of the United  
Nations

