Greenhouse gas balances in organic and conventional farming in Germany – results from the Network of pilot farms

Lucie Chmelikova[1], Harald Schmid, Sandra Anke, Kurt-Jürgen Hülsbergen

[1] Technische Universität München, Freising, Germany, e-mail: lucie.chmelikova@mytum.de

Agriculture releases greenhouse gases by soil cultivation, livestock and the use of fertilizers and manure. Nevertheless, there are some opportunities to reduce emissions e.g. storage of carbon on agricultural lands. A network of 40 pairs of organic and conventional farms in four regions of Germany was established focusing on research on climate impacts and sustainability indicators in agricultural production. In one part of the joint project "Climate Effects and Sustainability of Agricultural Systems – Analyses in a Network of Pilot Farms" greenhouse gas balances were investigated and compared.

The GHG-balance of plant production takes into account N_2O-emissions from soil, emissions from the use of fossil energy and C sequestration. Balances were estimated according to standardized methods in the model REPRO (REPROduction of soil fertility), which can be used to evaluate and optimise environmental effects of farming systems. Nutrient and energy-balances were calculated for 64 pilot farms (13 organic cash crop farms and 19 organic mixed farms respectively conventional farms) between 2009 and 2012. The elevation of the farms ranged from 0 to 780 m and the annual precipitation from 536 to 1507 mm. The size of the farms was between 30 and 1317 ha.

The results suggested differences between systems as well as farm types (cash crop, dairy farm and farming structure). The humus-balance of the farms showed the potential of organic dairy farms to sequester C (mean 280 kg C ha^{-1} a^{-1}) while organic cash crop systems were estimated to have a constant humus-content. Negative humus-balances (mean -158 kg C ha^{-1} a^{-1}) were calculated for conventional cash crop farms. The N balances of the organic farms (cash crop: 21 kg N ha^{-1}; dairy: -5 kg N ha^{-1}) were lower than the N balances of the conventional farms (cash crop: 74 kg N ha^{-1}; dairy: 62 kg N ha^{-1}). Energy demands were affected mainly by application of mineral N and pesticides suggesting differences in management intensity. The energy use efficiency of the farms ranged from 6.8 to 26.2. The dairy farms had lower site- and product-related CO_{2eq} -emissions than cash crop farms. The organic farms had lower emissions than the conventional farms. In organic farming the site-related emissions were lower, but the product-related emissions were higher than in conventional farming.

The generalization of this results is difficult. Nevertheless, they showed the need to take into account site conditions and management practices.

Keywords: climate effects, humus-balance, energy balance, nitrogen balance

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Dr. Claudia Heidecke
Thünen Institute of Rural Studies
Bundesallee 64
38116 Braunschweig, Germany
Telefon: +49 531 596-5219
Fax: +49 531 596-5599
E-Mail: claudia.heidecke@thuenen.de

Hayden Montgomery
Special Representative
Global Research Alliance on Agricultural Greenhouse Gases

Dr. Hartmut Stalb
Research and Innovation
Federal Ministry of Food and Agriculture
Rochusstraße 1
53123 Bonn, Germany

Dr. Lini Wollenberg
University of Vermont
Low Emissions Agriculture
617 Main Street
Burlington 05405, United States of America

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