Climate balance of organic and conventional foodstuffs compared

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In the discussion regarding the climate-relevance of foodstuffs, the terms regionalism and non-regionalism are often at the center of public debate. Hereby the often much higher CO_2-emissions which are generated in agriculture and it's inputs as well as in foodstuff processing are regularly neglected. It is also the case that many CO_2-balances do not pay due attention – or just do not incorporate - land use change or the climate specific advantages of organic farming.

Every foodstuff causes greenhouse gas emissions (CO_2-eq), during production and processing, which contribute toward global warming.
A broad study conducted by FiBL Austria – for the organic brand *„Zurück zum Ursprung“* of the supermarket chain Hofer/Aldi Süd, investigated the CO_2-emissions of organic products and compared these with similar conventional products. In this process the value chain, from agriculture - including it's inputs (i.e. the production of fertilizer) - to the supermarket shelf, was taken into account. 95 foodstuffs from organic and conventional agriculture respectively, were subject to comprehensive CO_2-balancing. On the basis of the CO_2-savings ascertained, a CO_2-label has been established, which placed on the packaging of every *„Zurück zum Ursprung“*-product, makes the climate advantages apparent (s. Fig. 5).

CO_2- balancing: From the farm gate to the supermarket branch

The CO_2-balance was carried out along the entire value chain, from the agricultural production including it´s inputs (production of seeds, fertilizer etc.) to the supermarket branches. As a result, processing, packaging, transport and storage were also considered in detail. The foodstuff processing and marketing of the balanced products in question, is carried out on the level of nation-wide supermarket chains.

The eco-balancing was carried out as a Life Cycle Assessment (LCA) according to the IPCC guidelines (Smith et al./IPCC 2007). For this purpose FIBL Austria developed a climate assessment model, based strictly on the international eco-balance guidelines (ISO-guidelines 14040 and 14044). The CO_2-balancing carried out in this study includes all relevant greenhouse gases:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O),

These three greenhouse gases were calculated according to their climate effect in the form of „CO_2-equivalents“ (CO_2-eq).

Dairy, bread and vegetable products were all balanced in three different variations:

- Organic premium brand *„Zurück zum Ursprung“* (Bio-ZZU)
- Organic EU-standard (Bio-EU)
- Conventional foodstuffs (Konv.)

The study was based on detailed primary data for the organic brand *„Zurück zum Ursprung“* from the supermarket chain Hofer/Aldi Süd. These data provided, inter alia, the basis for an Austria-specific „supermarket standard“ for transport, processing, packaging and distribution.

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Approx. 20 Austrian and international statistics, as well as current national and international literature regarding CO_2-balances evaluation, made it possible to take the specific production conditions in Austria, as well as the current level of knowledge about CO_2-balance evaluation and land use change into consideration.

Until now generally not considered:

a) Humus accumulation through organic agriculture

The CO_2-binding in the ground resulting from humus increase in organic farmland has been scientifically documented in many cases (i.e. Niggli et al. 2009, Fließbach et al. 2007) and has been incorporated in the CO_2-balance of this study in detail. A study from Bavaria served as an – for Austria relevant – point of reference: On average 400kg CO_2/ha per year is bound through organic farming and thus long-term humus increase is achieved. In contrast, conventional agriculture leads to a humus decrease of 202 kg CO_2/ha per year (Hülsbergen and Küstermann 2007).

b) Land use change due to soy cultivation in the tropics

Austria imports large quantities of soy, used in conventional animal feed, primarily from Brazil (partially also from Argentina). In contrast, the quantity of organic soy imported from South America for organic agriculture is small. The organic brand „*Zurück zum Ursprung*“ does not import any soy from South America. soy cultivation in tropical regions, particularly in Brazil, contributes to the continued destruction of tropical forests. This causes, inter alia, huge CO_2-emissions, much larger than those caused by the transportation of soy from Brazil to Austria. The greenhouse gas emissions of this ecologically threatening land use change (LUC), contribute to 15-20% of global CO_2-emissions, more than the total emissions of global agriculture (Smith et al. 2007/IPCC). This is the first study which incorporates these LUC-caused CO_2-emissions, through the CO_2-balance of dairy products from conventional agriculture. These were not – or only partially – previously calculated, due to inadequate data.

CO_2-eq emissions of organic and conventional foodstuffs in Austria

Primary result of this study: All organic products (of the brand *„Zurück zum Ursprung“*) display per hectare but also per kg of foodstuff lower CO_2-emissions than comparable, conventional products:

- Dairy products: **10-21 % lower** CO_2-eq/kg milk
- Wheat bread: **25 % lower** CO_2-eq/kg bread
- Vegetables: **10- 35 % lower** CO_2-eq/kg fresh vegetables

The variation in CO_2-emissions between conventional and organic products arises through the kind of agriculture and it’s inputs. In contrast, processing, packaging, transport and storage do not differ between the organic and conventional supermarket products investigated.

The methane, emitted from a cow’s stomach, related to dairy products, causes 40-70% of the high CO_2-eq-emissions of dairy in agriculture. Agricultural production of vegetable products, generally causes considerably lower CO_2-eq-emissions (s. Figure 1, s. also Fritsche and Eberle 2007).

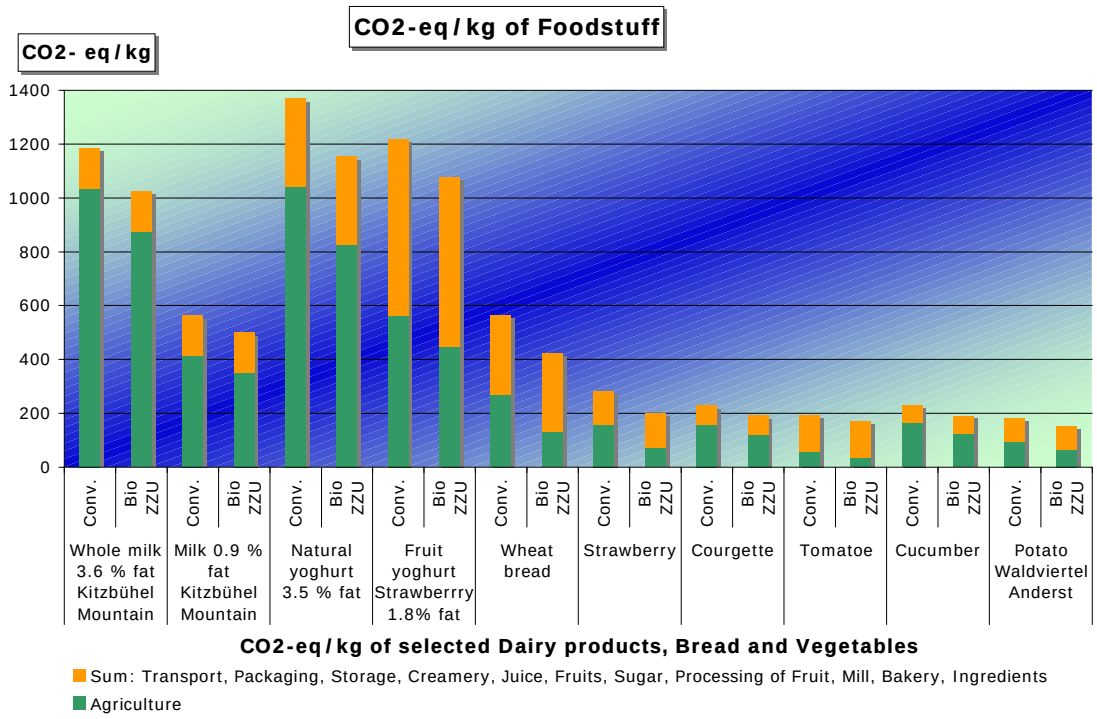

Figure1: CO_2-emissions of selected dairy products, bread and vegetables in g CO_2-eq/kg product (Conv. = conventional, Bio ZZU = organic premium-brand „Zurück zum Ursprung“)

Dairy

Despite lower milk output of organic cows, 15.7% less greenhouse gases (CO_2-eq) per kg of fresh milk are emitted compared to conventional production (Figure 2). The lack, or low proportion, of soy from South America in organic feed is the primary reason for the lower CO_2-emissions caused by organic milk. Transportation causes only a small proportion, 5-8%, of the total CO_2eq-emissions in all variations.

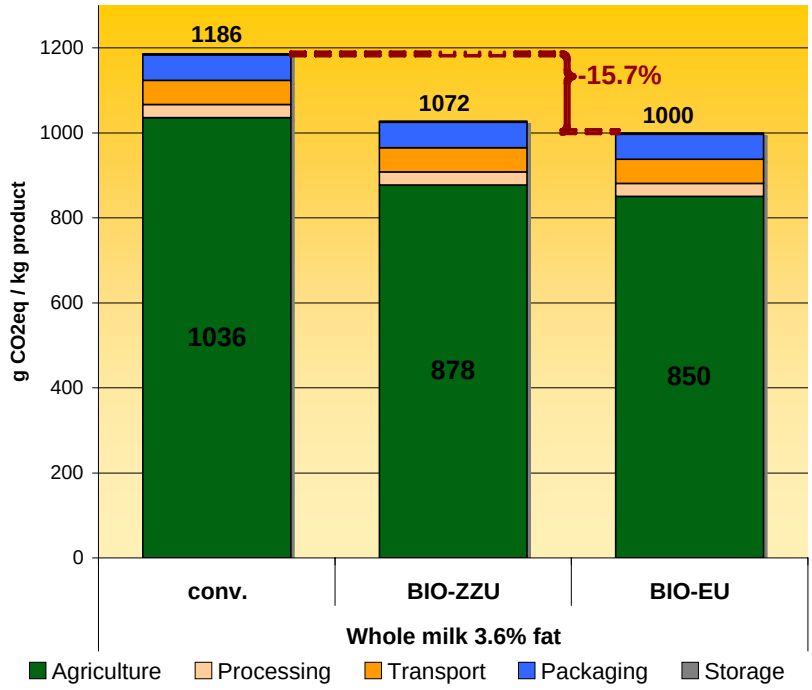

Figure 2: CO_2-emissions of 1 kg of fresh milk from conventional and organic agriculture in g CO_2-eq/kg milk (Konv. = conventional, Bio ZZU = organic premium-brand „Zurück zum Ursprung“, Organic-EU = organic EU-standard)

Wheat bread

The production of 1 kg of organic wheat bread from the brand „*Zurück zum Ursprung*“, with a balance of 433g CO_2-eq causes around 25 % lower CO_2-emissions than comparable, conventional bread (**Figure 3**). 1 kg of organic wheat bread produced following the organic EU guidelines, also displays 22% lower greenhouse gas emissions. Hereby the emissions caused by agriculture and baking make up the largest proportion of the CO_2eq-emissions. The proportion caused by transport is also under 10 %!

Although cereal and vegetable crops in organic agriculture are generally one third to half smaller than those produced using conventional agriculture, the CO_2-eq emissions/kg organic product are still around 10-35 % lower. An important reason for this is the lack of nitrogen (N)-mineral fertilizer, as this on the one hand requires much natural gas and crude oil for production. On the other hand, N-mineral fertilizer use causes considerably higher nitrous oxide (N_2O)-emissions than organic fertilizer.

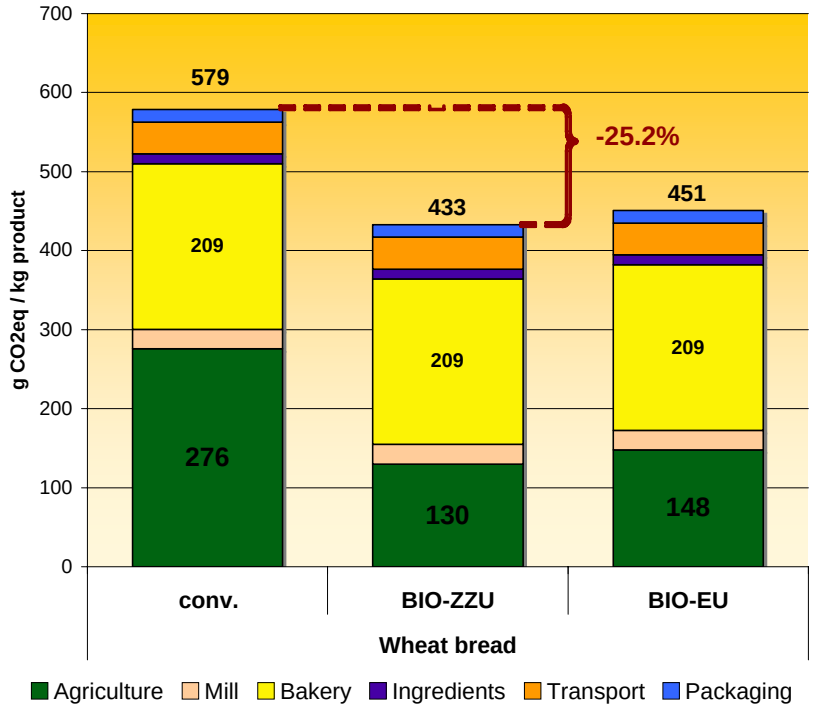

Figure 3: CO_2- emissions of 1 kg wheat bread from conventional and organic agriculture in g CO_2-eq/kg bread (abbreviations s. Fig. 2)

Onions

One kilogramme of *„Zurück zum Ursprung“* onions causes 139 g CO_2-eq/kg along the entire value-added. This is a saving of 13.7% compared to the conventional product (**Figure 4**). The example of onions demonstrates the low absolute CO_2-quantities of most freerange fresh vegetables. (s. also Fritsche and Eberle 2007).

In the area of agriculture the ecological production of onions (both organic variations) causes around 40% less greenhouse gas emissions than conventional production. Again the reason is the lack of N-mineral fertilizer.

The greenhouse gas emissions caused by transport are similar to dairy and bread at 57g CO_2-eq/kg, however exceed the small absolute emissions of agriculture. The proportion of the low total CO_2-emissions caused by packaging, becomes high in relation (around one quarter of the total emissions). Hence the saving effect of both organic variations is reduced over the total value-added chain to around 13%.

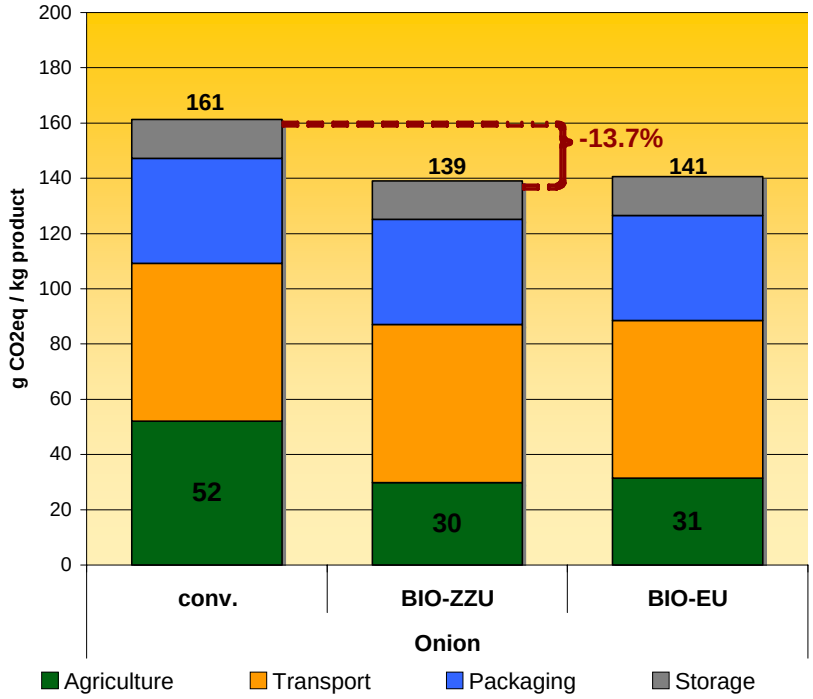

Figure 4: CO_2-emissions of 1 kg of onions from conventional and ecological agriculture in g CO_2-eq/kg onions (abbreviations s. Fig. 2)

Conclusion

Due to environmentally friendly cultivation and the low use of readily soluble mineral fertilizers, CO_2-emissions can be dramatically reduced in ecological agriculture. Moreover, through humus accumulation, CO_2 can be bound in the ground. This is also apparent in the lower CO_2-emissions/kg of product. In terms of dairy, the practice in ecological agriculture of (general) non-use of soy from South America (part. Brazil) results in lower CO_2-emissions per kg of organic milk. Hence the lower output of dairy in organic farms is more than compensated for. The results demonstrate that through the consumption of organic products, the CO_2-emissions/capita can be reduced considerably. In Austria this is made apparent to consumers through a packaging label on an entire organic product line (**Figure 5**).

Figure 5: CO_2-label on organic products of the brand *„Zurück zum Ursprung*“ (Example milk: Kitzbüheler Heumilch)

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Table: Differences in the CO_2-balances of organic and conventional foodstuffs (there are further products examples, here only the organic-EU variation is displayed)

Product	**CO2-eq/kg**	**CO2-eq/kg**	
	Conventional	Bio-EU*	**CO_2-Savings Bio-EU***
Natural yoghurt 3.5% fat	1.369	1.142	**-16.6%**
Fruit yoghurt, raspberry 1.8% fat	1.186	1.035	**-12.7%**
Sour cream 15% fat	5.257	4.190	**-20.3%**
Sweet cream butter	24.661	19.066	**-22.7%**
Alpine cheese, piece	9.923	8.137	**-18.0%**
Cream	10.869	8.798	**-19.0%**
Camembert	7.898	6.603	**-16.4%**

Butter milk strawberry 0.8% fat	0.650	0.576	**-11.4%**
Natural cream cheese 70% FiT	8.647	6.736	**-22.1%**
Cabbage turnip	0.165	0.138	**-16.5%**
Lettuce	0.124	0.109	**-12.2%**
Carrot	0.097	0.081	**-16.7%**
Wheat buns (incl. coarse ground rye and linseed)	0.799	0.654	**-18.1%**
Bun (wheat)	0.840 1.014	0.610 0.610	**-18.6%** **- 40%**
Whole grain bread	0.732	0.578	**-21.1%**
Loaf of rye bread	0.680	0.577	**-15.2%**
Wheat bread	0.579	0.451	**-22.1%**

* Organic products produced following Bio-EU-VO 834/07, under Austrian location and cultivation conditions