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Impact of different Agricultural Systems and Patterns of Consumption on Greenhouse-Gas Emissions in Austria

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Abstract

Agricultural systems as well as consumer patterns influence the green house gas emissions. Therefore, we analysed different farming systems, consumption patterns and seasonal oriented food consumption. Whereas conventional production and the current meat oriented nutrition patterns lead to high green house gas emissions, there is a tremendous reduction potential, if products are organically produced and if there is a shift to vegetarian-based diets.. Nevertheless, there is a need for research in terms of data quality, and a differentiation of farming systems as well as nutrition patterns.

Introduction

Agricultural systems follow different approaches in their energy budget. Conventional crop rotation systems uses plants with a low capacity for potential carbon sequestration in soils, e.g. with cropping systems like – winter wheat - winter barley - rape, where the root mass of the rotation is on average 0.8-1.5t DM $ha^{-1}a^{-1}$. In the contrary, organic cropping systems have the following rotation patter:– red clover - red clover - winter wheat - green manure – potatoes - grain legumes - green manure - winter rye - green manure - summer barley. The biomass output of the root system in organic crop production is 2.5-3.5t DM $ha^{-1}a^{-1}$ (Freyer 2003), which is more than double the conventional output. Additionally the organic system fixes between 50-90 kg N $ha^{-1}a^{-1}$. Several authors outline that the organic system has a high potential to reduce greenhouse-gas emissions (Dalgaard et al. 2003, Haas et al. 2001, Bockisch 2000, Haas et al. 1995). Furthermore, animal husbandry systems, where the whole fodder is organic, the fodder input and livestock per hectare are limited, and serve to impact positively on the reduction of greenhouse gas emissions (Koerber and Kretschmer 2000).

Agriculture is responsible for 14% of the global greenhouse-gas emissions (Stern 2006). Rough estimations state that nutrition and all related processes are responsible for 15 to 20% of the current energy consumption in developed countries (Jungbluth 2000). The most important factor in the food chain is animal production as well as consumption patters with a high share of meat (Taylor 2000). There is no doubt that consumer nutrition habits influence the green house gas emissions, especially if they prefer vegetable instead of meat. Besides these positive effects, the adoption of

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nutrition would reduce human diseases, which are a result of malnutrition and super-nutrition (Elmadfa et al. 2003; Kiefer et al. 2002).

Objectives

The aim of the study was to investigate the impact of agricultural production systems and different nutrition patterns on greenhouse-gas emissions in Austria.

Methods

The potency of the individual greenhouse gases is taken into account by the concept of the global warming potential (CO_2-equivalents). Based on this indicator we compared the current status quo with three scenarios to make a total of four scenarios:

- Scenario 1: Status quo: conv. agriculture/nutrition-average: average of Austrian nutrition pattern with conventional products.
- Scenario 2: org. agriculture/nutrition-average: average of Austrian nutrition pattern with bio-products.
- Scenario 3: conv. agriculture/nutrition-opt.: optimised nutrition pattern with conventional products.
- Scenario 4: org. agriculture/nutrition-opt.: optimised nutrition pattern with bio- products.

The average nutrition pattern of adult Austrians (S1) was derived from Austrian consumption statistics (Statistik Austria 2003). These we compared with standard nutritional science recommendations (DGE 2004). Data on greenhouse gas emissions for the production cycle of foods from the databank GEMIS 4.2 and from literature were used to calculate and compare the annual per capita emissions of the different nutrition patterns. Greenhouse-gas emissions for agricultural production and processing of foodstuff were calculated. Some simplifications and estimations were necessary because of lack of data on organic drinks, coffee, tea, cocoa, nuts, alcohol, processed organic foods among others. The food life cycle phases at transportation, trade and at household levels, which take place after agricultural production were not part of the analysis. Also in this sector we assumed, that if we account for these effects, the organic result would be better than conventional, because of regional oriented consumption patterns.

Results and discussions

There is a higher consumption of bread, vegetable and fruits in the recommended nutrition level. As a result of this, the fresh matter (FM) of recommended food consumption increased from 644.4 kg capita^{-1} a^{-1} in the average to 723.0 kg capita^{-1} a^{-1} in the recommended nutrition levels (Table 1). The analyses showed that greenhouse gas emissions caused by the current Austrian nutritional pattern can be reduced fundamentally. The change of products from conventional (S1) to organic production (S2) reduces the emissions by 30%. A change of nutritional pattern from the average (S1) to the recommended level of conventional products (S3)results in a reduction of the emissions by 16%, but the emission further reduces to 39% if there is change to the recommended level of bio-products (S4). The realisation of scenario 4 means a tremendous change in nutritional style; the food quality change (to organic products) as well as the daily food consumption pattern (to recommended levels). Based on a total of 10.6t CO_2-equivalents per capita and year, the adaptation contributes to a reduction of 4.7% (the last statement is not in the table).

Table 1: Scenarios on greenhouse-gas emissions based on agriculture system and nutrition patterns

Agriculture and Nutrition Pattern	Total Food Consumption	CO_2-Equivalents (E)	Savings versus Scenario 1	
Scenarios (S)	kg FM capita^{-1} yr^{-1}	kg capita^{-1} yr^{-1}	kg CO_2-E	%
1 Conv. Agriculture (S1)	644	1230	-	-
2 Org. agriculture (S2)	644	856	374	30.4
3 S1+recomm. Conv. Nutrition (S3)	723	1031	199	16.2
4 S2+recomm. organic nutrition (S4)	723	742	489	39.7

Source: own

Our results further indicated that the most important effects is realised with a change of meat, milk and cheese production and consumption to vegetable-based diet (Figure 1).

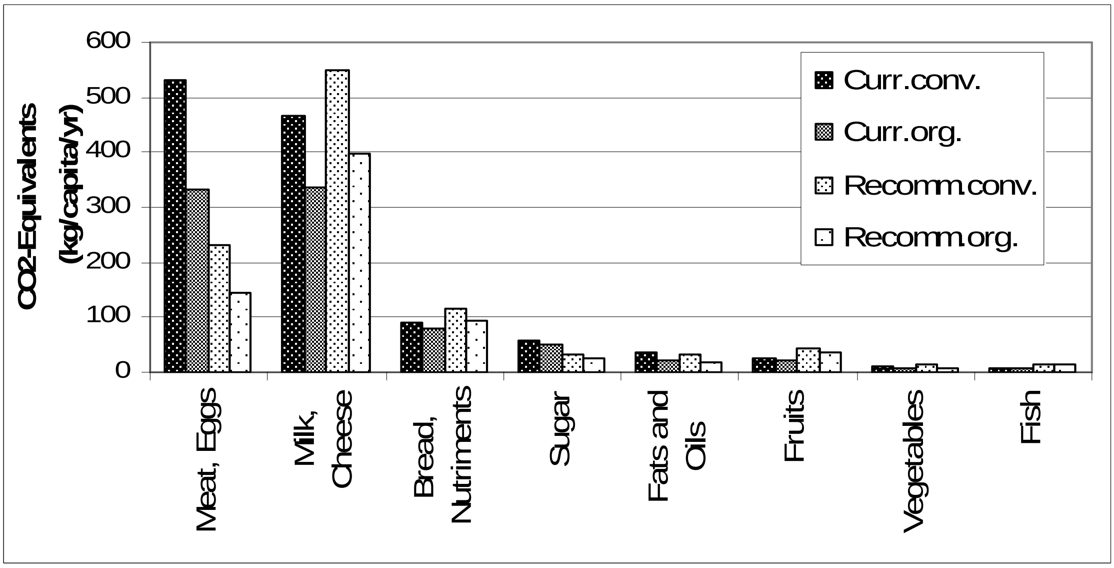

Figure 1: Greenhouse-gas emissions for product groups and nutrition patterns

Source: own

The most important effect is realised with a change of meat, milk and cheese production and consumption (Figure 1). There is a slightly increase of CO_2-equivalents with organic products and recommended nutrition pattern in terms of bread, nutriments, fruits, vegetables and fish, but not essential for the total emissions.

Conclusions

The calculations have shown that there is a high potential to reduce greenhouse-gas emissions by changing the agricultural system as well as the nutrition pattern towards a healthy nutrition. Several data of the organic production are over estimated in the estimation process, because of a lack of data on organic production. Both the conversion to organic agriculture as well as in nutritional patterns imply a high challenge for society. Additional costs are common arguments against the purchase of organic products, but the change in nutritional patterns implies the possibility to reduce costs because of lower meat consumption. In contrast to this, the change in consumption of milk products to the recommended levels, which could an increase of cost for the consumer, does not change the carbon emissions, Further investigations are needed for a detailed analysis of different nutrition patterns and their effect on both greenhouse-gas emissions as well as food costs. The production potential of organic products also need to be studied.

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