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Reduction of greenhouse gas emissions due to agriculture - Research results from Schleswig-Holstein –

The Research Group:
For many years, the Grassland and Forage Science/ Organic Agriculture Group of the Faculty of Agricultural and Nutrition Science in Kiel has considered the optimisation of the efficient use of resources in agricultural systems in various regions of Schleswig-Holstein, whereby the emphasis has been on the emission of greenhouse gases. Detailed information and publications of the results described below can be obtained via the homepage of the Institute (www.gassland-organicfarming.uni-kiel.de).

Challenges of future land utilisation and evaluation of emissions:
The reduction of greenhouse gases in only one aspect of the future challenges which face agriculture. Against the background of an increasing global population, the primary goal will be to produce more food and to produce this increased amount with less environmental pollution. In addition to climate change, the eutrophication of our water bodies and the loss of biodiversity are the central environmental impacts. The link between increased productivity and minimum environmental impact is expressed by an "eco-efficiency value" which means to produce more with less environmental pollution. This means recording of all relevant emissions (greenhouse gasses; nutrients) with reference to the product unit and not the area! With this approach it is possible to identify the production locations and production intensities with the greatest ecological efficiency on a global basis. Taking the example of the greenhouse gas emissions in the milk production process, this is expressed as the "carbon footprint" for milk, which is stated in CO_2 equivalents (g) per litre of milk. Milk is a good example, because there are already several figures available in the literature. What does this method mean for the optimisation of ecological efficiency with regard to the reduction of greenhouse gas emissions in the area of Schleswig-Holstein?

Is organic farming a method for the reduction of greenhouse gas emissions?
With the aid of the evaluation of greenhouse gas emissions per unit product, locations which favour conventional farming are those which have a very high potential yield. For Schleswig-Holstein it can be demonstrated that specialisation in cash crops (cereals; rape seed) in the favourable locations of the coastal uplands results in a definite superiority of the ecological efficiency of conventional systems, while the ecological efficiency of the intensity of ecological farming is definitely superior in the forage producing farms on the sandy soils (less use of fertilizer and less greenhouse gas emissions). The reasons for these differences in favour of ecological farming at the poorer locations include the lower potential yield with conventional farming and the possibility to grow legumes (clover, alfalfa). Due to this results we have developed a concept for "Suitable areas for ecological farming", which has been implemented by the Ministry of Agriculture, Environment and Resources.

Forage legumes (clover, lucerne) reduce greenhouse gas emissions by 70%!

In precise experiments we were able to demonstrate that fodder legumes which capture nitrogen such as white clover, red clover and alfalfa show a 70% reduction in greenhouse gases compared with fertilized grassland. This means that programmes for the promotion of cultivation of legumes are one of the most efficient climate protection measures. Furthermore, they are able to sustainably reduce the "protein gap" in Europe and reduce our dependence on imports of soy meal from South America.

"Pasture milk" –a method for the reduction of greenhouse gas emissions in milk production

At present we are working to produce a "carbon footprint milk" for Schleswig-Holstein and for this, we are investigating various milk production systems, ranging from "low input pasture systems" to very high intensities which use high levels of concentrates, the present standard system: Initial results now indicate that these high-intensity production systems with annual productions of more than 10,000 litres of milk per cow must be assessed as unfavourable to climate protection, as a large proportion of the fodder is provided in the form of imported concentrate (soy). This imported fodder for milk production in Europe corresponds to a "virtual import of greenhouse gasses" of more than 16 million tons of CO_2 equivalents per year, primarily caused by the change in land use in South America (forest and grassland changed to arable use). These climate costs for the change of land use in South America must be added to our milk production. With regard to greenhouse gas emissions, this makes intensive systems 30% less favourable than low input pasture systems.

A European land register of "absolute grassland" is necessary

For several years now, within the context of the CC regulations, the cultivation of grassland has been prohibited, with the aim of preserving grassland soils as a carbon sink. However, our investigations show that it is necessary to differentiate long-term grassland into "absolute" and "optional" grassland.

Optional grassland means that arable use would be conceivable at this location without serious negative ecological consequences, among other things because it has already been used as such in the past. We were even able to demonstrate that at such locations silage maize has a considerably greater ecological efficiency (less greenhouse gas emissions per unit of fodder energy produced) than grassland. Therefore a prohibition of cultivation of grassland is not justified here.

Absolute grassland especially relates to hydromorphic soils (peat soils, old marshes) with a high potential for carbon storage, or low mountain areas with high risk of erosion etc, which are also locations which should not be used for arable farming for ecological and economic reasons. Schleswig-Holstein and Lower Saxony are the federal states with the highest proportion of moorland grassland which contribute to milk production in the state. At these locations the question arises as to whether climate-friendly grassland farming is possible for milk production, or whether it is necessary to abandon agricultural land use (succession) and to dam the groundwater up to the surface level in order to allow the moors to regenerate and to reduce greenhouse gas emissions.

For 3 months we have been carrying out a measurement programme in the Eider-Treene-Sorge lowlands and the initial results indicate that with modified grassland farming (high ground water level) it is possible to achieve a win-win situation, i.e. this option ensures reduced greenhouse gas emissions, secures further agricultural value creation and finally ensures a successful protection of meadowland birds which fulfils the specifications of the FFH Directive in a convincing manner.