Accounting for greenhouse gas emissions at farm level

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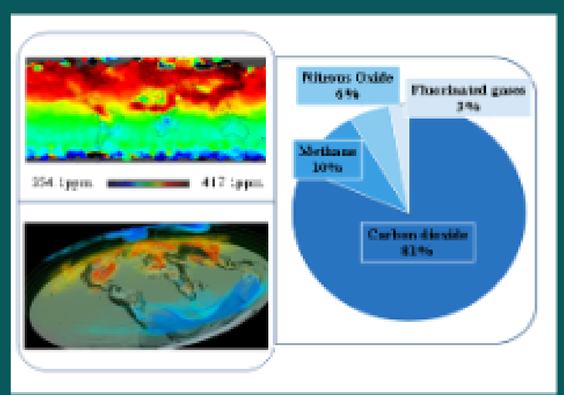
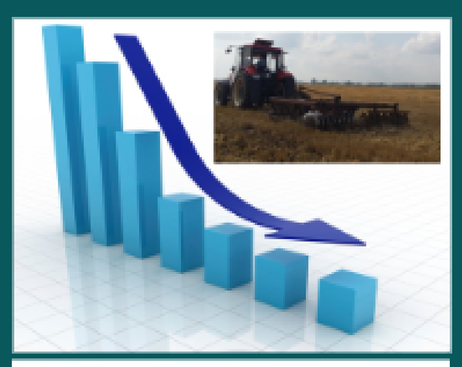
Introduction

Gases evaporate from manure, mass exchange takes place between the liquid on the manure surface and the surrounding air flow. This evaporation process corresponds to the general structure of all evaporation processes, and the basis of its structure is convective mass exchange, where the gas flow varies depending on the convective mass transfer coefficient and the gas concentration gradient on the surface of the manure layer and on the surface of the manure (Rong et al., 2009). When choosing methods for the study of GHG emissions, it is necessary to evaluate the technology and technical solutions of keeping animals in the barn. When modernizing animal husbandry technologies, it is very important to reduce the impact on environmental pollution. Gas emissions must be reduced at all stages of manure management: barns, manure pits and during transport and incorporation of manure into the soil (Rzeznik et al., 2015; Zhang et al., 2005; Wu et al., 2012). In order to account for the modelling of greenhouse gas (GHG) emissions at the farm level, it is necessary to define the main farm components from a farm-wide perspective (Schils et al., 2007).



Method



The accounting system for GHG emissions and CO2 absorptions at the farm level is an IT tool created according to specially prepared GHG calculation methodologies, adapted formulas with selected variables and parameters. The main aspects of the activities of the mixed, animal husbandry and crop farms that influence GHG were evaluated.

It is mandatory to use the GHG accounting methodology of the Intergovernmental Panel on Climate Change (IPCC - Intergovernmental Panel on Climate Change). According to the IPCC methodology, based on the experience of other countries, a spectrum of GHG emission sources has been determined at the farm level, including criteria defining the sustainability of the farm, and a methodology and system for accounting for GHG emissions at the farm level has been created. The developed model-system for calculating GHG emissions is calculated in three stages. The animal population is divided into subgroups and each of them is described. The emission coefficients of each subgroup in kilograms per animal per year and the number of animals in the subgroup are evaluated. Three (Tier 1, Tier 2, Tier 3) detail and complexity methods were used for calculation. The accounting system for GHG emissions at the farm level is created according to specially prepared GHG calculation methodologies, adapted formulas with selected variables and parameters. It was calculated main parameters - enteric fermentation, CH_4, direct and indirect N_2O emissions, recalculated CO_2 eq and total emissions from manure management. The calculation platform was tested by 3 scenarios. SC1 - pasture 25%, solid manure management system 75%, SC2 - pasture 0%, solid manure management system 100%, SC3 - aerobic recycling 100%.

Results

farm GHG calculator

Enteric Fermentation (For Livestock Farms)

Livestock kept on the farm:

Nr.	A type of animal	Annual average number of animals	Average animal weight, kg
1	Dairy cattle (cows)	459	500

Manure management technologies (for livestock farms)

Manure management system, %:

	Nr.	A type of animal	In the pastures	Solid manure handling system	Liquid manure handling system with natural crust on the surface	Liquid manure management system without natural crust on the surface	Uncovered anaerobic lagoon	Deep litter system (up to 1 month)	Deep litter system (more than 1 month)	Bird manure with litter	Bird manure without litter	Aerobic processing
SC1	1	Dairy cattle (cows)	25	75	0	0	0	0	0	0	0	0
SC2	1	Dairy cattle (cows)	0	100	0	0	0	0	0	0	0	0
SC3	1	Dairy cattle (cows)	0	0	0	0	0	0	0	0	0	100

SC1 → Total GHG of the farm: **1811470.17** kg per year in CO_2 equivalent

SC2 → Total GHG of the farm: **1720401.22** kg per year in CO_2 equivalent

SC3 → Total GHG of the farm: **1461226.50** kg per year in CO_2 equivalent

SC1 -5.03% SC2 -15.06% SC3

SC1 -19.33% SC3

After calculation platform assessment of different scenarios when is simulating different manure management such effective measurements for GHG reduction. It was evaluated that SC1 scenario (pasture 25%, solid manure management system 75%) when average number of animals 459 and animal weight 500 kg, was effective and 5% reduce CO_2 eq per year. SC2 scenario (pasture 0%, solid manure management system 100%) was more effective and 15% reduce CO_2 eq per year. The most effective was scenario SC3 (aerobic recycling 100%) and more then 19% reduce CO_2 eq per year.

Conclusions

- After analyzing all the factors that shape emissions at the farm level and correctly reflect sustainable farm actions that ensure the principles of circularity and sustainable resource use, the FarmGHG calculation tool will help determine the emission sources of technologies and tools applied on the farm according to the IPCC methodology.
- A methodically based GHG accounting system, which will record more accurate data collection in specific farms, would enable the state to know problem areas to which support measures aimed at reducing GHG emissions could be directed more appropriately, to carry out monitoring and to analyze the benefits provided by the support.
- The FarmGHG assessment system is an effective tool for consultants providing consulting services, preparing farm sustainability plans and monitoring the results of the implementation of measures. Also, more detailed farm-level data will allow the farmer to make individual decisions related to reducing greenhouse gas emissions, optimizing the farm, and increasing productivity.

References

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