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Animal Husbandry and Manure Management Systems in Austria

Surveying Concept and a Methodological Approach

To compute emission inventories, knowledge about animal husbandry and farm manure management is very important. The Division of Agricultural Engineering collects production process data from about 2,500 farms. Model farms are simulated from this and emissions calculated.

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Literature

Literature references can be called up under LT 06424 via internet <http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm>.

Austria has to comply with several air emission related obligations. Emissions must be reported on an annual basis following internationally agreed reporting guidelines [1]. Austria must reduce greenhouse gas and ammonia emissions and must prove the effect of mitigation measures.

For the agricultural sector, emission inventories for nitrous oxide (N₂O), methane (CH₄), and ammonia (NH₃) must be compiled. Emissions are estimated by multiplying activity data (e.g. animal numbers, manure management systems, N excretion) with emission factors. Emission inventory guidelines give default values for activity data and emission factors that have to be applied if national values are unavailable. Default values tend to be high in order to encourage countries to collect national data.

Agricultural emissions strongly depend on the animal housing and on the manure management system (MMS) distribution. These data are a mandatory pre-requisite for accurate emission estimates that comprise a low range of uncertainty. Mitigation measures can only show up, if representative data on the MMS distribution are available. Currently, these data lack in Austria which in consequence leads to two major disadvantages: Austrian specific values can only to a small extent be integrated in the national emission inventory and due to the lack in activity data, the effect of mitigation measures can at this point of time not show up in the national emission inventory.

The necessity of collection more accurate data on national manure management system distributions is well acknowledged. Lately, a number of European countries have surveyed their manure management system distribution and have published improved emission inventories [2, 3, 4, 5, 6]. These improved inventories reflect country specific conditions much better than inventories that are based on default emission factors.

In Austria, the research project "Animal husbandry and manure management systems in Austria" surveys representative farms.

The Division of Agricultural Engineering (DAE) of the Department for Sustainable Agricultural Systems of the University of Natural Resources and Applied Life Sciences Vienna heads the project and closely co-operates with the Swiss College of Agriculture, the Austrian Chamber of Agriculture, the Austrian Environment Agency, the Federal Research Centre for Agriculture in Alpine Regions, and the Statistics Austria.

The Austrian survey follows the Swiss "DYNAMO"¹ methodology [3]. The project aims at the following: detailed overview on Austrian animal husbandry, improvement of the Austrian emission inventory, modelling of typical farms and estimation of their emissions, development of emission scenarios, proposal of feasible mitigation measures and target-oriented and efficient consultancy for commercial farms.

In November 2005, the questionnaire was sent to a representative sample of 5,000 Austrian farms. A high rate of questionnaire return (40 to 50 %) had to be achieved to receive representative data on animal husbandry and manure management systems in Austria.

Survey and questionnaire

Accurate emission inventories must be based on national activity data rather than on default values. DAE surveys a representative sample of Austrian farms by sending them a questionnaire that had to be filled in by the farmer. The survey is the basis of the further data processing, emission estimates and proposal of abatement measures. Special consideration was given to carry out a high quality survey.

Questionnaire design

Greenhouse gas and ammonia emission can arise from the whole agricultural production process: fodder production, animal husbandry, manure management and manure

¹ Dynamic emission inventory for ammonia

application. The questionnaire assesses relevant parameters in all stages of animal husbandry systems: housing and exercise yard, grazing, waste and washing water, manure storage, manure application, animal feeding, and mineral fertiliser application.

The sections "animal housing", "exercise yard" and "grazing" assess details on the housing system, and on the yard and grazing management. The sections "manure storage" and "manure application" ask for manure storage facilities, manure treatment and when and how the manure is applied to agricultural land and/or grassland. Questions on feeding strategies and animal diet composition serve as a basis for estimates of N excretion, manure composition and CH₄ emissions from enteric fermentation. In the last section, data on amount and composition of mineral N fertilisers have to be filled in. The Austrian questionnaire is based on the questionnaire that was used in the Swiss DYNAMO project. Austrian experts gave their view on the questionnaire in context with Austrian agriculture and made proposals for necessary adaptations to more specifically meet Austrian farming conditions.

Prior to the full survey, a pre-test was carried out on 50 commercial farms that covered the range of Austrian farming types in order to check all sections of the questionnaire. Most of these 50 farms were contacted by phone after having filled in the questionnaire and were asked for their opinion and for the understandability of the questionnaire. The experiences gained in the pre-test helped to further optimise the questionnaire before sending the final version to the full sample of Austrian farms.

Representative sample of Austrian farms

The sample design and the subsequent drawing of the sample were done in close cooperation with the Statistics Austria. For the sample design, the Statistics Austria proposed the following criteria:

- NUTS²1 region:

- 1 Eastern Austria (Burgenland, Lower Austria, Vienna)
- 2 Southern Austria (Carinthia, Styria)
- 3 Western Austria (Upper Austria, Salzburg, Tyrol, Vorarlberg)

- Weighing factor "hv": weighted sum from arable area and the number of livestock units scaled with 1.21.

Farms with animal husbandry play a greater role in the emission inventory than farms without animal husbandry and should be more often represented in the survey sample. Thus, the Statistics Austria weighed arable land with the factor 0.2 and livestock num-

ber with the factor 0.8.

$(hv = 0.2 \cdot \text{arable land} + 0.8 \cdot 1.21 \cdot \text{livestock units})$.

The sample size was 5,000 farms and was distributed to the three NUTS 1 regions proportionally to $hv \cdot 0.8$. In each of the NUTS 1 regions, the sample sizes were distributed according to the product from sample size and standard deviation of the weighing factor "hv". Through this allocation algorithm, classes with larger farms were disproportionately considered in the sample.

Measures to increase the rate of questionnaire return

The survey aimed to achieve a rate of questionnaire return of 40 to 50 %. This made a range of accompanying measures necessary. Special attention was given to an early and comprehensive information of Austrian farmers. Project background and details were published in a range of farmer journals and on a project web site.

Project preparation and questionnaire development were done in close cooperation with the Austrian Chamber of Agriculture and with the Regional Chambers of Agriculture. The joint acting of DAE and the Austrian Chamber of Agriculture increased the project acceptance by the Austrian farmers and their willingness to contribute to the survey.

Members of the Regional Chambers of Agriculture directly contacted farmers and informed them about the project. In the case of no return of the questionnaire, farmers were contacted again and asked to fill in the questionnaire and return it to DAE which considerably increased the rate of return.

Up to now, 2,060 questionnaires have been returned to DAE which corresponds to a rate of return of 41 %.

DYNAMO – Dynamic Ammonia Emission Inventory

Currently, the returned questionnaires are manually fed into a data template by the Statistics Austria. On the basis of this template, a data base is created that contains the questionnaire information. Anonymity of the farms that supplied data is guaranteed. The data base will be checked for representativeness and plausibility prior to the emission calculations.

Emissions will then be calculated with the help of the computer based program "DYNAMO" (Dynamic Ammonia Emission Inventory) [3]. "DYNAMO" is based on the simple empirical model to estimate ammonia emissions from animal husbandry published by [7, 8]. The model was further refined and can now estimate ammonia losses from the whole manure management conti-

num. Emission estimates are based on the amount of N in the sections housing, grazing, exercise yard, manure storage and manure application. "DYNAMO" differentiates animal categories, manure management systems and a range of management parameters. Ammonia losses from mineral fertiliser application are estimated, as well.

"DYNAMO" emission estimation procedures are based on the N flow model as it has been describe in the CORINAIR Guidelines [9]. Ammonia emissions mainly depend on the amount of total ammonia nitrogen (TAN) rather than on the amount of total N. Ammonia emissions are estimated as a percentage of TAN present in each stage of the manure management continuum. Only for fresh excreta in the animal house or during grazing, "DYNAMO" estimates ammonia losses from their total nitrogen content.

The Swiss College of Agriculture makes the computer based program "DYNAMO" available for DAE. "DYNAMO" may be used within the research project "Animal husbandry and manure management systems in Austria". "DYNAMO" parameters will be adapted to Austrian specific conditions. In addition to NH₃ emissions, emissions of the greenhouse gases N₂O and CH₄ will be calculated.

In a first step, model farms will be calculated from the survey results. Then, emissions will be estimated for the Austrian provinces and for the whole of Austria. Abatement potentials will be shown and measures for a reduction of ammonia and greenhouse gas emissions will be derived from the results. The project lasts until the end of December 2006 and is financially supported by the Austrian Federal Ministry for Agriculture and Forestry, Environment and Water Management.

² NUTS: Nomenclature des unites territoriales statistiques".