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Emission Inventory in Austria

State of the Art and Future Developments

It is mandatory for countries to report emissions annually. The Division of Agricultural Engineering (ILT) is involved in compiling the emission inventory for the agricultural sector in Austria. ILT is a member of national and international working groups, which update guidelines for emission inventories and make proposals for abatement measures.

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Literature

Literature references can be called up under LT 05209 via internet http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm.

Countries have to comply with several air emission related obligations. The UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) entered into force in 1983. It consists of eight protocols which identify specific obligations for distinct air pollutants. The latest protocol is the Gothenburg Protocol to abate acidification, eutrophication, and ground level ozone. It aims to achieve the following reductions until 2010 compared to the base year 1990: sulphur 63 %, NOx 41 %, NMVOC 40 %, and NH_3 17 %. Austria has a national emission ceiling of 66 Gg NH_3. The Protocol requires best available techniques to be used to keep emissions down.

Sources and sinks of the direct greenhouse gases (GHG) CO_2, CH_4, N_2O, HFC, PFC, and SF_6, and of the indirect GHG NOx, NMVOC, CO, and SO2 are reported under the United Nations Framework Convention on Climate Change (UNFCCC). Austria signed the UNFCCC in 1992. In 1997, the Kyoto Protocol was adopted. Building on the UNFCCC, the Kyoto Protocol broke new ground with its legally-binding constraints on GHG emissions. The industrialised countries pledged to reduce their GHG emissions by 5% below 1990 levels by the period 2008 to 2012. The European Union agreed on a reduction target of 8 %. For Austria, an emission target of minus 13 % was set. The Conference of the Parties (COP) decided that a National Inventory Report (NIR) has to be prepared annually. The NIR must provide transparent, consistent, comparable, complete, and accurate data on sources and sinks of national emissions and must evaluate the progress towards meeting the GHG reduction commitments under the Kyoto Protocol.

Austrian emission inventory

In Austria, the Umweltbundesamt has a legal responsibility for the preparation of Austrian emission inventories. In order to fulfil various national and international obligations, the Umweltbundesamt annually prepares a comprehensive Austrian Air Emission Inventory („Österreichische Luftschadstoff-Inventur, OLI"). A quality management system (QMS) has been installed according to the European Standard ISO EN 45004 [1].

Regulations under the UNECE/LRTAP Convention define standards for the preparation and reporting of national emission inventories. In 2002, new guidelines were adopted to ensure that the transparency, consistency, comparability, completeness, and accuracy requirements are met [2]. Ammonia emissions are reported according to the methodologies outlined in the EMEP/CORINAIR Guidebook [3]. GHG emissions are estimated following IPCC1 methodologies [4, 5].

IPCC-GPG requires uncertainty estimates as an essential part of a complete emission inventory. Uncertainty information is not intended to dispute the validity of the inventory as a whole but to help prioritise efforts to improve the accuracy of inventories. In Austria, a comprehensive uncertainty analysis was performed by [6] on the GHG CO_2, CH_4, and N_2O. The emissions of CO_2 have a low uncertainty (2.3 %). Estimates of CH_4 and N_2O emissions comprise a higher range of uncertainty: 48.3 %, and 89.6 %, respectively [7].

Emissions and trends

From 1990 to 2003 Austria's total GHG increased by 16.6 %. This was mainly due to an increase in CO_2 emissions which contributed 82.3 % to the total GHG. 8.8 % of total GHG emissions resulted from CH_4, and 6.8 % from N_2O (year 2002 [7]).

Agriculture had a share of 8 % in national GHG emissions. 42 % of agricultural GHG emissions came from enteric fermentation, 36 % from agricultural soils [1]. 51 % of Austrian CH_4 emissions and 61 % of N_2O emissions resulted from agricultural activities. Agricultural GHG emissions are composed of 46 % CH_4, and 54 % N_2O [1].

In 2002, 96.7 % of national NH_3 emissions in Austria resulted from the agricultural sector. Animal husbandry held the biggest share in agricultural NH_3 emissions (84.8 %) with cattle husbandry contributing 74.8 % to these emissions, followed by the pig sector with 15.3 % [8].

Livestock category	VS excretion after [11] [kg head^{-1} day^{-1}]	IPCC default value [kg head^{-1} day^{-1}]
suckling cows	3,41	
beef cattle	2,96	2,7
cattle 1 - 2 years	1,60	
cattle < 1 year	0,23	

Table 1: VS-excretion of "other cattle" in Austria and IPCC default value

Update of the Austrian emission inventory, sector „Manure Management"

In 2001, the Umweltbundesamt assigned the Division of Agricultural Engineering (ILT) and the ARC Seibersdorf research Ltd. to update the agricultural sector of the Austrian NH_3 and GHG inventory for the years 1989 to 2002 [9, 10]. The update had the following aims:

- fulfil requirements on inventory preparation
- integrate Austrian specific data
- reduce uncertainties in emission estimates.

ILT estimated emissions from the sector „manure management". CH_4, and N_2O emissions were calculated following the „Revised 1996 IPCC guidelines". The „EMEP/CORINAIR Guidebook" was the basis for the NH_3 estimates. All details on the inventory preparation can be taken from [9]. The following sections summarise the main aspects.

CH_4 emissions

CH_4 emissions from sheep, goats, soliped and poultry play a minor role in Austria, and were estimated with the „Tier 1" approach and the IPCC default emission factors. The Austrian inventory uses the „Tier 2" methodology to estimate CH_4 emissions from management of cattle, and swine manure as these are key sources. Data on volatile solids (VS) excretion were required. Austrian specific data were obtained from the studies by [11], and [12]. VS excretion of dairy cattle varies with the milk yield, and was annually adapted. VS excretion of other cattle and pigs was kept constant for the inventory period 1989 to 2002. The IPCC guidelines only give one default value for VS excretion of other cattle, and pigs. However, these animal categories comprise several sub-categories with contrasting VS excretion. This was taken into account in the Austrian inventory (*Table 1*).

Estimates of CH_4 emissions from manure management are based on the maximum methane producing capacity (B_0). Methane conversion factors (MCF) give the percentage of B_0 that is volatilised during manure storage on commercial farms. As no Austrian specific data are available, IPCC default values were used in the inventory.

IPCC default values distinguish several manure management systems (MMS). An accurate emission inventory requires data on the MMS present in a country. However, IPCC default values for Western Europe do not always represent Austrian conditions. E.g. the default values assume 20 % „daily spread", and 2 % „burned for fuel". Both MMS did not exist in Austria. Thus, compiling the inventory with IPCC default values would result in larger uncertainties than using country-specific values.

The GPG recommended to conduct an independent survey of MMS usage. In Austria, only one survey has been carried out so far in the years 1989 to 1992 [13]. These data were used to compile the inventory as no data are available that would allow a more accurate estimation of the MMS distribution in Austria.

N_2O emissions

For the estimation of N_2O emissions from MMS only a „Tier 1" approach is available. The IPCC Guidelines method for estimating N_2O emissions from manure management entails multiplying the total amount of N excretion in each type of MMS by an emission factor for that type of MMS. Emissions are then summed up all over MMS. Austrian specific data were available for N excretion of cattle, and pigs (*Table 2*). IPCC default values were taken for N excretion the other animal categories. N excretion of Austrian dairy cattle was related to annual milk yield. Data were taken from an extensive study [12]. N_2O emissions were estimated with the default emission factors given in the IPCC guidelines.

NH_3 emissions

NH_3 emissions from cattle, and pigs were estimated with EMEP/CORINAIR detailed methodology. For the other animal categories, the simple methodology was applied.

Besides the data mentioned in the sections above, estimation of NH_3 emissions requires data on TAN content of manures, and on the housing systems in which the animals are kept. Schechtner [11] gives Austrian specific values for manure TAN (total ammonia nitrogen) content. With dairy cattle, the housing system is a key factor for NH_3 emissions. Emissions from tied systems are very different from emissions from loose housing systems [15]. In 1992, 98 % of Austrian dairy cattle were kept in tied stalls [13]. Changes in dairy housing after 1992 can not be shown in the inventory as no data are available yet.

No Austrian specific emission factors are available for NH_3 emissions from pastures, manure stores and manure application. The Austrian inventory was mainly compiled with Swiss values [14] or with emission factors given in [15].

Livestock category	N-excretion [kg per animal per yr]	Source
Dairy cattle[1]	63,0	[12]
suckling cows[2]	51,9	[12]
cattle 1 - 2 years	42,2[2]	[12]
cattle < 1 year	16,0[3]	[15]
beef cattle >2 years	60,0[4]	[14]
breeding sows[3]	26,9[2]	[12]
fattening pigs	15,0[3]	[14]

[1]... milk yield: 5,000 kg a^{-1}
[2]... milk yield: 3,000 kg a^{-1}
[3]... 2.1 litters per year

Table 2: N excretion of cattle and pigs in Austria

Future improvements

Emission inventories must:

1. Estimate national emissions as accurately as possible.
2. Show the annual trend in emissions, and the effect of mitigation measures.

Agricultural emissions mainly depend on the animal housing, and on the manure management system. These data are a mandatory pre-requisite for emission estimates which comprise a low range of uncertainty. Mitigation measures can only show up, if representative data on the MMS distribution are available.

In Germany, [15] conducted a substantial project and improved the inventory quality. In England and Wales, research efforts were undertaken to estimate agricultural emissions more accurately [16]. The project „DYNAMO" was carried out in Switzerland. Questionnaires were distributed to 2,000 Swiss farms and detailed data on the housing system and on the manure management were assessed [17].

In Austria, the project „Animal husbandry and manure management in Austria" will start soon. Following the Swiss methodology, around 5,000 questionnaires will be distributed to farmers. 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
- Target-oriented and efficient consultancy for commercial farms

ILT will closely cooperate with the Austrian Chambers of Agriculture, the Austrian Environment Agency, the Federal Research Centre for Agriculture in Alpine Regions, and the Statistics Austria.