Calculating CRIs 18 & 19 in Austria:
Reduced emissions of methane and nitrous dioxide & reduced ammonia emissions

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Background

RDP Measures

10.1.2	Limitation of yield increasing inputs [1]
10.1.3	Renouncement of fungicides and growth regulators in cereals[1]
11.2.1	Organic farming[1]
10.1.9	Surface-near spreading of liquid farm manure [2]

R 18

[1]secondary contribution to 5D; [2]primary contribution to 5D

Background

RDP Measures

10.1.9	Surface-near spreading of liquid farm manure[2]	R 19
14.1.1	Animal welfare – grazing of livestock [1]	R 19
14.1.2	Animal welfare – stable[1]	R 19
4.1.1	Solid covering of slurry tanks[1]	

[1]*secondary contribution to 5D;* [2]*primary contribution to 5D*

Calculation of CRI 18

Reduced N_2O emissions

For Measures (VHA) 10.1.2, 10.1.3 and 11.2.1 (limitation of yield increasing inputs, renouncement of fungicides and growth regulators in cereals, organic farming):

- **Expert judgements** on abated N amounts
- Assumptions for abated N amounts verified with the results from a national study using the **model LandscapeDNDC** (version 1.9.3) to calculate N_2O emissions of different measures
- N_2O emission calculations based on the **2006 IPCC Guidelines**

For Measures (VHA) 10.1.9 (spreading of slurry close to the ground reduced indirect N_2O emissions were calculated:

- On the basis of the **2006 IPCC Guidelines** and **NH_3 abatement potentials** provided in **UNECE (2015)** in accordance with the national inventory

Calculation of CRI 18

1) Data sources

A) Activity data: IACS database:

areas of RDP measures (10.1.2 etc…) in ha

amount of slurry in m^3 applied by trailing hose spreaders and injection

B) Emission factors: Austria's GHG Inventory (Umweltbundesamt, submission 2019).

Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions (UNECE 2015).

PÖLLINGER, A. et al. (2011): Evaluierung der ÖPUL-Maßnahme Verlustarme Ausbringung von flüssigen Wirtsdüngern und Biogasgülle. Projekt Nr./Wissenschaftliche Tätigkeit Nr. Antrag 100585.

FOLDAL et al. (2019): Forschungsauftrag Evaluierung verschiedener ÖPUL Maßnahmen in Hinblick auf die Reduktion von Treibhausgasemissionen, insbesondere Lachgas. Endbericht, 15.10.2019.

Calculation of CRI 18

2) Assumptions: Reductions of N fertilizer input compared with the representative management without RDP measures

Limitation of yield increasing inputs esp. by cattle and diary farmers (Objective: Preservation of grassland, increase the percentage of clover, Lucerne and mixture of grass & clover on arable land):

Grassland minus 10 kg/ha; Arable land minus 30 kg/ha

Renouncement of fungicides and growth regulators in cereals (Objective: Reduction of pesticides, esp. resistant cultivars and extensive cultivation (lower density - ears per m^2 - is required):

Arable land grown with cereals minus 15 kg/ha

Organic farming (Area percentage: Arable land 20%, Grassland 32%, Wine growing area 16%, Fruit growing area 35%)

Arable land minus 65 kg/ha; Grassland minus 25 kg/ha; Vineyards minus 30 kg/ha; Fruit growing (esp. apple) minus 30 kg/ha

Calculation of CRI 18

3) Emission Calculation (measures 10.1.2, 10.1.3, 11.2.1) acc. to IPCC 2006 methodology

Limitation of yield increasing inputs, renouncement of fungicides and growth regulators in cereals, organic farming

1) **AD:** Areas (ha) under specific measures multiplied with specific nitrogen reduction potentials (kg N abated per ha). Result are total annual amounts of **N not applied on agricultural land** (“annually abated N amounts, N_{abated}”).

2) Calculation of abated **direct N_2O-N emissions** (2006 IPCC Guidelines):

    Multiplication with the IPCC default EF of 0.01 kg N_2O -N per kg N_{abated} in investigated year

3) Calculation of abated **indirect N_2O-N emissions from leaching and run-off** (2006 IPCC Guidelines):

    N_{abated} multiplied with the country specific fraction of leaching and run-off (0,15) based on (Eder et al. 2015)

    and multiplied with the IPCC default EF of 0.0075 kg N_2O -N per kg N leaching & run-off

4) Calculation of abated **indirect N_2O-N emissions from N volatilization and re-deposition**:

    N_{abated} multiplied with the country specific fraction of volatilization from synthetic fertilizers (from national inventory)

    and multiplied with the IPCC default EF of 0.01 kg N_2O -N per kg NH_3-N +NO_x-N volatilized

N_2O-N is converted to N_2O by multiplication with the **factor *(44/28)**

Calculation of CRI 18

Limitation of yield increasing inputs, organic farming, renouncement of fungicides and growth regulators in cereals (use on arable land, grassland, wine, fruits)

Results:

	2015	2016	2017	2018
Area [ha]	745 333	763 614	809 061	817 998
Saved mineral N amounts	21 638	22 655	24 564	25 355
Abated emissions [t N_2O]	399	417	453	467
Abated emissions [t CO_2eq]	118 808	124 392	134 872	139 215
N_2O Agriculture* [t CO_2eq]	2 476 303	2 559 545	2 487 532	2 440 575
Total GHG Agriculture** [t CO_2eq]	7 246 136	7 360 923	7 313 779	7 224 351

* Austria's N_2O emissions from IPCC Sector 3, Agriculture, UNFCCC submission 2020 (in CO_2 equivalent)

** Austria's emissions of N_2O, CH_4, CO_2 from IPCC Sector 3, Agriculture, UNFCCC submission 2020 (in CO_2 equivalent)

Calculation of CRI 18

3) Emission Calculation (measure 10.1.9) acc. to IPPC 2006 methodology

Surface-near spreading of liquid farm manure

1) **AD: Supported amounts** of slurry (m^3 per year) applied by **trailing hose spreaders** and **shallow injection**
2) Calculation **baseline emissions** assuming **broadcast spreading** techniques would be applied (1kg NH_3-N/ m^3 following Pöllinger & Amon 2011)
3) Calculation of abated NH_3-N emissions due to **trailing hose spreaders** (30% following UNECE 2015)

   EF: 0.7 kg NH_3-N per m^3 of liquid manure when spreading with a drag hose close to the ground
4) Calculation of abated NH_3-N emissions due to **shallow injection** (80% following UNECE 2015)

   EF: 0.2 kg NH_3-N per m^3 of liquid manure if an injector is used
5) Calculation of **abated indirect N_2O-N emissions** due to reduced N volatilization and re-deposition

   Abated kg NH_3-N volatilized multiplied with the IPCC default EF of 0.01 kg N_2O -N per kg NH_3-N volatilized

N_2O-N is converted to N_2O by multiplication with the **factor *(44/28)**

Calculation of CRI 18

Surface-near application of liquid farm manure

Results:

Slurry [m^3]	2015	2016	2017	2018
Trailing hose spreaders	1 904 884	2 715 305	2 936 440	2 979 067
Injector	112 707	156 542	203 040	192 869
Abated emissions	**2015**	**2016**	**2017**	**2018**
NH_3 [t]	803	1 141	1 267	1 273
Indirect N_2O [t]	10	15	16	16
Indirect N_2O [t CO_2eq]	3 098	4 401	4 886	4 908

Challenges and solutions for the calculation of CRI 18

Challenge

- Estimation of N input due to different RDP measures
- Estimation of the amount of organic fertilisers bought in addition in organic farming

Solution

- Use of statistic data (fertiliser sale) and expert judgement of regional plant cultivation experts and synopsis with official field experiment data (e.g. for administration of new cultivars)
- Cooperation with organic control body to get anonymous management data in organic farming

Calculation of CRI 19

Reduced NH_3 emissions

For Measures (VHA) 10.1.9, 14.1.1, 14.1.2 and 4.1.1 (Surface-near spreading of liquid farm manure, Animal welfare – grazing of livestock, Animal welfare – stable, Solid covering of slurry tanks):

- **Activity data** was taken or derived from IACS database
- **Abatement efficiency** is considered as the difference to emission estimates when using baseline assumptions (calculations without consideration of specific abatement measures)

Calculation of CRI 19

1) Data sources

A) Activity data: IACS database

livestock units (cattle etc.)

amount of slurry in m^3 applied by trailing hose spreaders and injection

B) Emission factors: Austria's Air Emission Inventory (Umweltbundesamt, submission 2019).

EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016. EEA Technical Report No. 21/2016.

Guidance document on preventing and abating ammonia emissions from agricultural sources (UNECE 2014).

Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions (UNECE 2015).

PÖLLINGER, A. et al. (2011): Evaluierung der ÖPUL-Maßnahme Verlustarme Ausbringung von flüssigen Wirtsdüngern und Biogasgülle. Projekt Nr./Wissenschaftliche Tätigkeit Nr. Antrag 100585.

Calculation of CRI 19

2) Assumptions and Emission Calculation (measure 10.1.9)

Surface-near application of liquid farm manure

1) **AD: Promoted amounts** of slurry (m^3 per year) applied by **trailing hose spreaders** and **shallow injection**
2) **Assumption: broadcast spreading** techniques would be applied (1kg NH_3-N/ m^3 following Pöllinger & Amon 2011)
3) Calculation of abated NH_3-N emissions due to **trailing hose spreaders** (30% following UNECE 2015)

   EF: 0.7 kg NH_3-N per m^3 of liquid manure when spreading with a drag hose close to the ground
4) Calculation of abated NH_3-N emissions due to **shallow injection** (80% following UNECE 2015)

   EF: 0.2 kg NH_3-N per m^3 of liquid manure if an injector is used
5) Calculation of **total abated NH_3-N emissions** due to the use of surface-near application techniques

   The difference to the baseline emissions (broadcast spreading assumed) are abated kg NH_3-N amounts

NH_3-N is converted to NH_3 by multiplication with the **factor *(17/14)**

Effect: 1 273 t NH_3 was abated in 2018 (Austria's sector agriculture 2018: 60 358 t NH_3)

Calculation of CRI 19

3) Emission Calculation (measure 14.1.1)

Animal welfare – grazing of livestock (cattle, sheep, goats)

1) **Activity data** are the supported **livestock units** (LU) for cattle, sheep and goats
2) **Abatement efficiency** is considered as the relative total NH_3 emissions from **grazing systems versus housed systems** (UNECE 2014)

    Baseline LU emission rates for housing, yard, storage, spreading: national NH_3 emissions divided through LU units (cattle, sheep, goats)

    For supported grazed livestock: baseline LU emission rates were reduced by 10%

3) **Calculation of abated NH_3 emissions** from the supported LU of cattle, sheep and goats

    Multiplication of supported LU with (1) the baseline LU emission rates and (2) the reduced emission rates due to the effect of grazing

    Abated NH_3 amounts are the difference of both

Effect: 1 638 t NH_3 was abated in 2017

Calculation of CRI 19

3) Emission Calculation (measure 14.1.2)

Animal welfare – stable

Subsidies for the housing in littered, soft and dry areas with a continuous solid surface for lying down

1) **Activity data** are the **supported animal numbers** in the relevant cattle and swine categories
2) **Abatement efficiency** is considered as the relative total NH_3 emissions from **liquid systems versus solid systems**
3) **Calculations** were carried out on the basis of the **Tier 1 methodology** following the **EMEP/EEA Guidebook 2016** for manure management

    Assumption in the baseline: animals are held on liquid systems (NH_3 EF for liquid systems used)

    Assumption for animal welfare: animals are held on solid systems (NH_3 EF for solid systems used)

    Abated NH_3 amounts are the difference of both

Effect: 204 t NH_3 was abated in 2017

Calculation of CRI 19

3) Emission Calculation (measure 4.1.1)

Solid covering of slurry tanks

1) **Activity data:** capacity of covered storages elaborated on the basis of funding data (m^3 and LU)
2) Evaluation of IACS database indicated that 75% of LU are cattle and 25% of LU are swine
3) **Calculations** were carried out on the basis of the **Tier 1 methodology** following the **EMEP/EEA Guidebook 2016** for "Manure management"
4) As the manure management includes emissions from housing, storage and yards the **share of the storage within the manure management** was derived from the Austrian national NH_3 emission (25% for cattle and 14% for swine)
5) **Abatement efficiency** is considered as the relative total NH_3 emissions from **liquid tanks without solid cover versus liquid tanks with solid cover**

   Assumption in the baseline: the liquid manure is stored in open tanks

   Assumption for measure 4.1.1: the liquid manure is stored in tanks with solid cover (abatement potential: -80% following UNECE 2015)

   Abated NH_3 amounts are the difference of both

Effect: **184 t NH_3** was abated in 2017

Challenges and solutions for the calculation of CRI 19

Challenge

- No detailed data on the level of farms are available
- Specific measures for animal welfare do not focus on the abatement of NH_3 emissions. Thus, simplified assumptions are needed

Solution

- Gathering of representative data samples on the level of farms
- Information needed for emission calculation (e.g. liquid system, solid system, abatement technologies) should be recorded in the data base (in conjunction with supported activity data, e.g. animal livestock)

Main conclusions and lessons learned

Calculation of GHG and ammonia must be in accordance with the official national emission inventories, the national authorities should be involved	Improvement of the RDP measure for reduction commitments for ammonia emissions are necessary, esp. the max. application rate should meet the nutrient demand for a better acceptability to the farmers (max. 30 m3 slurry per ha)
Assumptions of N input have to be checked with official statistic data (fertiliser purchase)	Further improvements have to be done on the assumed N input reductions, N fertiliser inputs are also influenced by different weather conditions (drought periods)
Higher tier methods are only applicable if sufficient detailed data and information is available	The agronomical benefits such as increased crop yield and reduced need for nitrogen fertilisers should be stressed, when farmers are investing in low-emission spreading equipment

Recommendations / suggested improvements for future CAP

- Acc. to the EU-Nitrate Regulation a lot of management records have to be done by the farmers, but these data are not available in anonymous and digital form for evaluation purposes
- Also for FADN-data (freiwillige Buchführungsbetriebe) economic data of different farm types and regions are recorded: This recording should be extended for detailed data (e.g. purchase of N and P, pesticides, etc.)
- The postulated requirements concerning data for evaluation of the helpdesk might be performed to some extent by using and improving the existing data sources. A multi-stakeholder approach, esp. due to data protection issues, is necessary

Thank you

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