



Information on methodologies and data used for reporting Cropland Management and Grazing Land Management, The Netherlands

Reporting in accordance to Article 3.2(b) of Decision No
529/2013/EU

15 March 2020

Separate annex to the NIR 2020 pursuant art 40 (b) of Regulation (EU) 749/2014

Information on methodologies and data used for reporting Cropland Management and Grazing Land Management, The Netherlands

Reporting in accordance to Article 3.2(b) of Decision No 529/2013/EU

15 March 2019

Authors: Eric Arets and Jan Peter Lesschen
Wageningen Environmental Research



Dit rapport is in opdracht van het Ministerie van Landbouw, Natuur en Voedselkwaliteit opgesteld door Wageningen Environmental Research in overleg met het Ministerie van LNV en de 'National Inventory Entity' bij de Rijksdienst voor Ondernemend Nederland.

This report was commissioned by the Dutch Ministry of Agriculture, Nature and Food quality (LNV) and has been prepared by Wageningen Environmental Research in consultation with the Ministry of LNV and the Dutch National Inventory Entity.

Project number BO-43-012.02-013

1. Introduction

Background and context

On 21 May 2013 the European Parliament and the Council of the European Union adopted decision No 529/2013/EU on “*accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities*” (EU LULUCF decision).

Article 3.2 (b) of this decision 529/2013/EU requests Member States to provide and submit to the Commission by 15 March each year initial, preliminary and non-binding annual estimates of emissions and removals from cropland management (CM) and grazing land management (GM). The Netherlands has not elected any voluntary activities under Article 3.4 of the Kyoto Protocol. In accordance with Article 3.2 (b) of decision 529/2013/EU the Netherlands therefore has submitted by 15 March 2020 estimates for emissions and removals from CM and GM for the base year 1990, and the years 2013 to 2018. Other categories already reported in the CRF and NIR 2020 (Ruysenaars et al. 2020), like Afforestation/Reforestation, Deforestation and Forest Management, are not included. For those activities we refer to the NIR 2020 and corresponding CRF data.

Additionally on 30 June 2014 the European Parliament and the Council of the European Union adopted Regulation No 749/2014/EU on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No 525/2013 of the European Parliament and of the Council. Chapter IV of the regulation, which includes Articles 38-43, provides the measures that were adopted on reporting for the purposes of decision No 529/2013/EU.

Pursuant Article 40 of Regulation No 749/2014/EU, in this Note, which should be considered as a separate Annex to its National Inventory Report (NIR) 2020, the Netherlands provides explanatory information on methodologies and data used for reporting CM and GM under Decision 529/2013/EU.

The information follows the structure of the corresponding relevant sections of the KP-LULUCF chapter (Chapter 11) in the NIR 2020, and will focus in particular on issues not yet included in the NIR:

Chapter 11.1: General information

Chapter 11.2: Land-related information

Chapter 11.3: Activity-specific information

Chapter 11.5: Article 3.4 focus on additional information related to CM and GM issues not included in the NIR, i.e. 11.5.1 (on direct-human induced) and 11.5.3 (for information on the base year).

Chapter 11.6: Other information, i.e. key sources analyses

Reporting and accounting under the Kyoto Protocol

Under the second commitment period of the Kyoto Protocol (KP2) the Netherlands reports and accounts the three mandatory activities, Afforestation/Reforestation (AR), Deforestation (D) and Forest Management (FM). For this The Netherlands considers all AR and D as human induced. All forest land in The Netherlands is considered to be managed.

The Netherlands has not elected any of the voluntary KP Article 3.4 activities for accounting and reporting under KP2. Reporting of Cropland Management (CM) and Grazing land Management (GM) therefore needs to be elaborated specifically to allow for the compulsory reporting as required by the EU LULUCF decision. Given the relatively small contribution of LULUCF to the overall greenhouse gas emissions and the new approaches to be developed under the EU LULUCF regulation 841/2018 the Netherlands implemented a pragmatic approach for reporting of CM and GM as required under the EU LULUCF Decision.

For reporting of the LULUCF sector to the UNFCCC and supplementary reporting to the Kyoto Protocol the Netherlands implements the IPCC 2006 guidelines (IPCC 2006), the supplementary guidelines for KP reporting (IPCC 2014), and the UNFCCC reporting guidelines (24/CP.19) as need to be followed in the post 2012 inventories.

11. KP-LULUCF

11.1. General information

This separate annex to the NIR 2020¹ of the Netherlands provides the required additional information pursuant Article 40 of Regulation No 749/2014/EU and Article 3.2 (a) of Decision 529/2013/EU on Cropland Management (CM) and Grazing land Management (GM). For clarity it includes all sub-headings as included in the NIR 2020 Chapter 11 for supplementary reporting of KP-LULUCF, but only the sections with additional information contain further text.

11.1.1. Definition of forest and any other criteria

The Definition for Forest land is provided in Chapter 11 in the NIR 2020, with detailed methodological information provided in Arets et al. (2020). To report initial, preliminary and non-binding annual estimates of emissions and removals for CM and GM the Netherlands has adopted an approach that is based on the information from Cropland (CL) and Grassland (GL) as reported under the convention (See Chapter 6 of the NIR 2020). Here the same definitions for CL and GL apply as used under the UNFCCC reporting in Chapter 6.2 of the NIR 2020 and in Arets et al. (2020).

Croplands (convention category 4.B)

The Netherlands has chosen to define Cropland as arable lands and nurseries (including tree nurseries). Intensively managed grasslands are not included in this category and are reported under Grassland. For part of the agricultural land, rotation between cropland and grassland is frequent, but data on where exactly this is occurring are not available. Currently, the situation on the topographical map is used as the guideline, with lands under agricultural crops and classified as arable lands at the time of recording reported under Cropland and, lands with grass vegetation at the time of recording classified as Grassland.

Grassland (convention category 4.C)

Under the Grassland category two distinct sub-categories are identified, that are spatially explicitly assessed. These are 1) Grassland, and 2) "Trees outside Forests" (TOF). Both are explained below. The Grassland subcategory Grassland is identified with 'Grassland (non-TOF)' to prevent confusion with the main category Grassland.

Grassland (non-TOF)

Under Grassland (non-TOF) any type of terrain which is predominantly covered by grass vegetation is reported. It also includes vegetation that falls below the threshold used in the forest land category and is not expected to exceed the threshold used in the forest land category. It is further stratified in:

- 'Grassland vegetation', i.e. all areas predominantly covered by grass vegetation (whether natural, recreational or cultivated).
- 'Nature', i.e. all natural areas not covered under the grassland vegetation. It mainly consists of heathland, peat moors and other nature areas. Many have the occasional tree as part of the typical vegetation structure.
- 'Orchards', i.e. areas with standard fruit trees, dwarf varieties or shrubs. They do not conform to the forest definition, and while agro-forestry systems are mentioned in the definition of Croplands, in the Netherlands the main undergrowth of orchards is grass. Therefore, these orchards are reported under Grassland (non-TOF). A separate carbon stock for orchards was estimated, which then contributes to an area weighted averaged carbon stock in grasslands (see Chapter 6.6 in the NIR 2020 and Arets et al., 2020).

¹ References to NIR 2020 are always referring to the National Inventory Report 2020, reporting Greenhouse gas emissions in the Netherlands 1990–2018 (Ruyssenaars et al. 2020).

In the calculations orchards are not spatially explicitly included, Instead statistics on areas of fruit orchards are used. See Chapter 6 in the NIR 2020 and Arets et al. (2020) for more details.

Trees outside Forest (TOF)

Trees outside forests (TOF) consists of wooded areas that comply with the forest definition except for their surface area (< 0.5 ha or less than 30 m width). These represent fragmented plots of trees as well as groups of trees in parks and nature terrains and most woody vegetation lining roads and fields.

Conversions from CL and GL to non-forest land-use categories

According to the guidelines for KP-LULUCF reporting (IPCC 2014) also transitions from cropland or grassland to non-forest categories need to be included in CM and GM. However, because part of these areas of cropland or grassland converted to settlements, wetland or other land are already included under the KP Deforestation category (for instance in a land-use transition from FL to CL and then to Settlement), their inclusion under CM and GM in our approach here would partly result in double counting of the associated emissions and removals. Therefore, the emissions and removals from units of CL or GL converted to settlement, wetland and other land are not included in the current initial, preliminary and non-binding annual estimates of emissions and removals for CM and GM. Instead, the emissions and removals associated with these conversions are provided separately in 11.3.1.1.

11.1.2. Elected activities under Article 3, paragraph 4 of the Kyoto Protocol

The Netherlands has not elected any activities to include under Article 3, paragraph 4 of the Kyoto Protocol. The purpose of this note is to report initial, preliminary and non-binding annual estimates of emissions and removals for cropland management and grazing land management under the EU LULUCF decision.

11.1.3. Description of how the definitions of each activity under Article 3.3 and each mandatory and elected activity under Article 3.4 have been implemented and applied consistently over time

For each individual pixel, an overlay of land-use maps shows all mapped land-use changes over time since 1990. All of these are taken into account to ensure that CM and GM are identified and that they are not on D land. For the current initial, preliminary and non-binding annual estimates of emissions and removals for CM and GM the emissions and removals from CL and GL (land converted to these categories and CL or GL remaining CL or GL respectively) are the basis. To prevent double counting with the units of CL and GL that are accounted under Deforestation, the emissions and removals on units of Cropland that are classified as Deforestation are subtracted from the emissions and removals as reported for CL under the convention (Chapter 6 of the NIR 2020). Similarly to estimate emissions and removals for GM, emissions and removals on units of Grassland that are classified as Deforestation are subtracted from the emissions and removals as reported for CL under the convention. Once land is classified as deforested (D land), it remains in this category.

AR land remains AR land unless it is deforested and that D land remains D land, even when it is later again converted to forest.

Units of CL or GL that become subject to Article 3.3 Afforestation and reforestation (AR) from that moment onwards are reported as AR land. Units of AR land that are deforested again later will be reported under Article 3.3 Deforestation from that point in time onwards.

11.1.4. Description of precedence conditions and/or hierarchy among Article 3.4 activities and how they have been consistently applied in determining how land was classified

In the reporting of the Netherlands there are no interlinkages between Article 3.4 activities. Areas of land that are forest in 1990 are reported under Forest Management as long as they remain forest land. As soon an area of FM is deforested it will be reported under Deforestation.

Areas of CL that are converted to GL will from that point onwards be reported as GM and *vice versa* GL that is converted to CL will be reported as CM. However, at this moment the system in place does not explicitly track changes from CM and GM to land uses other than Forest land. Therefore areas of land reported as CM or GM that are converted to Settlement, Wetland or Other land are no longer reported until they are converted back again to CL or GL, or converted to FL (AR). On this issue also see Chapter 11.1.1 regarding potential double counting with deforestation for units of land converted from CL or GL to the other non-forest land-use categories. For transparency reasons information on conversions from CL and GL to these other non-forest land-uses are provided separately in Chapter 11.3.1.1.

11.2. Land-related information

11.2.1. Spatial assessment unit used for determining the area of the units of land under Article 3.3 and Article 3.4

The Netherlands applies complete and spatially explicit land-use mapping that allows for geographical stratification at 25 m x 25 m (0.0625 ha) pixel resolution (Kramer et al., 2009). This corresponds with the wall-to-wall approach used for reporting under the Convention, i.e. approach 3 in Chapter 3 of IPCC (2006) and is described as reporting method 2 in the 2013 IPCC KP Guidance (Par. 2.2.2 of IPCC 2014)). AR, D and FM activities as well as CL and GL are recorded on a pixel basis. The status of each pixel is monitored over the full time series.

11.2.2. Methodology used to develop the land transition matrix

The basis for the spatially explicit land-use mapping are wall-to-wall maps for 1 January 1990, 1 January 2004 (Kramer et al. 2007 and 2009), 1 January 2009 (van den Wyngaert et al. 2012) 1 January 2013 (Kramer and Clement 2015), and 1 January 2017 (Arets et al. 2020), also see Chapter 11.2.3 in the NIR 2020 and Chapter 3 in Arets et al. 2020). An overlay was made of those five land-use maps plus two maps with soil types (Arets et al. 2020). This resulted in four land-use change matrices; a first matrix between 1 January 1990 and 1 January 2004, a second matrix covering the period 1 January 2004 to 1 January 2009, a third matrix covering the period January 2009 to 1 January 2013 and a fourth matrix covering the period 1 January 2013–1 January 2017. Together, the 4 matrices thus cover the period 1 January 1990 to 1 January 2017, ensuring that all land-use changes are captured. Mean annual rates of change for all land-use transitions in between the years with maps were calculated by linear interpolation. From 2017 onwards the annual changes as obtained from the matrix 2013-2017 are used to extrapolate the land use changes. These values will be used until a new land use map is available (provisionally planned to be included in the NIR2022 with a map date of 1 January 2021).

The area of CM and GM is determined based on the total area of CL or GL, minus the area of CL and GL that is already accounted for under Deforestation. Because in the current system part of the CL and GL is in units of deforested land and also conversions from CL or GL to other land-use for units of deforested land are accounted for under Deforestation, specific changes to and from CM and GM cannot be assessed in the current system in place. Therefore in the table NIR 2 only total areas estimated for CM and GM are provided.

The 2006 IPCC Guidelines prescribe a transition period of 20 years in which carbon stock changes in mineral soils take place after land-use conversions. Such a transition period in mineral soils means that land-use changes in 1970 will still have a small effect on reported carbon stock changes in 1990. Currently these effects are not included. All grassland present in 1990 is included as Grassland remaining Grassland for which the carbon stocks in mineral soils are considered to be in equilibrium. This means that for GM accounting, the 1990 (base-year) carbon stock gains in mineral soils are underestimated. In order to improve on this a new 1970 land-use map is being prepared and tested. It is foreseen that this map will be included in the next inventory report.

11.2.3. Maps and/or database to identify the geographical locations and the system of identification codes for the geographical locations

See Chapter 11.2.3 in the NIR 2020 and Chapter 3 and Annex 2 in Arets et al. (2020).

11.3. Activity-specific information

11.3.1. Methods for carbon stock change and GHG emission and removal estimates

11.3.1.1. Description of the methodologies and the underlying assumptions used

The methodologies used to calculate carbon stock changes in biomass and soil for CM and GM are in accordance with those for CL (in the case of CM) and GL (in the case of GM) under the Convention as presented in Chapters 6.5 (CL) and 6.6 (GL) in the NIR 2020, and in Chapters 3 (Representation of land), 5 (CL), 6 (GL) and 11 (organic and mineral soils) in Arets et al. (2020).

Living biomass

Emissions and removals of CO₂ from carbon stock changes in living biomass for Land converted to Cropland or Grassland (non-TOF) is calculated using a Tier 1 approach (for details see Chapters 6.5 and 6.6 in the NIR 2020 and Chapters 5 and 6 in Arets et al. (2020)). This value is also used for determining carbon stock losses for Cropland converted to Grassland or Grassland converted to Cropland. Carbon stock changes in biomass for Trees outside Forests under Grassland largely follow the methodology for Forest land (for details see Chapter 6.6 in the NIR 2018 and Chapters 5 and 6 in Arets et al. (2020)). The only difference is in the size of the stand (<0.5 ha for TOF), so this seems to be a reasonable assumption. It is assumed that no building up of dead wood or litter occurs in TOF. It is also assumed that in TOF no harvesting takes place. Instead all wood from the national harvest statistics is assumed to be harvested from Forest land.

Soil

Carbon stock changes in mineral and organic soils are reported for all soils changing land to Cropland or Grassland and that were not already reported under Deforestation. For the soil emissions, a 20-year transition period is included, starting from 1990.

Net carbon stock changes in both mineral and organic soils for land use changes involving Cropland are calculated based on the methodology provided in Arets et al. (2020). Both for Cropland, and Grassland (non-TOF) the emissions from lowering the ground water table in organic soils under agricultural use constitute a significant source of emissions. Therefore these are explicitly calculated for areas of Cropland remaining Cropland and Grassland remaining Grassland (non-TOF) and land converted to Cropland and land converted to Grassland (non-TOF) (see Arets et al. 2020).

Wildfires

Because wildfires in the Netherlands are infrequent and relatively small scale there is no active monitoring of wildfires, and consequently no recent statistics on wildfires are available. The area of wild fires is therefore based on a historical series from 1980–1992, for which the annual number of

forest fires and the total area burned are available (Wijdeven et al. 2006). Emissions of CO₂, CH₄ and N₂O from wild fires are reported according the Tier 1 method as described in the 2006 IPCC guidelines (IPCC 2006).

All emissions from wild fires, other than forest fires, are included under Grassland remaining Grassland. CO₂, CH₄ and N₂O emissions from wild fires are based on the default carbon stock in living biomass on grassland. The emission from Wildfires under GM are calculated as the emissions under GL-GL minus those emissions from units of Grassland that are already reported under Deforestation.

Conversions from CL and GL to other non-forest land-use classes

For transparency reasons information on conversions from CL and GL to Settlements, Wetlands or Other land are provided in Table 11.1 (Cropland), Table 11.2 (Grassland (non-TOF)) and Table 11.3 (TOF).

Table 11.1

Area (total, mineral and organic), carbon stock changes in biomass (gains and losses), mineral and organic soils and dead organic matter (DOM) and direct N₂O emissions resulting from land-use change in mineral soils for Cropland converted to Wetlands, Settlements and Other land.

CL to	Item	Unit	1990	2013	2014	2015	2016	2017	2018
Wetland	Area (tot)	kha	0.49	6.76	6.71	6.68	6.65	6.62	6.60
	Area (min)	kha	0.44	6.06	6.02	5.96	5.92	5.87	5.84
	Area (org)	kha	0.05	0.70	0.70	0.71	0.73	0.75	0.77
	Biomass C (gains)	Gg C	NE	NE	NE	NE	NE	NE	NE
	Biomass C (losses)	Gg C	-2.44	-2.09	-2.09	-2.09	-2.09	-2.04	-2.04
	Soil C (min)	Gg C	0.74	9.33	9.30	9.30	9.31	9.27	9.25
	Soil C (org)	Gg C	-0.22	-0.28	-0.27	-0.27	-0.27	-0.26	-0.25
	DOM	Gg C	NE	NE	NE	NE	NE	NE	NE
	Soil N ₂ O (min)	Gg N ₂ O	0.000	0.001	0.001	0.001	0.001	0.001	0.001
	Settle- ments	Area (tot)	kha	5.84	71.58	67.24	58.66	54.95	51.98
Area (min)		kha	5.28	66.36	62.47	4.35	3.95	3.62	49.12
Area (org)		kha	0.56	5.23	4.77	4.38	4.00	3.69	3.30
Biomass C (gains)		Gg C	NE	NE	NE	NE	NE	NE	NE
Biomass C (losses)		Gg C	-29.21	-11.08	-11.08	-11.08	-11.08	-11.00	-11.00
Soil C (min)		Gg C	2.33	31.48	29.93	28.43	26.99	25.93	24.96
Soil C (org)		Gg C	-2.49	-21.71	-19.65	-17.77	-15.97	-14.48	-13.08
DOM		Gg C	NE	NE	NE	NE	NE	NE	NE
Soil N ₂ O (min)		Gg N ₂ O	0.002	0.021	0.019	0.018	0.017	0.016	0.015
Other Land		Area (tot)	kha	0.01	0.13	0.12	0.11	0.10	0.10
	Area (min)	kha	0.01	0.13	0.12	0.11	0.10	0.09	0.09
	Area (org)	kha	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	Biomass C (gains)	Gg C	NE	NE	NE	NE	NE	NE	NE
	Biomass C (losses)	Gg C	-0.07	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02
	Soil C (min)	Gg C	-0.06	-0.52	-0.48	-0.45	-0.41	-0.40	-0.38
	Soil C (org)	Gg C	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DOM	Gg C	NE	NE	NE	NE	NE	NE	NE
	Soil N ₂ O (min)	Gg N ₂ O	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 11.2

Area (total, mineral and organic), carbon stock changes in biomass (gains and losses), mineral and organic soils and dead organic matter (DOM) and direct N₂O emissions resulting from land-use change in mineral soils for Grassland (non-TOF) converted to Wetlands, Settlements and Other land.

GL (non-TOF) to	Item	Unit	1990	2013	2014	2015	2016	2017	2018
Wetland	Area (tot)	kha	1.33	28.80	28.96	29.16	29.39	30.03	30.71
	Area (min)	kha	0.91	19.45	19.32	19.21	19.12	19.35	19.61
	Area (org)	kha	0.43	9.35	9.64	9.95	10.27	10.68	11.11
	Biomass C (gains)	Gg C	NE	NE	NE	NE	NE	NE	NE
	Biomass C (losses)	Gg C	-8.84	-15.15	-15.15	-15.16	-15.16	-14.81	-14.81
	Soil C (min)	Gg C	0.08	5.10	5.31	5.52	5.72	6.02	6.33
	Soil C (org)	Gg C	-1.97	-4.37	-4.33	-4.28	-4.24	-4.14	-4.09
	DOM	Gg C	NE	NE	NE	NE	NE	NE	NE
	Soil N ₂ O (min)	Gg N ₂ O	0.000	0.008	0.008	0.007	0.007	0.007	0.007
	Settlements	Area (tot)	kha	5.59	114.32	114.31	114.40	114.59	115.84
Area (min)		kha	4.86	102.07	102.25	102.52	102.87	104.14	105.51
Area (org)		kha	0.73	12.25	12.06	11.88	11.72	11.70	11.69
Biomass C (gains)		Gg C	NE	NE	NE	NE	NE	NE	NE
Biomass C (losses)		Gg C	-37.16	-47.30	-47.31	-47.35	-47.34	-46.91	-46.91
Soil C (min)		Gg C	-2.98	-55.12	-54.52	-54.06	-53.76	-53.87	-54.10
Soil C (org)		Gg C	-3.32	-52.08	-50.93	-49.85	-48.83	-48.38	-48.01
DOM		Gg C	NE	NE	NE	NE	NE	NE	NE
Soil N ₂ O (min)		Gg N ₂ O	0.003	0.062	0.062	0.062	0.062	0.062	0.063
Other Land		Area (tot)	kha	0.06	2.06	2.28	2.51	2.74	2.98
	Area (min)	kha	0.06	2.03	2.25	2.48	2.71	2.95	3.20
	Area (org)	kha	0.00	0.03	0.03	0.03	0.03	0.03	0.03
	Biomass C (gains)	Gg C	NE	NE	NE	NE	NE	NE	NE
	Biomass C (losses)	Gg C	-0.43	-2.29	-2.29	-2.29	-2.29	-2.19	-2.19
	Soil C (min)	Gg C	-0.27	-6.97	-7.42	-7.92	-8.46	-9.37	-10.29
	Soil C (org)	Gg C	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00
	DOM	Gg C	NE	NE	NE	NE	NE	NE	NE
	Soil N ₂ O (min)	Gg N ₂ O	0.000	0.006	0.006	0.006	0.007	0.008	0.008

Table 11.3

Area (total, mineral and organic), carbon stock changes in biomass (gains and losses), mineral and organic soils and dead organic matter (DOM) and direct N₂O emissions resulting from land-use change in mineral soils for Trees outside Forest (TOF) converted to Wetlands, Settlements and Other land.

TOF to	Item	Unit	1990	2013	2014	2015	2016	2017	2018
Wetland	Area (tot)	kha	0.02	0.45	0.45	0.45	0.45	0.46	0.46
	Area (min)	kha	0.02	0.34	0.33	0.33	0.33	0.34	0.34
	Area (org)	kha	0.01	0.12	0.12	0.12	0.12	0.12	0.12
	Biomass C (gains)	Gg C	NE	NE	NE	NE	NE	NE	NE
	Biomass C (losses)	Gg C	-1.49	-2.06	-2.15	-2.25	-2.35	-1.76	-1.80
	Soil C (min)	Gg C	0.00	0.02	0.02	0.02	0.02	0.02	0.02
	Soil C (org)	Gg C	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	DOM	Gg C	NE	NE	NE	NE	NE	NE	NE
	Soil N ₂ O (min)	Gg N ₂ O	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Settle- ments	Area (tot)	kha	0.21	5.68	5.88	6.07	6.27	6.47
Area (min)		kha	0.20	5.35	5.52	5.70	5.89	6.07	6.26
Area (org)		kha	0.01	0.34	0.35	0.37	0.38	0.40	0.41
Biomass C (gains)		Gg C	NE	NE	NE	NE	NE	NE	NE
Biomass C (losses)		Gg C	-14.01	-23.95	-25.15	-26.37	-27.61	-30.02	-30.98
Soil C (min)		Gg C	-0.09	-2.13	-2.16	-2.19	-2.23	-2.31	-2.38
Soil C (org)		Gg C	-0.02	-1.43	-1.50	-1.58	-1.65	-1.73	-1.59
DOM		Gg C	NE	NE	NE	NE	NE	NE	NE
Soil N ₂ O (min)		Gg N ₂ O	0.000	0.002	0.002	0.002	0.002	0.002	0.002
Other Land		Area (tot)	kha	0.01	0.12	0.13	0.13	0.13	0.13
	Area (min)	kha	0.01	0.12	0.13	0.13	0.13	0.13	0.13
	Area (org)	kha	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Biomass C (gains)	Gg C	NE	NE	NE	NE	NE	NE	NE
	Biomass C (losses)	Gg C	-0.51	-0.47	-0.49	-0.52	-0.55	-0.47	-0.49
	Soil C (min)	Gg C	-0.02	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
	Soil C (org)	Gg C	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DOM	Gg C	NE	NE	NE	NE	NE	NE	NE
	Soil N ₂ O (min)	Gg N ₂ O	0.000	0.000	0.000	0.000	0.000	0.000	0.00

11.3.1.2. Justification for omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and mandatory and elected activities under Article 3.4

See 11.3.1.1.

11.3.1.3. Information on whether or not indirect and natural GHG emissions and removals have been factored out

For calculation of the carbon stocks for biomass in CM and GM Tier 1 default values have been used. Thus indirect GHG emissions and removals due to the effects of elevated carbon dioxide concentrations or nitrogen deposition have not been factored out explicitly.

11.3.2. Changes in data and methods since the previous submission (recalculations)

This year, five methodological changes have been implemented resulting in changes in various carbon stock changes and associated emissions and removals along the whole time series (see Chapter 6.1). Only two of the changes also resulted in recalculations for CM and GM. Because the separate changes may interact with each other, the effects of the separate changes cannot be quantified. The two changes with an effect for CM and GM are briefly explained below. Descriptions of all changes are included in Chapter 6.1 of the NIR 2020.

1) In addition to the new soil map 2014 that was included in the NIR 2019 and which showed a gradually decreasing area of organic soils in the Netherlands between 1977 and 2014, the decreasing trend now has been extrapolated after 2014. In the NIR 2019 this was kept constant after 2014. This is in line with a recommendation of the ERT in the 2019 review. The change results in a further reduction of the extent of drained organic soils under CM and GM from 2014 onwards, and hence an overall reduction of emissions from organic soils in CM and GM. Because at the same time the area of mineral soils increases, the emissions and removals in mineral soils that are associated with land-use changes also change in CM and GM.

2) The emission factors for drainage of organic (peat and peaty) soils have been corrected to take into consideration the changed area of organic soils. Emission factors decreased from an average 19 (peat) or 13 (peaty) ton CO₂ per ha of drained organic soil in 2000 to 17.7 (peat) or 12 ton (peaty) ton CO₂ per ha of drained organic soil in 2014. Between 2004 and 2014 the trend in decreasing emissions factors has been interpolated and after 2014 the trend is extrapolated. This resulted in the further reduction of the emissions from organic soils in CM and GM.

11.3.3. Uncertainty estimates

No uncertainty assessment has been carried out for CM and GM, but since these largely cover CL and GL as reported under the convention, the uncertainty assessment for these will also largely hold for CM and GM. See chapter 6.5.3 and 6.6.3 of the NIR 2020 and Chapter 14 in Arets et al. (2020).

11.3.4. Information on other methodological issues

-

11.3.5. The year of the onset of an activity, if after 2013

-

11.4. Article 3.3

-

11.5. Article 3.4

11.5.1. Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

The land-use mapping approach used allows for following land-use changes over time. All land in the Netherlands is considered to be managed land. With the historic and current scarcity of land in the

Netherlands (which has the highest population density of any country in Europe), any land use is the result of deliberate human decisions.

11.5.2. Information relating to Forest Management

-

11.5.3. Information relating to Cropland Management, Grazing Land Management and Revegetation, Wetland Drainage and Rewetting if elected, for the base year

For reporting of emissions and removals for CM and GM in the base year, i.e. 1990, the Netherlands follows the same approach as for the reporting years in the commitment period. The data are based on the 1990 data reported for CL and GL the under Convention. Inherited emissions and removals in soil resulting from land use conversion to CL or GL in the period 1971-1989 are not estimated.

11.6. Other information

11.6.1. Key category analysis for Article 3.3 activities and any mandatory and elected activities under Article 3.4

The smallest key category based on an Approach 1 level analysis including LULUCF is 544.0 Gg CO₂ (1A4 Liquids (excluding 1A4c; see NIR 2020 Annex 1). With net emissions of 2328.3 Gg CO₂ eq. in 2018 (see Table 11.4), the initial, preliminary and non-binding estimates for CM would be larger than this smallest key category (Approach 1 level analysis including LULUCF). Moreover under the convention CL, which is closely associated with CM, is considered to be a key category (level and trend). Also with 2328.3 Gg CO₂ eq. (see Table 11.4), the initial, preliminary and non-binding estimates of the annual contribution of GM in 2018 are larger than the smallest key category (level and trend), while also GL is considered a key category under the convention (see NIR 2020 Annex 1).

Table 11.4

Initial, preliminary and non-binding annual estimates of net emissions from cropland management and grazing land management (Gg CO₂ eq.). Emissions that are larger than the base year emissions are indicated in italics

Activities	Net emissions (Gg CO ₂ eq.)						
	1990	2013	2014	2015	2016	2017	2018
B. Article 3.4 activities							
B.2. Cropland management	1787.8	<i>1864.0</i>	1760.6	1669.8	1583.4	1548.3	1515.8
B.3. Grazing land management	5181.5	2882.3	2790.5	2734.4	2636.9	2478.1	2328.3

References

- Arets, E. J. M. M., J. W. H. van der Kolk, G. M. Hengeveld, J. P. Lesschen, H. Kramer, P. J. Kuikman and M. J. Schelhaas. (2020). *Greenhouse gas reporting of the LULUCF sector in the Netherlands. Methodological background, update 2020*. WOT Technical report. Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), Wageningen UR, Wageningen, The Netherlands.
- IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry and Other Land Use*. IPCC National Greenhouse Gas Inventories Programme. Published by the Institute for Global Environmental Strategies (IGES), Kanagawa, Japan.
- IPCC. (2014). *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*. in T. Hiraishi, Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. , editor. IPCC, Switzerland.
- Kramer, H. and J. Clement. (2015). *Basiskaart Natuur 2013; Een landsdekkend basisbestand voor de terrestrische natuur in Nederland*. WOT-technical report 41. Wettelijke Onderzoekstaken Natuur & Milieu Wageningen, The Netherlands. <http://edepot.wur.nl/356218>.
- Kramer, H., G. W. Hazeu and J. Clement. (2007). *Basiskaart Natuur 2004. Vervaardiging van een landsdekkend basisbestand terrestrische natuur in Nederland*. WOT-werkdocument 40. WOT Natuur & Milieu, Wageningen, The Netherlands. <http://edepot.wur.nl/39219>.
- Kramer, H., G. J. van den Born, J. P. Lesschen, J. Oldengram and I. J. J. van den Wyngaert. (2009). *Land use and Land use change for LULUCF reporting under the Convention on Climate Change and the Kyoto protocol*. Alterra-rapport 1916. Alterra, Wageningen.
- Ruysenaars, P. G., P. W. H. G. Coenen, P. J. Zijlema, E. J. M. M. Arets, K. Baas, R. Dröge, G. Geilenkirchen, M. 't Hoen, E. Honig, B. van Huet, E. P. van Huis, W. W. R. Koch, L. L. Lagerwerf, R. A. te Molder, J. A. Montfoort, C. J. Peek, J. Vonk and M. C. van Zanten. (2020). *Greenhouse gas emissions in the Netherlands 1990-2018. National Inventory Report 2020*. RIVM; National Institute for Public Health and Environment, Bilthoven, The Netherlands.
- van den Wyngaert, I. J. J., E. J. M. M. Arets, H. Kramer, P. J. Kuikman and J. P. Lesschen. (2012). *Greenhouse gas reporting of the LULUCF sector: background to the Dutch NIR 2012*. Alterra-report 1035.9. Alterra, Wageningen UR, Wageningen.
- Wijdeven, S. M. J., M. J. Schelhaas, A. F. M. Olsthoorn, R. J. Bijlsma and K. Kramer. (2006). *Bosbrand en terreinbeheer - een verkenning*. Alterra, Wageningen UR, Wageningen, The Netherlands.