Greenhouse gas reporting of the LULUCF sector, revisions and updates related to the Dutch NIR 2008

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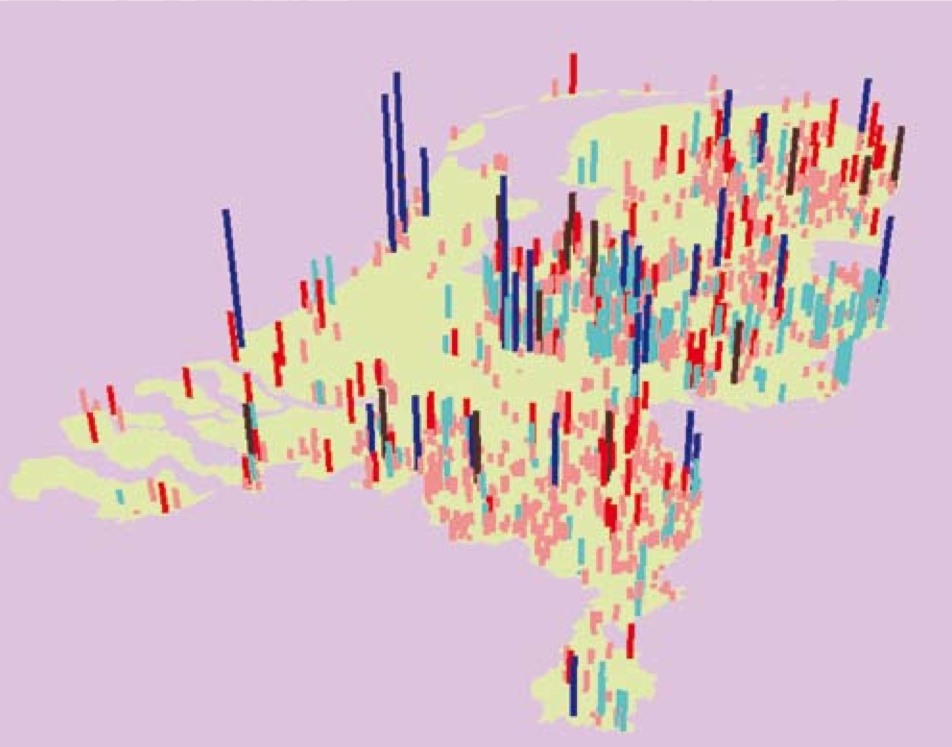

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ABSTRACT

Wyngaert, I.J.J. van den, H. Kramer, P. Kuikman, G.J. Nabuurs & H. Vreuls , 2008. *Greenhouse gas reporting of the LULUCF sector, revisions and updates related to the Dutch NIR 2008*. Wageningen, Alterra, Alterra-rapport 1035.6. 130 blz.; 18 figs.; 20 tables.; 50 refs.

This report contains the overview of the process of updates and revisions after the 2007 review that has led to the current Dutch National System for Greenhouse gas reporting of the LULUCF (Land Use, Land Use Change and Forests) sector. It also gives a complete description LULUCF part of the system as in force for the submission of 2008.

Keywords: national system greenhouse gases, LULUCF, The Netherlands

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Contents

Preface

This report contains a complete description of the Dutch National System for Greenhouse gas Reporting of the LULUCF sector used for the 2008 submission as used for the final calculation of the assigned amount. It also provides an overview of the planned changes and updates incorporating the comments of two reviews.

Summary

This report contains a complete description of revisions and updates of the Dutch Greenhouse gas calculations and reporting of the LULUCF sector used for the 2008 submission. This was earlier described in Nabuurs et al. (2003, 2005), De Groot et al (2005), Kuikman et al. (2003; 2005) and Van den Wyngaert et al. (2007). An overview of the history of this system since its development is given in chapter 2.

This system has been reviewed by an external expert (Van den Wyngaert et al., 2007) and by several UNFCCC review teams. The outcomes of the 2007 in country review indicated several areas of possible improvement. Apart from comments related to syntax, the main issues were related to (chapter 3):

- methodological issues related to the land use change matrix
- how to deal with inherited emissions 1970-1990
- changes in soil carbon as land use changes and for forest soils also when land use does not change
- implied emissions factors of Forest Land converted to any other land use type
- implied emission factor of cultivation of organic soils

Some of the comments indicated a limited transparency of the system to the reviewers. Therefore a full overview of the calculations leading to the final values submitted in 2008 was presented in this report. Chapters 4 to 7 summarize the methods used for the submission 2008 to:

- Calculate the full land use change matrix (chapter 4)
- Calculate the emissions associated with Forest Land (Forest Land remaining Forest Land, Forest Land changing to any other land use category and land changing to Forest Land) (chapter 5)
- Calculate carbon stocks in soils per land use category and emissions associated with changes to and form Other Land (Chapter 6)
- Calculate carbon emissions associated with cultivation of organic soils (Chapter 7).

In chapter 8 the values submitted in the NIR 2008 are presented, and a comparison is made between those and the values reported in earlier emissions (several versions). Differences between versions are found for emissions from Forest Land and for emissions from soil carbon change with land use change. These were related to methodological improvements, data improvements and calculation errors.

The last three chapters deal with the future. In chapter 9 a formalization of the QA/QC system is proposed. Experience with this improved QA/QC system for LULUCF will show up during the preparation of the 2009 submission So this will be dealt with in more detail in future reports .

In chapter 10 the planned improvements and updates are discussed. Summarizing the plans for the near future, the following improvements are expected for the NIR 2009:

- improvements to land use and land use change area estimates (par 10.2)
- soil carbon emissions when land use changes to and from forest (par 10.4)
- soil carbon emissions in Forest Land remaining Forest Land
- a series of improvements to carbon emissions from biomass changes to Forest Land remaining Forest Land
- reporting of areas organic soils for categories 5A Forest Land, 5B Cropland and 5C Grassland

The following improvements are envisaged for the NIR 2010 or later, either because they are still under discussion, still under development or need data that will become available only at a point further in time:

- installation of subcategories in Grassland, i.e. distinction between rotational grassland, permanent grassland and natural grasslands
- periodic updating of carbon emission from change in biomass in Forest land remaining Forest land as new data become available (new MFV cycles)

The following subjects have been discussed in relation to the need of updating, and will remain as they are now:

- soil carbon emissions in relation to land use changes to and from agricultural soils (especially rotation between cropland and grassland) (par 10.5)
- inherited emissions 1970-1990 (par 10.6)

Chapter 11 deals with the preparation of the future reporting on the Kyoto Protocol. Special attention is given to the likeness and differences for reporting on article 3.3 and to the Convention.

List of abbreviations

ARR	Annual Review Report
BEF-1	Biomass Expansion factor type 1: conversion from increment volume to increment biomass
BEF-2	Biomass Expansion factor type 2: conversion from stock volume to stock biomass
BF	Biomass Function
CO2	Carbon dioxide
CRF	Common reporting format
FAD	Forests according to definition (defined in par. 5.1)
FAO	Food and Agricultural Organization
GHG	Greenhouse Gas
GPG2000	Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC,2000)
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003)
IEF	Implicit Emission Factor
IPCC	Intergovernmental Panel on Climate Change
IRR	Initial Review Report
LULUCF	Land Use, Land Use Change and Forestry
NFI	National Forest Inventory
NIR	National Inventory Report
TOF	Trees outside forests (defined in par. 5.1)
UNFCCC	United Nations Framework Convention on Climate Change
1996 IPCC GuidelinesRevised	1996 IPCC Guidelines for National Greenhouse Inventories (IPCC, 1997)
2006 IPCC Guidelines	2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2007)

1 Introduction

As a Party to the United Nations Framework Convention on Climate Change the Netherlands has the obligation to design and make operational a system for reporting of greenhouse gases (GHG) (Article 4 of the UNFCCC). The emissions to be reported are organised in six predefined sectors, with an additional seventh one for other country-specific emissions. Within the sector Land Use, Land Use Change and Forests (LULUCF), total emissions from above-ground biomass, below-ground biomass and soil carbon caused by forest and land use (change) activities are to be reported (IPCC, 1996). Official guidance on what is good practice was formalized in 2003, with the publication of the Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF; IPCC, 2003).

For GHG reporting of the LULUCF sector, the Netherlands has developed and improved an overall approach within the National System since 2003. This LULUCF part of the National System has been deployed for the National Inventory Reports (NIR's) since 2005, covering the period since 2003. It was also used for a full recalculation of the period 1990 – 2003. This LULUCF part of the Dutch National System has been documented in several publications. See e.g. Nabuurs et al. (2003, 2005), De Groot et al (2005) and Kuikman et al. (2003; 2005).). In the first years after development, several improvements and updates were implemented as described in Van den Wyngaert et al. (2007)

The system has gone through a series of reviews since then. In compliance with the GPG-LULUCF the system has to be reviewed by an external expert. This can be done in parts, and has been carried out for the forest by Wojtek Galinsky in 2006 (see Van den Wyngaert et al., 2007). In 2007, an in country review was held by the UNFCCC (see also chapter 3). Both reviews indicated limited transparency for some parts and a need for further updating and improvement. Additionally, the need to read several background reports to understand the whole of (the last update of) the LULUCF system was experienced as a problem by the UNFCCC review team. This report aims to fill this gap.

This report summarise the development of the LULUCF system with its different updates and revisions in period till 2007 (chapter 2), the process of the 2007 in country review and its consequences for GHG reporting for the LULUCF sector (chapter 3). It also provides a description of the system as used for the 2008 submission, summarizing from previous reports and filling earlier gaps in methodology description (chapter 4-7). It gives a full overview of the values submitted for 2008 (chapter 8).

It also gives insight in foreseen improvements: a new design for QA/QC for the LULUCF sector planned for the 2009 submission (chapter 9); a plan of future improvements to the National System for LULUCF (chapter 10) and (additional) requirements associated with reporting for the Kyoto Protocol and impact on the assigned amount (chapter 11).

2 Development of the National System for GHG reporting for the LULUCF sector – an overview for the period 2004-2006

Until 2004 the Netherlands reported only carbon emissions for a few categories in the Land Use Change and Forestry sector to the UNFCCC (Nabuurs et al., 2003; Klein Goldewijk et al., 2004). As there were no justifications for the forest sector to be considered a key category, calculations were based in IPCC default methods (Tier 1 methodology) and data: one nationally derived stem increment was converted to tree biomass change based on one IPCC biomass expansion factor.

However, for a series of reasons this was not tenable (Nabuurs et al., 2005). A full overview of the discrepancy of future reporting requirements and the former reporting practice is given in Nabuurs et al. (2003) and Kuikman et al. (2004). Based on an inventory of the databases available (Nabuurs et al., 2003) and the outcomes of an expert meeting on potentially important options under the Kyoto 3.4 article, a National System to report carbon emissions from the LULUCF sector using mostly Tier 2 methodology was set up (Nabuurs et al., 2003, 2005; Kuikman et al., 2004). Tier 2 applies the same basic approach as Tier 1 (stock change) but applies detailed emission factors and activity data which are defined by country specific data for the most important land uses and activities. It lacks, however, the full dynamic and full geographically explicit approach typical of Tier 3.

A first version of this National System was described in three reports:
1. Nabuurs et al. (2005) for forests;
2. Kuikman et al. (2005) for emissions from cultivated organic soils and
3. de Groot et al. (2005) for carbon in soils.

This first version was used for the 2005 submission (Klein Goldewijk et al., 2005) and following calculated emission values (Table 2-1).

Table 2-1: Variables for which emissions are reported in the National System per land use (transition) category

From→ To↓	Forest	Cropland	Grassland	Wetland	Settlement	Other land
Forest	Biomass + Harvest + Necromass	Biomass + Soil	Biomass + Soil	Biomass + Soil	Biomass + Soil	Biomass + Soil
Cropland	Biomass	Lime application	-	-	-	Soil
Grassland	Biomass	-	Organic soils	-	-	Soil
Wetland	Biomass	-	-		-	-
Settlement	Biomass	-	-	-		Soil
Other land	Soil	Soil	Soil	Soil	Soil	

The system was based on the establishment of a land use and land use change matrix for the period 1990-2000 based on topographical maps (chapter 4; see also de Groot et al. 2005 for motivation of topographical maps as basis for land use calculations).

The maps for 1990 and 2000 were gridded in a harmonised way and an overlay produced all land use transitions within this period (Nabuurs et al., 2005).

The carbon balance for forests remaining forests was based on National Forest Inventory (NFI) data, as were the emission factors for emissions through changes in forest area (Nabuurs et al., 2005). NFI plot data were available from two National Forest Inventories: the HOSP dataset (1988-1992; 3448 plots) and the first two recording years of the MFV dataset (2001-2002; 1811 plots out of 3622 plots in total).

For each plot common forestry variables like age, main tree species, dbh of middle tree, height, volume, volume increment and representative area were available. Allometric functions were used to convert volume, height and diameter values to plot biomass before and after adding the annual increment, and the difference between these was converted to carbon. The HOSP dataset was used to extrapolate from 1990 to 1999. From 2000 on, values from the MFV dataset were used. Soil carbon was reported as stocks, not stock changes (in accordance with Tier 1 for land use not changing) for all land uses (de Groot et al., 2005). After a thorough study of all datasets available, carbon in the soil was based on a recent National Soil Sampling Programme (NSSP). The NSSP was carried out between 1990 and 2000 to quantify the Soil Map of the Netherlands scale 1:50,000 with statistical features. Organic matter content has been determined for all (geographically referenced) sample locations (de Groot et al., 2005). A national soil C map was constructed based on these samples (including some gaps). The C stock for each land use (transition) category was derived from overlays between the soil C map and the land use maps for 1990 and 2000 (de Groot et al., 2005). The carbon emission from cultivation of organic soils was estimated for all organic soils based on ground surface lowering and the characteristics of the peat layers (Kuikman et al., 2005). Ground surface lowering was estimated from either ditch water level or mean lowest groundwater level (Kuikman et al., 2005).

An external expert, Wojtek Galinsky, was asked to review the first version of the National System. At the same time, after the implementation in 2005, lessons learned led to further improvements. The overlay of the land use maps as derived from the topographical maps from 1990 and 2000 yielded unexpectedly high values for some land use transitions. Among these were changes to and from forests, and transitions from settlements to grasslands. These were in first instance explained through uncertainties related to the methodology. A field validation was set up, resulting in lower values (64% and 44% of original values) for changes to and from forests (Van den Wyngaert et al., 2007). The national soil C map was improved by increasing the number of strata for calculation and applying corrections for organic soils (Van den Wyngaert et al., 2007). Apart from these improvements, a Monte Carlo uncertainty analysis for the carbon balance in forests remaining forests was carried out (Van den Wyngaert et al., 2007).

3 The 2007 review process

As part of the annual review of the National System for GHG reporting for the UNFCCC as well as the initial review for the Kyoto Protocol the Expert Review Team (ERT) visited the Netherlands 16-21 April 2007. The results of this UNFCCC review are listed in this paragraph, for the outcomes of the future Kyoto Protocol reporting the reader is referred to chapter 11. In general the review expert was very critical with regard to the current methodology for land use change area estimates, the emission factors for deforestation and afforestation, the way carbon in soils was treated after land use changes as well as inherited emissions from the period 1970-1990 (ARR, 2007). shows the comments from the review team relevant for LULUCF (see also Annex A for full comments).

These issues have for the majority **not** yet been addressed in the 2008 submission (with exception of the notation keys and syntax comments). In chapter 10, a list of improvements is proposed, based on the review comments and other sources.

Table 3-1: Review comments as noted in the Annual Review Report & chapters with proposed actions or additional motivation

ARR nr	Comment	Addressed in
108	Reconstruction of time series from 1971 to 1990 for inherited emissions from land use change	10.6
109	Change reporting for information item grassland converted to other land-use categories, to report carbon stock changes under the category grassland converted to other land (soil C changes).	10.13
110	Wrong title for lime application in CRF	10.13
111	(In)Consistency of land use maps affecting estimates of gross transitions in land use change matrix	10.2
112	Higher Tier for C change in soils for category 5A Forests	10.4
113	Definitions of Trees outside forests and heather do not match the definition of forest land of the IPCC good practice guidance for LULUCF.	
114	Inconsistency in methodology from 1990 to 2000 and after 2000 for forests according to the definition remaining forests. Use the data provided by the model used between 1990 and 2000 for the years 2001 onwards.	10.10, 10.11
115	EF for cultivation of organic soils is very high and needs better documentation (in English)	
116	IEF for afforestation grows to unrealistic values	10.9
117	Change notation key for net carbon stock change in cropland soil from “NE” to “NO” & substantiate in NIR	10.13
118	Change notation keys for carbon emissions from agricultural lime application from “NE” to “NA” & justify the trend.	10.13
119	The ERT noted that CH_4 and N_2O emissions are reported as “NO” for forest land. Considering that some small forest fires have occurred, the ERT recommends that the Party either report estimated data or use the notation key “NE”.	10.13
120	The new EF for deforestation (after the resubmission) is considered too high.	10.13

4 Area determination of land use and land use change

4.1 Data selection and background

In 2003, an inventory of land use maps, statistics or other classification systems was made to determine the most suitable one for LULUCF reporting. The area systems were assessed for the following criteria:

- regular updates in the future
- verifiable definitions of land-use classes
- costs
- accuracy of area estimate: minimum size of grid cells or area unit
- accuracy of land use classification
- delay in final product

The process and outcome of this is described in Nabuurs et al. (2003) and resulted in the selection of the Historical land use maps (HGN) system, based on the topographical maps. It was decided to derive the land use change matrix from the HGN 1990 and HGN 2000, so from two detailed geographically explicit maps. This corresponds with approach 3 (geographically explicit land-use data) as described in Good Practice Guidance (IPCC 2003, p. 2.12), also known as a wall-to-wall approach. The base maps for these, the topographical maps of around 1990 and 2000, were completely available in a digital form only for 2000. For 1990, the hard copy version was digitized following the method explained below (par. 4.2), respecting the format set by the 2000 map. The latter map was gridded to a 2.5 m x 2.5 m raster, corresponding with the 1990 digitized map, and both maps were aggregated to a 25 m x 25 m raster map (Figure 4-1).

4.2 Digitizing HGN 1990: from map to geo-information

The process for transforming the cartographic maps to geo-information has been reflected schematically in Figure 4-1.

In the following paragraphs the separate steps are described. The most important step is converting the colours from the scanned maps to the ten classes with land use. The procedure has been followed separately for all individual maps. The colour - and quality differences between the maps make this necessary. For a number of maps the digital topographical map has been used in the form of Top10Vector.

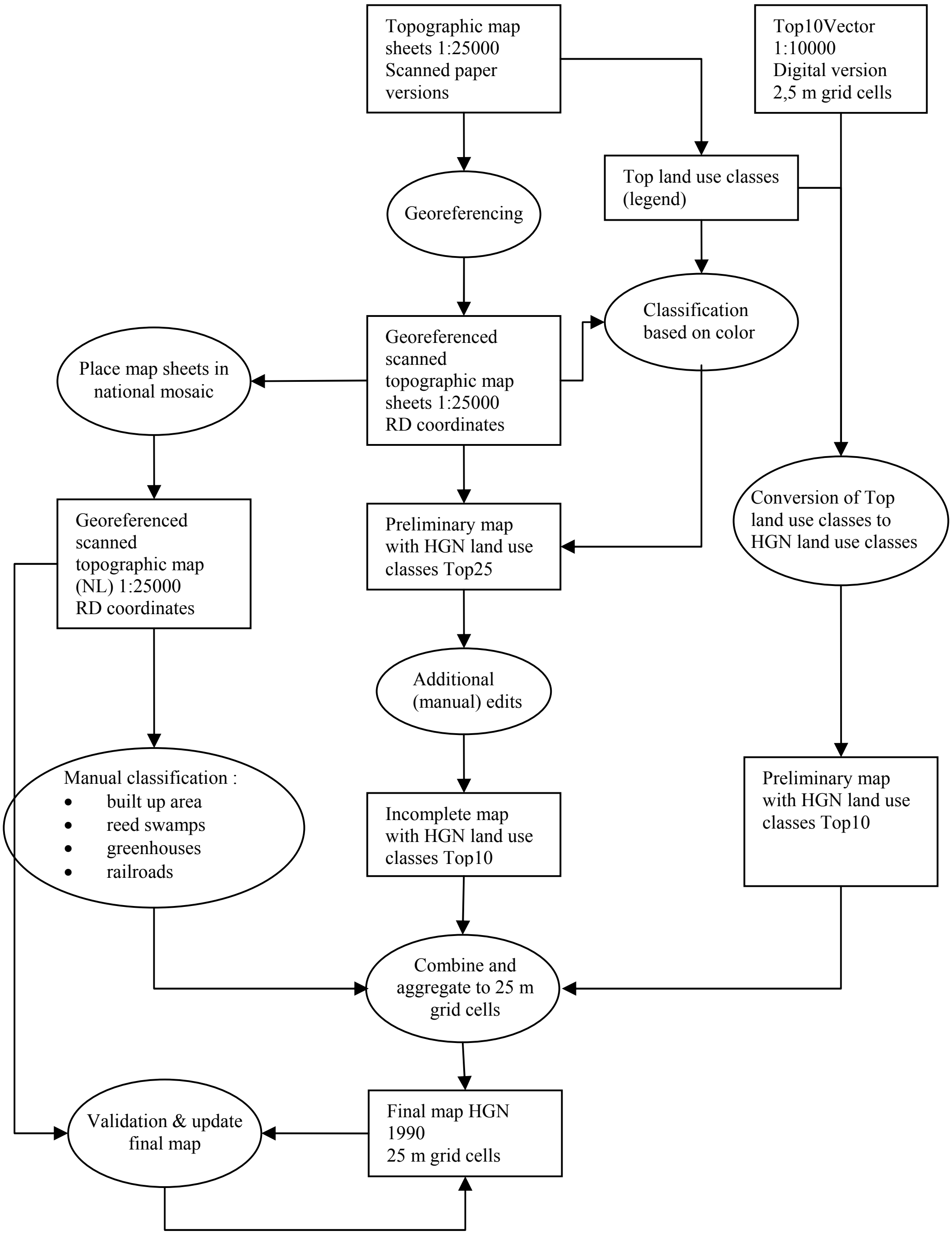


Figure 4-1: Overall working method at the development of HGN-1990

4.2.1 Source material

The source material for HGN1990 consists of the topographical maps 1: 25,000 (Top25) and digital topographical maps 1: 10,000 (Top10Vector). All topographical maps have been explored in the period 1986 - 1995. For most of the maps this is the only available exploration, for a number of maps several revisions have appeared during this period. As far as possible, the revision which is closest to the exploration year of neighbouring maps has been chosen. For some of the Top25 maps, no versions of the scanned maps were available at the start of the project in 2004. However, the digital versions of Top10Vector were available for these maps. The Top10vector maps have the same exploration year as top25 the maps, the information is thus the same, it is only in another form (digitally) and scale (1: 10.000) available. The choice then has been made to use the Top10Vector maps if available. The exploration year remains however determinative for the selection, for HGN1990 these must fall within the period 1986 - 1995.

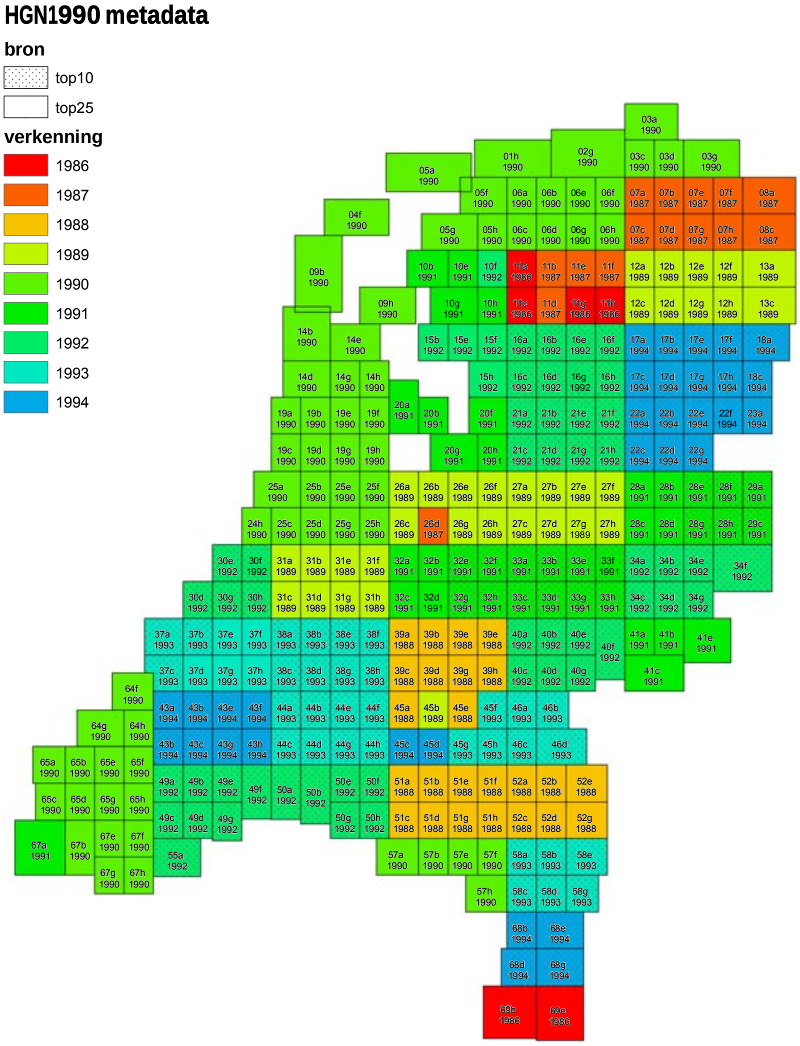
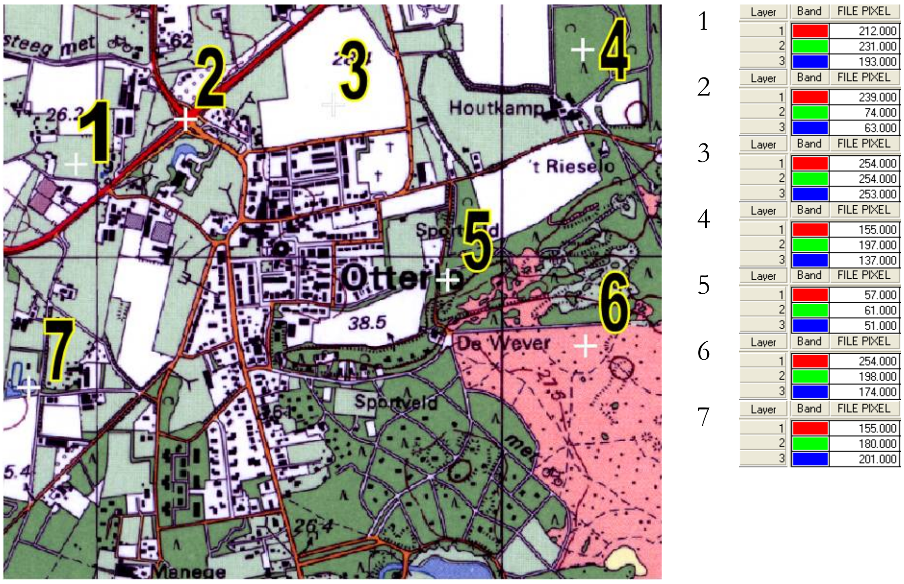


Figure 4-2: HGN1990 : type of source map and exploration year by mapsheet

4.2.2 Preparation

The maps of Top25 have been scanned with 300 dpi with 24-bit RGB colour depth. The 24-bit RGB colour depth implies that for each pixel the reflection is stored in the colours red (R), green (G) and blue (B) on a scale between 0 and 255. White areas in the scanned map for example get the RGB value 255,255,255; black becomes RGB = 0,0,0; red = 255,0,0; grey becomes RGB = 127,127,127. All colours in the scanned maps are stored this way (Figure 4-3). Theoretically, the scanned maps can contain up to 16 millions different colours. The maps have been produced with a limited number of colours, the legenda shows that a maximum of 15 colours occur on the map. A statistic analysis of the number of colours in the scanned map shows that more than 10000 colours are present. These are mostly different kinds of shades of the same colour which can not be distinguished by eye as being different. An area which appears to be even red will be interpreted by the scanner with a lot of different kinds of red. These differences already arise during the offset press process, for example by creating the desired colour by using several basic colours. Also this is caused by the influence of paper and discolouring ink over time. A map which is exposed to sunlight will discolour, the colours become barge. Also on the edge of colour areas (for example black line along red) different shades of colour from black to red are created during the scanning process.



	Layer	Band	FILE PIXEL
1	1	🟥	212.000
	2	🟩	231.000
	3	🟦	193.000
2	1	🟥	239.000
	2	🟩	74.000
	3	🟦	63.000
3	1	🟥	254.000
	2	🟩	254.000
	3	🟦	253.000
4	1	🟥	155.000
	2	🟩	197.000
	3	🟦	137.000
5	1	🟥	57.000
	2	🟩	61.000
	3	🟦	51.000
6	1	🟥	254.000
	2	🟩	198.000
	3	🟦	174.000
7	1	🟥	155.000
	2	🟩	180.000
	3	🟦	201.000

Figure 4-3: Scanned map with seven locations (1-7) for which the reflection values of the pixels are shown.

The scanned maps are georeferenced to the Dutch coordinatesystem RijksDriehoekstel (Rd-stelsel). For each map the Rd-coordinates of the corner points have been used, these are printed on the map. The geometrical correction has been carried out with the programme Edras/Imagine 8.7 using to the rubbersheeting method. The four corner points of the map are digitized and the associated Rd-coordinates are entered. The program then transfers the scanned map to an imagefile with geo-coordinates. During this process a dimension is also assigned to the pixels in the scan. This dimension, the size of the area for one pixel in real world, can be calculated from the map scale and the scan resolution. The maps have been drawn on a scale of 1: 25000. This implies that a distance of one centimetre on the map corresponds to a distance of 25000 centimetres or 250 meters in the field. At a scan resolution of 300 dpi, for each inch (2.54 cm) on the map, 300 pixels are produced, this means approximately 118 pixels for each centimetre. One pixel on the scanned map corresponds now to approximately 2.1 meters in the real world. For practical reasons, a dimension of 2.5 meters has been chosen. The standard dimension of top25 a map is 10000 by 12500 meters (there are exceptions). At a choice for pixel size of 2.5 meters a scanned map exists off 4000 by 5000 pixels and the coordinates of the corner pixels match exactly to the coordinates of the corner points which are indicated on the map.

For georeferencing of the maps, the rubbersheeting method has been used. The scanned map is exactly corrected to the rectangle which is described by the four given corner points. Possible distortions, originating from the behaviour of paper in time, are thereby partly corrected. This way, the connection between adjacent maps on the corner points is always good. Mismatches can lie in the different way paper behaves in time but also in version differences between the maps or in inaccuracies in cartographic production. Other methods for georeferencing such as digitizing up to dozens of reference points for each map are particularly time-consuming and do not always produce a better result.

4.2.3 Preliminary classification of the scanned maps

As first step in the classification process the classes have been defined on the basis of different map colours in the legend of the map. The map thereby is considered as reality. The land use classes mentioned below have been distinguished.

Table 4-1: Distinguished land use classes in HGN1990

1	Grassland	7	Water
2	Agricultural land and bare soil	8	Reed swamp
3	Heather	9	Dunes and sand plates
4	Forest	12	Build up area
6	Buildings and infrastructure	13	Greenhouses

** index number[1] corresponds to the actual class numbers in the GIS file.*

Visual interpretation has been used as little as possible because this decreases reproducibility. The classification process essentially comes down to converting the many RGB colours in the scan to ten desired land use classes. The most difficult part is the consistent assignment of noise and overlap in the maps to land use classes. This is further complicated by the differences in colour between and within maps due to discolouring associated with ageing.

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[1] Some of the index numbers are missing as classes were aggregated or left out: deciduous and coniferous forests were aggregated, fresh and salt water were aggregated and a class “other” was not used.

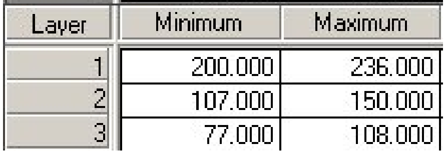
To convert the scans to a GIS file with thematic classes, the supervised classification method from the programme Erdas/Imagine 8.7 has been used. This supervised classification method implies that for each thematic class designated pixels on the scan are selected. On the basis of the RGB colour value of the selected pixels the programme looks for pixels in the neighbourhood with corresponding colour values (Figure 4-5a). With this sample a profile for a specific class is established (Figure 4-4). The profile contains a statistic description of the RGB colour values for this specific class. Then all pixels on the map are compared to the profile according to the box classifier method. When the RGB value of pixel lies within the profile of the class this pixel is assigned to this class (Figure 4-5b). By creating a profile for all desired classes the maps are classified (Figure 4-4 and Figure 4-5c). When the colours on the map are very variable several profiles for one class must be established to reach an acceptable result. However, a rest class ` not-classified always remains. These are the pixels which do not belong to any profile. Examples of this are cartographic elements such as text, hatchings and the coordinate grid. These classes disappear during the next step, the aggregation

Layer	Minimum	Maximum
1	238.000	251.000
2	232.000	245.000
3	163.000	184.000

Profile of the class gras1. For each band (layer) the minimum and maximum value for the reflection is shown in red (band1), green (band2) and blue (band3).

Layer	Minimum	Maximum
1	250.000	255.000
2	246.000	255.000
3	223.000	240.000

Profile of the class akker/kaal1. For each band (layer) the minimum and maximum value for the reflection is shown in red (band1), green (band2) and blue (band3).



Layer	Minimum	Maximum
1	200.000	236.000
2	107.000	150.000
3	77.000	108.000

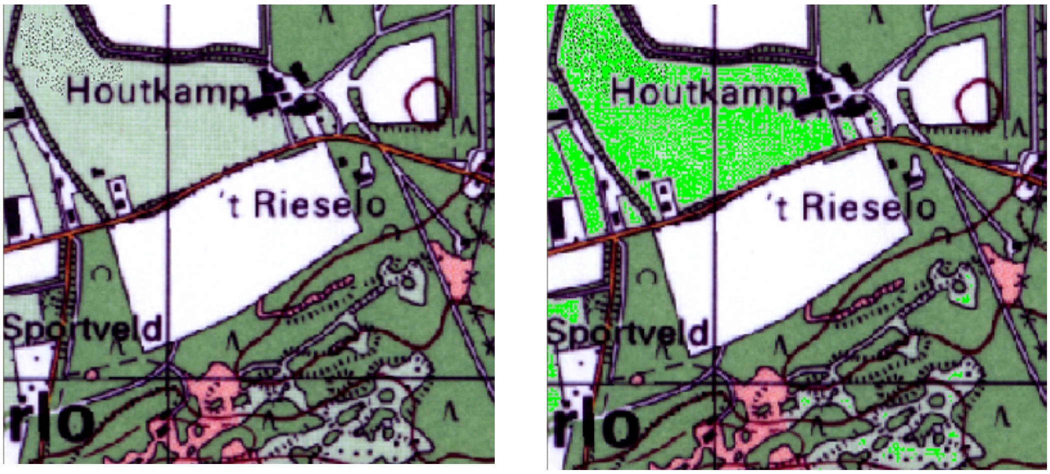
Profile of the class bebouwd/wegen. For each band (layer) the minimum and maximum value for the reflection is shown in red (band1), green (band2) and blue (band3).

Figure 4-4: RGB profiles for three land use classes, Grassland, Cropland/bare soil en Buildings / infrastructure).

Classification is carried out for each map individually. A RGB profile for a certain class is linked with the map on which this profile is produced. The colours of a class seem identical on the different maps, and visually they do match. Grass, for example, is always reflected with the same green colour. The exact RGB values can deviate slightly, however, between the maps because of aging of the colours with time, minimum differences in colouring for different editions or even caused by scanning.

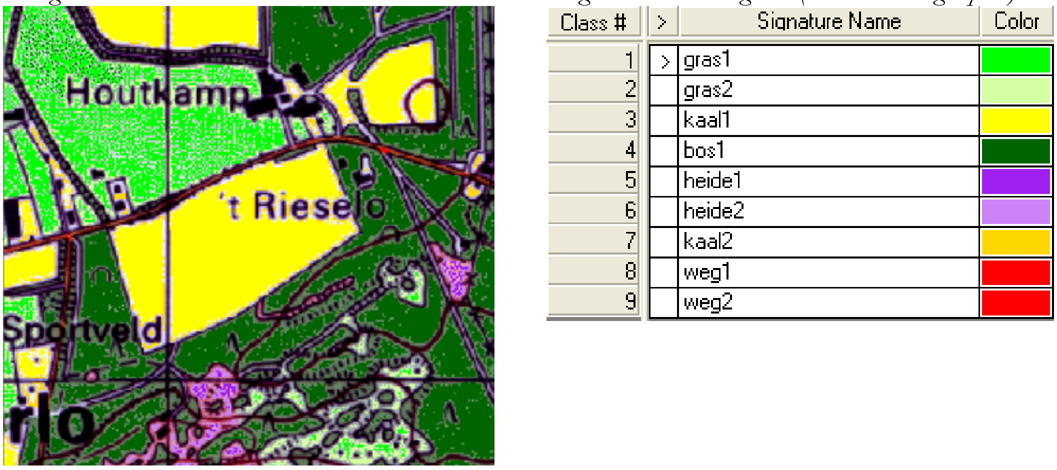
For all 176 scanned maps the above procedure has be applied separately. This 'training' of the classification is an interactive process where not only the technical allocation of colours plays an important role, but also the substantive interpretation is important. The correctness of classification is later established through validation of the classification results.

Not all classes mentioned in Table 4-1 can be classified this way. The classes concerned and the used procedure are discussed in paragraph 4.3.2



a: The black/white dotted area above Houtkamp reflects the area of which the reflection values from the scan are used for the drawing up of the profile for the class gras1.

b: The classification result on the basis of the profile of the class grass 1. In the background the scan is still visible and it also shows grass areas that are not assigned to the class gras1 (in the lower-right part)



Class #	>	Signature Name	Color
1	>	gras1	🟩
2		gras2	🟩
3		kaal1	🟨
4		bos1	🟩
5		heide1	🟪
6		heide2	🟪
7		kaal2	🟧
8		weg1	🟥
9		weg2	🟥

c: Classification result with the profiles of all classes. In the background still some parts off the scan remain visible, these are non-classified areas (e.g. black color, the text)

d: Overview of all produced classes. A class can be represented by several profiles.

Figure 4-5: Creation of profiles for several classes

4.3 Harmonising classification of the digital maps (1990 and 2000)

4.3.1 Preliminary classification of the digital maps

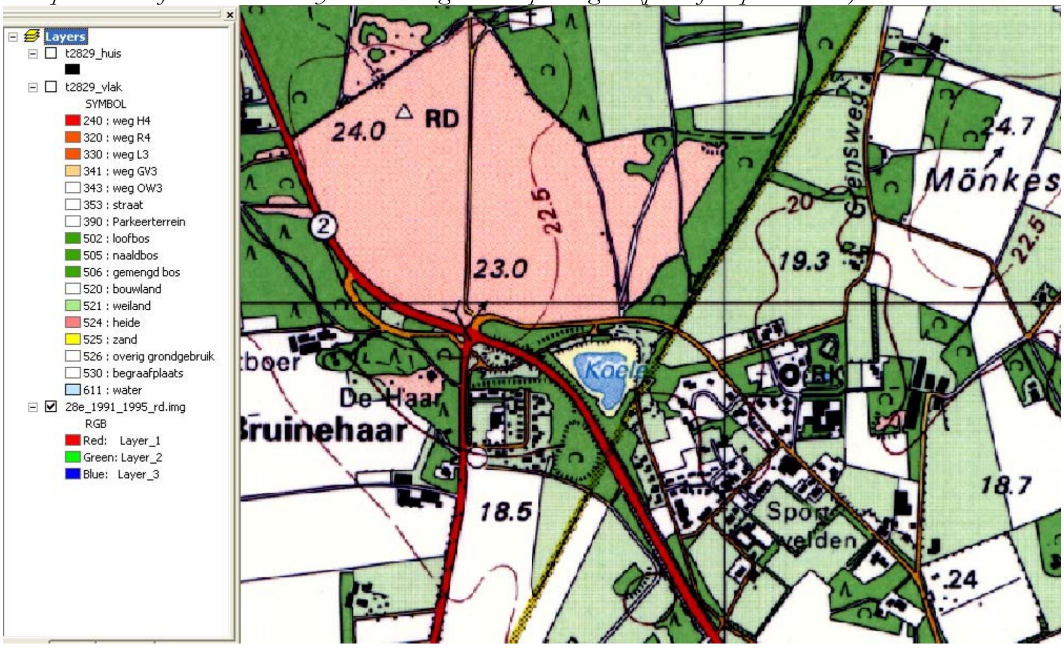
The preliminary classification of the maps that are available in digital form (Top10Vector 2000 and some maps of 1990) is split up in two steps. The first step is the recoding of the Top10Vector codes to the HGN preliminary classes. This corresponds to classification on the basis of the map colours as described in paragraph 4.2.3. The same exceptions which are discussed in paragraph 4.3.2 do apply for this process. After recoding the vector file a raster file is created with a 2.5

meter cell size on basis of the HGN code. This file is now similar with the result of the preliminary classification of the scanned maps. The second step is to tune the classification procedure of the digital maps to the classification procedure of the scanned maps. The final result of both procedures must be similar, the type of source material should not influence the final result.

Figure 4-6 shows for a part of map 28E the digital Top10Vector file and the scanned topographical map 1 : 25.000 (top25). The colours of the classes from Top10Vector are chosen similar to the colours of the classes in top25. The first difference that is notable is the lack of text in Top10Vector. This is not very important for the classification, during the aggregation step this is settled in a correct manner. There are however two classes where the difference in source file influences the classification; the roads and the houses. The roads on top25 do have a black line as an edge, the coloured part of the roads in Top10Vector are broader. Thus, some narrow (white) roads are omitted on Top25 whereas these roads are visible on Top10Vector. To make the results comparable with the results of the preliminary classification of the scanned maps the roads on the raster Top10Vector file are shrunk with one cell to create a narrower road. With the houses the problem is exactly reversed, these are generally drawn broader in top25 than in Top10Vector. This is also caused by a black line around the houses. Since the houses are drawn in black they become a bit broader. To make the two sources similar, the raster Top10Vector houses are expanded with one cell.

Layers
☑ t2829_huis
⬛
☑ t2829_vlak
SYMBOL
🟥 240 : weg H4
🟧 320 : weg R4
🟧 330 : weg L3
🟧 341 : weg GV3
⬜ 343 : weg OW3
⬜ 353 : straat
⬜ 390 : Parkeerterrein
🟩 502 : loofbos
🟩 505 : naaldbos
🟩 506 : gemengd bos
⬜ 520 : bouwland
🟩 521 : weiland
🟥 524 : heide
🟨 525 : zand
⬜ 526 : overig grondgebruik
⬜ 530 : begraafplaats
🟦 611 : water
☑ 28e_1991_1995_rd.img
RGB
🟥 Red: Layer_1
🟩 Green: Layer_2
🟦 Blue: Layer_3

a: Top10Vector file with colour layout according to the top25 legend (part of mapsheet 28E)



Layers
☐ t2829_huis
⬛
☐ t2829_vlak
SYMBOL
🟥 240 : weg H4
🟧 320 : weg R4
🟧 330 : weg L3
🟧 341 : weg GV3
⬜ 343 : weg OW3
⬜ 353 : straat
⬜ 390 : Parkeerterrein
🟩 502 : loofbos
🟩 505 : naaldbos
🟩 506 : gemengd bos
⬜ 520 : bouwland
🟩 521 : weiland
🟥 524 : heide
🟨 525 : zand
⬜ 526 : overig grondgebruik
⬜ 530 : begraafplaats
🟦 611 : water
☑ 28e_1991_1995_rd.img
RGB
🟥 Red: Layer_1
🟩 Green: Layer_2
🟦 Blue: Layer_3

b : scanned topographic map 1 : 25.000

Figure 4-6: reproduction of Top10vector a file and the topographical map 1: 25,000 of the same location with survey year 1991.

4.3.2 Manual classification and edits

Classes that do not have a unique reproduction colour must be classified in a derogatory manner. This also applies to classes which are reflected with a symbol or hatching.

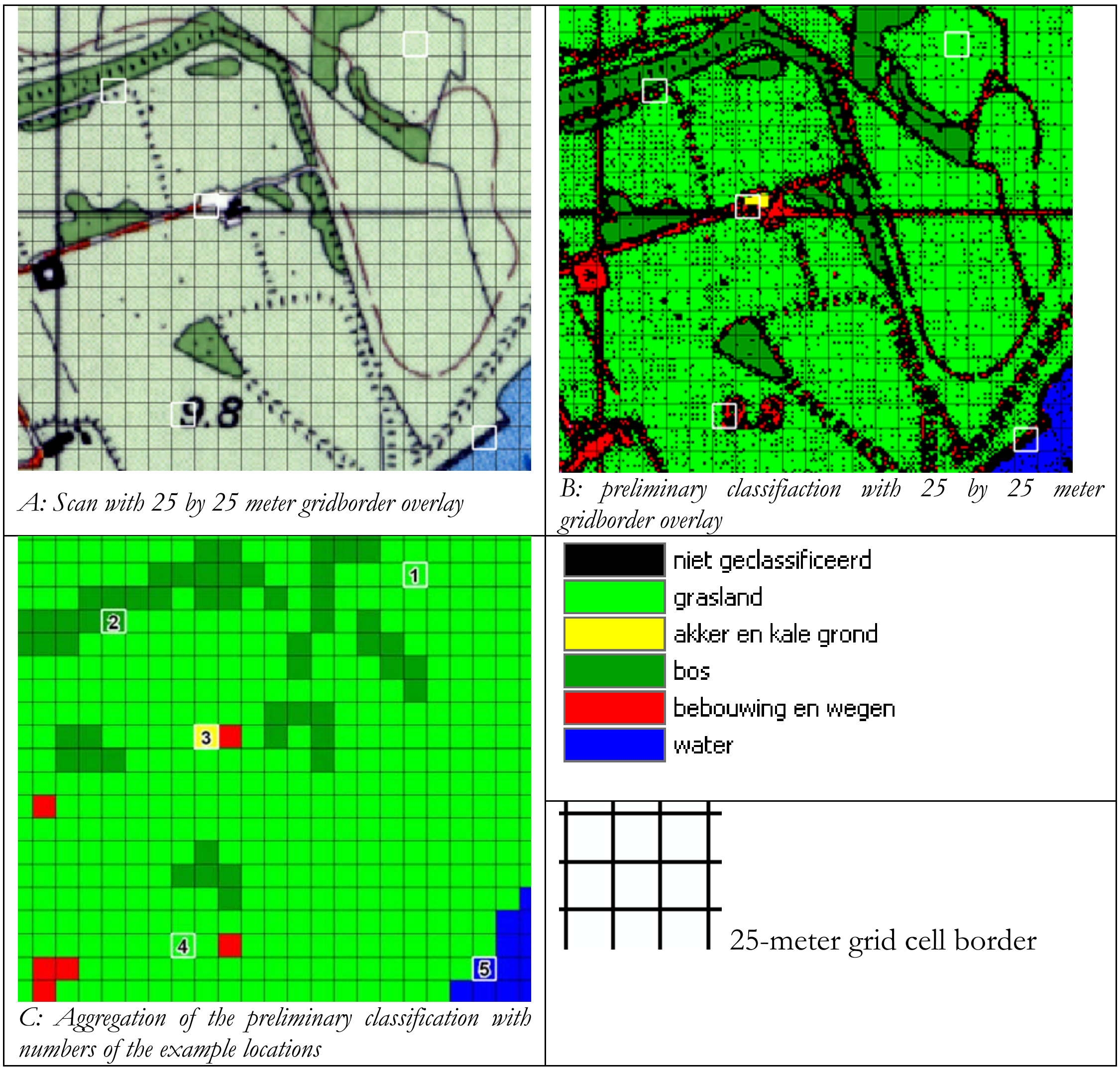
Table 4-2: Classes with derogatory classification procedure

1. The classes 'agriculture and bare soil' and 'built-up area' both are coloured white on the maps and are assigned to the same preliminary class during the preliminary classification process. For subdividing this preliminary class in the two HGN classes a manual post processing procedure is required. The border of the built-up area is digitized for this purpose and is used to recode the preliminary class to the HGN class 'built-up area'. Digitizing is done by visual interpretation, the border of the built-up area is stipulated by means of the existence of houses.
2. The class 'reed swamp' is reflected on the topographical map with a black point symbol and can only be classified by manual interpretation. This also means a visual interpretation of the area is which is commented as a reed swamp. A reed swamp area is represented on the map with a number of spread symbols. An area with several reed swamp symbols is digitized as reed swamp.
3. The class "greenhouses' is reflected on a part of the used maps with a black line hatching and on another part with grey/brown colour, depending on the year on expenditure on the maps. For the maps where the greenhouses are reflected with a hatching these are digitised manually.
4. The railroads are a part of the class "built-up area and infrastructure', these are drawn with a black/white block hatching crammed on the maps. These railroads have been digitized as a line where an attribute for the width of the railroad has been taken along. The railroad has been converted on the basis of this width into an area and then incorporated in the preliminary classification result.

4.4 Aggregation of the digital maps to 25m x 25m grid (1990 and 2000)

The procedure of classifying scanned topographical maps assumes an incomplete preliminary classification with a detail 2.5 meters grids. Incomplete means that there are still many not-classified pixels present. These are for example the cartographic elements as text and hatchings, but also not decisively colours in the scan. Such cloggings disappear mainly at aggregation. During the aggregation process to 25 meters grids nearly all not-classified pixels are assigned to the dominant land use class. Also at this grid size the impact of geometrical inaccuracy becomes limited. The procedure for aggregation is as follows. For each 25-meter grid cell the majority class of underlying 2.5-meter grid cells are calculated from the preliminary classification (Figure 4-7b) and assigned to the 25 m. grid cell (Figure 4-7c). During the majority calculation the class 0 (not-classified) is not taken along. For each 25-meter grid cell the definite land use class is calculated this way.

Figure 4-7 shows five example locations (1-5) are shown to comment the functioning of the majority rule. The numbers of the examples have been reflected in Figure 4-7c For a large number of grid cell the assignment of the majority is univocal.



A: Scan with 25 by 25 meter gridborder overlay

B: preliminary classifiaction with 25 by 25 meter gridborder overlay

C: Aggregation of the preliminary classification with numbers of the example locations

Figure 4-7: From scan to aggregated raster map

On location 1 only 2.5 meters grid cells from the preliminary classification of the class grassland and not-classified are contained within 25-meter the grid cells. The majority thus is grassland.

Location 2 concerns a 25-meter grid cells with forest, grassland and cartographic symbols for relief. The border between forest and grassland and the symbols has been incorporated in preliminary classification as not-classified. Within the 25 meter grid cell it is notable that not all the light green colour has been assigned to grassland in the preliminary classification. The colours on the black border and symbols deviate too much from the established profile for the class grassland and are assigned to the preliminary class not-classified. At grid cells which lie on the border of two land use classes this can cause the majority rule not to calculate the desired class for 25-meter grid cell. On this location the calculated majority from the preliminary classification is forest whereas on the scan it is clear to see that this should be grassland.

On location 3 occurs a mix of red (roads), white (agriculture) and black (map lines). The colour white has been well incorporated in the preliminary classification as the class agriculture, the rood as roads and built-up area and the black has been taken as roads and built-up area or as not-classified. The black buildings in the scan can be classified on the basis of its colour profile. The majority of the black in the scan (text, hatchings) deviates with regard to colour assignment enough from black buildings and as far as it is classified as the class buildings this is generally a small number of grid cells in the preliminary classification which within a 25-meter grid cell will not be the majority. On this location the correct majority is calculated, the class agriculture / bare soil.

Location 4 concerns a mix of grassland, black text classified as preliminary class 'buildings' and the class not-classified. For this location, the majority rule calculates the correct class value, the majority of the 25-meter grid cell is grassland. Two grid cells to the right an example of an incorrect majority calculation is shown. Here the calculated class is built-up area and roads. Seen from the basis material, this is correct, the majority within the 25-meter grid cell is black text. A visual interpretation of this area this would however result in the class grassland. The cartographic symbols cover here the actual land use. In figure 2.7b and c it is clear to see that in general this goes well. The largest part of text and hatchings that is incorporated as a built-up area in the preliminary classification disappears after aggregation with the majority rule. In the 25-meter grid file, the concerning locations do have the correct HGN class value.

Location 5 gives another example of a 25-meter grid cell on the border between water and grassland. Within this 25-meter grid cell there is almost as much grassland as water. The majority in this case is water.

4.5 Validation of the classification of the scanned maps

The validation method for HGN1990 is basically a validation of the classification procedure. No comparable independent source for land use from the 1990's is available so the original topographic maps are the only source for the validation. The land use depicted in the topographic maps therefore is considered as correct.

4.5.1 Validation procedure outline

The validation has been carried out by province. The results of this have been used for the validation of the whole of the Netherlands. For this the accuracy assesment tool of the programme Erdas/Imagine 8.7 has been used. With this tool a randoml set of validation points can be drawn where the number of points is chosen proportionally to the area for each class. Only the total number of points and the minimum number of points for each class must be given.

The minimum number of points for each class is 25. The total number of points for the smallest province is 400 (Utrecht) and for the biggest 800 (Gelderland). For the remaining provinces the number of validation points has been calculated pro rata of the area. For the validation large water surfaces have been excluded such as the lake IJssel, the Wadden Sea and the North Sea. These areas have been manually digitised and would form a too large part in the sample set for water. However, a counterfoil of 150 meters water has been taken along alongside the coast so that the classification of the coast is validated. For the national validation all provincial sample points have been used, as a result of which the national validation is based on 6700 points.

4.5.2 Implementation

The assignment of a class to a 25-meter gridcel is carried out in two steps. An incomplete preliminary classification with 2.5-meter grid cellls is carried out firstly, then for each 25-meter grid cell the most attentive class is calculated (the aggregation). This is assigned to the 25-meter grid cell. This means that for the validation of 25-meter grid cell the corresponding area of 25 by 25 meters on the map must be looked at. This means that there is not a reference point but a reference area for which the most attentive class must be valued. To be able to do this all drawn sample points for each province have been converted to a file with 25-meter grid cells. The position of 25-meter the grid cells matches with the position of the grid cells in HGN1990. The 25-meter grid cells which coincide with the validation points have been made entirely transparent. All other grid cells are partly transparent. This file is superimposed on the scans which results in a visible area of 25 by 25 meters for each sample point. For the orientation the surroundings are partly visible. Now the most attentive class for each validation point can be estimated from the map (Figure 4-8).

a : Validation point Gelderland 400. The HGN class is heath land. The reference class is also heath land.

b : Validation point Gelderland 224. The HGN class is forest. Within the 25 by 25 meter grid cell both a road and forest are visible The largest part is forest, therefore the reference class is forest.

Figure 4-8: Example of the implementation of the validation

4.6 Map overlay, calculation and validation of the land use change matrix

An overlay was made of the HGN maps 1990 and 2000, resulting in 9 land use types (1990) x 8 land use types (2000) = 72 land use type combinations. From this overlay, the number of grid cells per land use type combination was calculated. This resulted in a land use change matrix with gross transitions between classes for the period 1990-2000 (**Fout! Verwijzingsbron niet gevonden.**) (Nabuurs et al., 2005). According to these figures, land use changes are significant in the Netherlands. In total 642,000 ha had changed land use between 1990 and 2000, which is 15% of the land ! One third of these changes were between cropland and grassland, whereby grassland lost in total 113,000 ha. However, also for forested areas, the changes were large: deforestation amounted to 2504 ha per year (0.7% y^{-1}), and afforestation to 3124 ha per year (Nabuurs et al., 2005). These values seemed high, as other types of previous information indicated deforestation areas in the range of 500 ha/y and afforestations registered by Groenfonds of around 1000 ha in 5 years (Van den Wyngaert et al., 2007).

As many single cell (25x25 m) land use changes showed up in the final change map, we had the impression that methodological problems might still exist in the overlay. We suspected that many of the single cell land use changes were artefacts, leading to an overestimate of the emissions caused by deforestation. With the aim to be as conservative as possible with our deforestation emission estimate, a field validation was decided upon. The errors were attributed to small random errors in gridding of the polygon maps, scale differences between the 1990 and the 200 maps and most importantly, to systematic differences between the land use classifications of the topographical maps of 1990 and 2000.

Validation against other independent data sources (e.g. RS derived land use maps for the Netherlands) was not carried out.

4.7 Transformation of the HGN land use types to GPG land-use classes

The IPCC Good Practice Guidance (GPG2003 chapter 2, pages 2.5 – 2.7) are followed to transfer the HGN categories to LULUCF land-use categories in line with chapter 3 and 4 IPCC GPG. Additional a number of country specific allocations are conducted. The land use category “Forest Land” included three subcategories which are explained more in detail in paragraph 5.1. Table 4-3 shows the Dutch HGN classes and the GPG classes.

Table 4-3: Classification of HGN land use classes (in Dutch (a) and English (b) into GPG land use categories

HGN[2] Basis	HGN specified	GPG[3] classes
grasland	kwelder	Grassland
	grasland	Grassland
	natte vergraste heide	Grassland
akker/kale grond	akker	Cropland
	kale grond in bebouwd gebied	Settlement
heide/hoogveen	heide	Forest land
	hoogveen	Forest land
bos	loofbos	Forest land
	naaldbos	Forest land
bebouwing	huizen & gebouwen	Settlement
Water	zout getijde	Other land
	zout	Other land
	zoete meren en plassen	Other land
	rivieren	Other land
	vennen	Other land
rietmoeras	rietmoeras	Wetland
zand	onbegroeid kustduin	Other land
	zandplaat en strand	Other land
	stuifduinen binnenland	Other land
Verhard gebied	verharde stukken in bebouwd gebied	Settlement
	wegen	Settlement
kassen	kassen	Settlement

HGN Basis	HGN specified	GPG classes
Grassland	Former tidal marshy flatlands	Grassland
	Grassland	Grassland
	Wet grass heathland	Grassland
Agricultural land & bare areas	Cropland	Cropland
	Fallow land in built-up area	Settlement
Heathland/peat moor	Heathland	Forest land
	Peat moor	Forest land
Forest	Deciduous forest	Forest land
	Conifer forest	Forest land
Buildings	Buildings & houses	Settlement
Water	Salty tidal	Other land
	Salt	Other land
	Freshwater lakes and wetlands	Other land
	Rivers	Other land
	Softwater lakes / permanent oligotrophic waters	Other land
Reed marsh	Reed marsh	Wetland
Sand	Unvegetated coastal dunes	Other land
	Sandy areas and beaches	Other land
	Drifting sands (inland)	Other land
Build up area	Paved (urban) areas	Settlements
	Paved roads	Settlement
Greenhouses	Greenhouses	Settlement

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[2] HGN: Historisch Landgebruik Nederland

[3] GPG: IPCC Good Practice Guidance

Table 4-4:. Land use change matrix 1990 – 2000 between 9 main classes (in ha or ha/10 year). Horizontal summation gives the total land use area per class for 2000. It says for example that from 1990 to 2000, 10310 ha of forest was changed into grassland, and 10588 was changed from grassland into forest. All encircled cells are land use changes that have to do with deforestation and afforestation

From→ To↓	Forest	Forest	Forest	Cropland	Grassland	Wetland	Settlement	Other land	Other Land	Total
	FAD	TOF	Nature	Cropland	Grassland	Reed swamp	Settlements & Roads	Water	Sand/dunes	
FAD	334 821	2 254	4 906	10 356	10 588	87	4 125	620	555	368 313
TOF	3 130	11460	226	1 584	3 821	22	2 168	302	101	22 813
Nature	2 898	152	43 193	671	854	19	280	272	647	48 986
Cropland	1 274	422	67	759 056	207 172	16	5 261	924	14	974 205
Grassland	10 310	3 131	828	158 174	1 166 930	2 070	26 971	6 990	1 287	1 376 690
Reed swamp[4]										
Settlement	9 013	4 164	363	43 681	91 131	81	387 622	3 484	590	540 129
Water	946	228	657	3 500	8 623	540	2 603	764 383	2 232	783 711
Sand/dunes	604	111	301	153	686	16	264	2 111	33 383	37 626
Total	362 994	21 923	50 539	977 176	1 489 805	2 850	429 293	779 085	38 808	4 152 473

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[4] In 2000, the maps lacked information to distinguish reed swamps. Reed swamps that have not changed land use are reported under grasslands in 2000.

Table 4-5: Net changes per 10 years in land use resulting from the gross changes as given in Table 4-4

	Ha 1990	Ha 2000	Difference Ha/ 10 year
Grassland	1,489,800	1,376,690	-113,110
Cropland	977,200	974,204	-2,995
Nature	50,500	48,985	-1,514
Forest	363,000	368,312	5,313
Settlement	429,300	540,128	110,829
Water	779,100	783,711	4,611
Sand	38,800	37,626	-1,174
Trees outside the forest	21,900	22,813	913

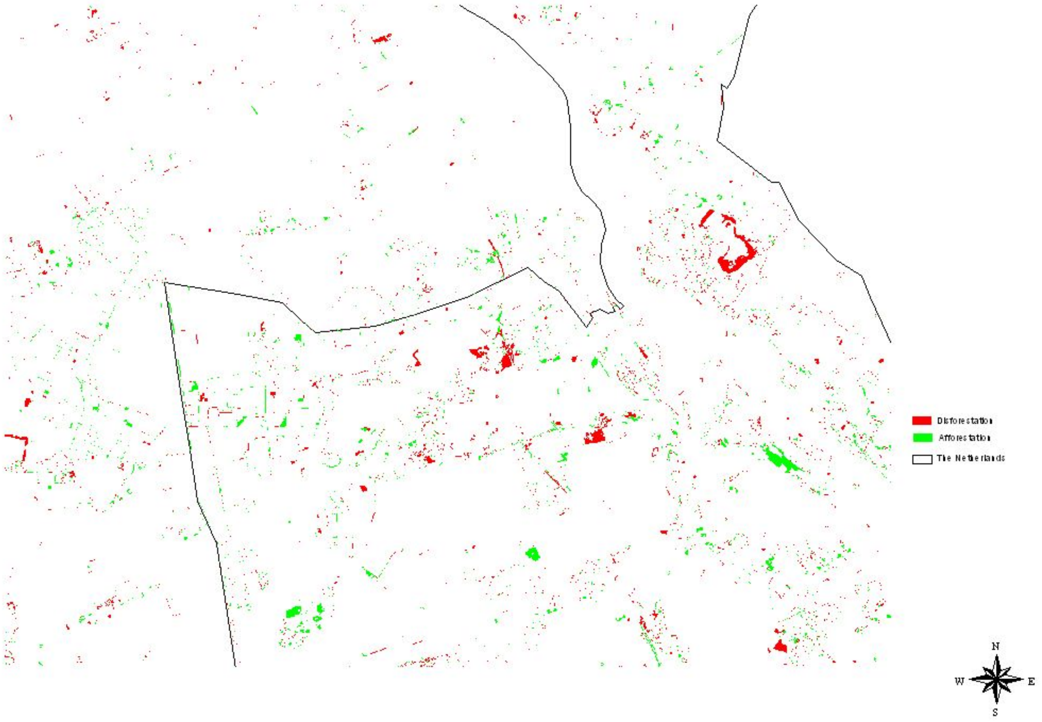

Figure 4-9: Pattern of afforestation (green) and deforestation (red) in one field validation area (the figure spans about 50x50 km).

4.8 Field validation of land use changes to and from forest (2005)

The field validation is described in detail in Van den Wyngaert et al. (2007). Two areas of 10 x 10 km were selected in which every occurrence of deforestation/afforestation was visited and visually assessed on its correctness. Regions were selected to represent the higher areas of the Netherlands (where most of the forests are), a small scale landscape, and the selected areas were areas where we had abundant field information. A field crew was provided with the change map (with all change events, both single and multiple cell land use changes) and a detailed topographical map, so they could be sure about their position in the field down to 5 meters (also within forests as The Netherlands has a dense road network). Based on what they saw in the field (April 2005), the field crew judged whether a land use change had taken place.

The field validation took into account only changes in forest according to the definition (FAD), and a change e.g. from FAD towards trees outside the forest (TOF) was also marked as a deforestation (see par 5.1 for detailed description). Thus, the percentages correctness calculated are valid for FAD, and were also used for TOF for lack of better information. For the first assessment, each single event of a land use change (no matter whether it was a single cell, or groups of cells), was counted as '1'. We call this the validation by number of occurrences. Table 4-6 gives the results.

Table 4-6: Correctness percentages for afforestation and deforestation by number of occurences (VandenWyngaert et al.2007)

	Afforestation	Deforestation
Hengelo-Ruurlo	73.7 %	46.8 %
Overloon	54.1 %	41.4 %
Average (NL)	63.9 %	44.1 %

Correctness percentages between the cases varied only slightly (between 41 and 47%). Correctness for either forest according to definition and trees outside the forest were also very comparable. The values used were the simple average between the results of two test sites.

4.9 Re-assessment of outcomes of field validation of land use changes to and from forest (May 2007)

During the in-country review questions were raised on the correctness percentages. As it could be that the results were biased by a high number of very small errors near roads and forest edges, the data collected in 2005 were revisited and each change event was scored on the number of pixels involved (patch size) and on whether or not the land use change event was part of a forest edge. This is called the validation by patch size. The analysis as presented here is based solely on the results for Overloon. This was chosen due to time constraints for the reaction to the ERT and because this was the site giving the most conservative estimate.

For each of the patches visited during the field validation, the patch size was determined by counting the number of pixels visually and the patches were classified as forest edge or part of forest. Patches were classified as forest edges if they were connected to other types of land use on one side and to forest on the other, and were often small (few pixels) or, if larger, narrow. Patches were classified as (continuous) forests if they either were large and wide patches or were one or a few pixels completely surrounded by forest (Figure 4-10).

The difference between the two types of validation can be illustrated with the example in Figure 4-10. Following the validation by number of occurrences the correctness of afforestation (in blue) and deforestation (in red) both would be 50%. According to the validation by patch size, the larger patches have more weight and the correctness of afforestation would be much higher than 50% (Figure 4-10).

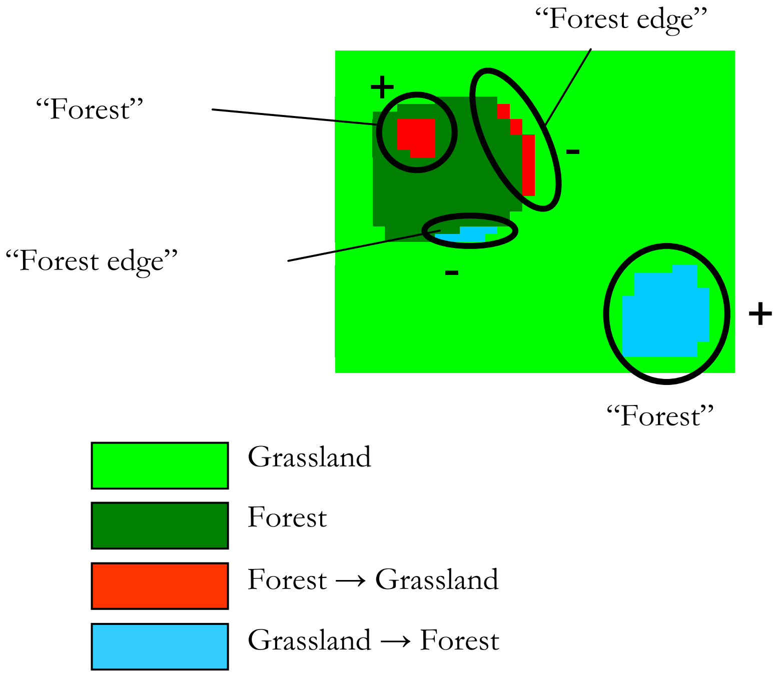

Figure 4-10: Example of classification of land use change patches into (continuous)forest and forest edges. + is correct (land use change is probable or certain) and – is not correct (land use change not probable). In the validation by number of occurrences each patch had the same weight in calculation of the mean correctness. In the validation by patch size the weight is proportional to the size of the patch.

Table 4-7: Correctness percentages for afforestation and deforestation for different patch sizes (based on validation by patch size)

Nr of pixels per patch	Afforestation	Deforestation
1	46.9	37.0
2-5	49.3	39.4
6-10	75	28.5
>10	100	80

Table 4-7 shows that land use change events of larger size have a higher certainty. The higher reliability of land use change of large patches affects the mean correctness estimates as reflected in Table 4-8. This difference is small for forest edges (mean size between 1 and 2 pixels), but large for forests (mean size of 8.3 pixels per event for afforestation and 19 for deforestation). The weight of forest edges in the total value is also much smaller if corrected for surface. Thus the correctness percentages are about 20% higher if corrected for surface, because now larger patches (with higher accuracy) have more weight in the total accuracy.

Table 4-8: Correctness percentages for afforestation and deforestation by the two validation methods (nr of occurrences, and patch size))

	Afforestation		Deforestation	
	Nr of occurrences	Patch size of single event	Nr of occurrences	Patch size of single event
Forest	61.7	89.7	60.0	70.2
Forest edges	51.4	52.2	38.0	43.3
Total	54.1	78.1	41.1	61.4

Summarizing, the following estimates for land use change to and from forests have been used for different submissions:

Table 4-9: Annual gross area changes (ha year^{1}) through afforestation and deforestation by the different methods (uncorrected, corrected for nr of occurrences, corrected for patch size) that have been used for different submissions (see also 8.1.1)

	Afforestation		Deforestation	
	FAD	TOF	FAD	TOF
Uncorrected	3100	800	2500	800
Corrected for field validation by number of occurrences	1984	512	1100	352
Corrected for field validation by patch size	2421	625	1535	491

5 Calculation of (changes in) forest biomass including associated uncertainties

5.1 Definitions for the forest category

The IPCC GPG distinguishes six main groups of land use categories[5]. The **land use category "**Forest land" is defined as all land with woody vegetation consistent with thresholds used to defined forest land in the national GHG inventory, sub divided into managed and unmanaged units and also by ecosystem type as specified in IPCC Guidelines. It also includes systems with vegetation that currently fall below, but are expected to exceed the threshold of the forest land category (IPCC, 2003). The Netherlands has chosen to define the land use category "Forest Land" as all land with woody vegetation. This is further subdivided in:

- "Forest" or "Forest according to definition" (FAD), i.e. all forest land which complies to the following (more strict) definition: forests are patches of land exceeding 0.5 ha with a minimum width of 30 m, with tree crown cover at least 20% and tree height at least 5 meters, or, if this is not the case, these thresholds are likely to be achieved at the particular site. Roads in the forest less than 6 meters wide are also considered to be forest. This definition is used for the Kyoto protocol article 3.3 and as requested by 16/CPM.1, Annex E, section 16, included in the Initial Report.
- "Trees outside Forests" (TOF), i.e. wooded areas that comply with the forest definition except for their surface (=< 0.5 ha). These represent fragmented forest plots as well as groups of trees in parks and nature terrains and most woody vegetation lining roads, fields etc…
- "Nature", i.e. all natural areas excluding grassland (natural grasslands and grasslands used for recreation purposes). It mainly consists of heathland, peat moors and other nature areas.

In the following paragraphs (par 5.2 & 5.3), calculation of the carbon budget is described for FAD. In par 5.4 the assumptions used to derive the carbon budget for other categories of Forest Land are given.

5.2 Carbon balance of live and dead trees in Forest land remaining forest land

5.2.1 Approach and data for Forests according to the definition (FAD)

The basic approach follows the IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry where a stock change approach is suggested. The net flux is calculated as the difference in carbon contained in the forest between two points in

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[5] IPCCC GPG for LULUCF, page 2.6: "Countries will use their own definitions of these categories, which may, of course, refer to internationally accepted definitions, such as those by FAO, Ramsar, etc. For that reason no definitions are given here beyond broad descriptions."

time. Carbon in the forest is derived from the growing stock volume, making use of other forest traits routinely determined in forest inventories. If no repeated measurements are available, the flux is derived from the volume increment in consecutive years. The last approach was used in the Netherlands.

For the period of interest, i.e. 1990 and on, two types of National Inventories were available for the Netherlands: the so called HOSP data (1988-1992) and the MFV data (2001-2002). The HOSP (Hout Oogst Statistiek en Prognose oogstbaar hout) inventory was designed to get insight in the amount of harvestable wood. In total 2007 plots (~ 400 plots per year) were characterized by age, tree species, growing stock volume, increment, height, tree number and dead wood. Each plot represented a certain area of forest ("representative area") of between 0,4 ha and 728,3 ha. Together they represent an area of 310736,3 ha, the estimated surface of forest where harvesting was relevant in 1988. The MFV (Meetnet Functie Vervulling Bos) inventory was designed as a randomized continuous forest inventory. In total 1440 plot recordings with forest cover were available for the years 2001 and 2002. After full completion, 3622 plots will be available.

Both forest inventories yielded the initial data needed to allow a plot level calculation of the volume of living and dead wood. The amount of wood harvested was available only at the national level and was downscaled to plot level scaled according to the probability of harvesting as calculated from plot age and growing stock volume. The volumes harvested per year are given in Annex B, based on Daamen (1991; 1994; 1996; 1997; 1998; 2000). All harvests were calculated as thinnings.

The conversion from wood to carbon of living trees was based on allometric relations from the COST E21 database converting plot diameter and height to above and below ground biomass (Annex C). Selection of the most suitable equations was based on a database collected by Van Hees (pers. comm.) and extended for this purpose. See Annex E for a more detailed description of the database and a list of studies included. The use of allometric relations yielding biomass directly made any conversions including wood density obsolete. Carbon content of live biomass was calculated assuming a IPCC default carbon concentration of 0.5 g C g^{-1} DM (IPCC, 2003). The conversion of dead wood volume to carbon did not take into account anything but the volume of the logs. This was converted to mass using an average dead wood density half that of live trees. A more detailed description of the carbon balance of forest remaining forests can be found in Nabuurs et al. (2003).

The full set of equations converting plot data into carbon fluxes for forests remaining forest is given in Annex D(I).

Not all plots in the inventories had a complete set of data. Four types of "data completeness" were found:
(1) plots with al data
(2) plots with volume and increment data, but missing variables like height, diameter or recording year
(3) plots with no volume or increment data
(4) plots with no volume and increment data but with the designation "clearcut area"

The calculations as described in Annex D were performed for plots with all data only (category 1). This was scaled back to national coverage on a representative area basis.

5.2.2 Uncertainty assessment

A sensitivity as well as an uncertainty analysis were carried out for the carbon balance of live and dead trees in forests remaining forests. The sensitivity analysis aims to give insight in the effects of the uncertainty cq. errors in single parameters cq. measured or recorded variables on the current carbon budget assessment for "forests remaining forest", while the uncertainty analysis is designed to obtain a reasonable estimate of the total uncertainty in the Dutch carbon budget for "forests remaining forest". Both analyses were carried out using realistic parameter uncertainties for the Netherlands (Van den Wyngaert et al., 2007). Additionally, an analysis was performed in which the uncertainty associated with the choice for a certain allometric equation was assessed, randomly picking from all possible equations if more than one was available (Van den Wyngaert et al., 2007).

The highest variability was associated with (coefficients of) equations that relate structural characteristics to volume or biomass and parameters that are drawn only once for the whole assessment. On the other hand, the plot data have a low to very low estimate of recording error, and contribute very little to overall uncertainty. The net outcome of the total carbon balance ranges between an uptake of 0.5 to 3 million tons CO_2 year^{-1} for 2000. Despite the high uncertainty, the resulting outcome always indicates a net uptake of carbon for forest remaining forest. The uncertainty is much larger than any variability between years, though this latter is underestimated for 1990-1999 as all years except 2000 are based on the same monitoring data.

A full discussion of the sensitivity and uncertainty analyses can be found in Van den Wyngaert et al. (2007).

5.3 Carbon balance of forests when land use changes

The calculation of the carbon balance of the tree component of deforested and afforested areas is based on the assumption that removals lead to immediate emissions, while increase of forest biomass and growth rate to national average levels take 20 years after afforestation. The latter value is based on the IPCC default for soils to reach equilibrium with the litter input after land use change. As soils change with a delay period after vegetation, this is considered the most acceptable and conservative estimate (Nabuurs et al., 2005).

The total emissions from the tree component after deforestation are calculated at national level, by multiplying the total area deforested with the mean carbon stock in living biomass, above- as well as below ground. The removal of dead wood is not taken into account. The mean carbon stock per ha is calculated from the average growing stock volume according to

$$\overline{C} = \overline{V} \cdot BEF2 \cdot D_W \cdot [C]$$

With:

$\overline{C}$	mean carbon stock in kg C ha-1
$\overline{V}$	mean growing stock volume in m^3
$BEF2$	default biomass expansion factor type 2 = 1.66 kg DM(Whole tree) kg^{-1} DM(Stem)
D_W	default wood density = 0.45 kg DM m^{-3}
$[C]$	default carbon concentration = 0.5 kg C kg^{-1} DM

For 1990 and based on the Hosp data, an average growing stock volume of 172 m^3 ha^{-1} (Hosp rapport) leads to a carbon loss of 64,24 Mg C ha^{-1} from removal of vegetation. It is assumed that this is all emitted within the same year. Thus nor the lifespan of products made of harvested wood nor the time to decompose for roots and residues is taken into account, nor is import or export of wood or wood products (Nabuurs et al., 2005).

The total carbon emissions from the tree component after afforestation are calculated at national level and including an inherited period. The National Forest Inventories are assumed to represent the state of the forest of that year, including young, recently planted forests. Thus for the years of the NFI themselves, no inherited emissions for biomass are added. As forward calculations are used to interpolate between NFI's, the forests age and recently afforested areas are not included anymore. These are included in a cumulative way in "areas converted to forests", and set to zero again when a new NFI is adopted which on its turn is representative of the state of all forests from then on. The full carbon emission as calculated for forests remaining forests is assumed to be reached in twenty years time. Linearly interpolating and averaging over this period, the mean carbon emission for afforested areas is assumed to be half that of forests remaining forests. This was the only reasonable assumption as specific data of each afforested lot were not available. (from Nabuurs et al., 2005).

5.4 Carbon balance of Trees Outside Forest and Nature

The two other subcategories in the land use category Forest Land are Trees outside Forest (TOF) and Nature. Trees outside Forests are generally not considered in the National Forest Inventories. However, as for this subcategory the only threshold not passed to comply with the forest definition is stand surface, there is no reason to assume differences in average growth conditions. Thus, as similar carbon flux in living biomass is assumed as for forests. Harvesting and dead wood carbon fluxes are assumed negligible and not estimated. (Nabuurs et al., 2005)

Nature terrains in The Netherlands consist mainly of heathland, inland sand dunes, coastal dunes, swamp and peat areas. For these areas, it is assumed that the living biomass or dead mass carbon stock does not change if land use does not change. (Nabuurs et al., 2005)

6 Calculating and estimating (changes in) soil carbon stocks in the Netherlands

The national system for carbon in soils currently calculates carbon stocks, not stock changes (de Groot et al., 2005). Carbon stocks are reported for the required land use categories Forests, Cropland, Grassland, Wetland and Settlements, but not for Other Land as this is optional. The selection of data sets and design of the National System for soil is described in de Groot et al (2005, in Dutch) and an extensive summary in English is included in Van den Wyngaert et al. (2007).

The method is based on a map overlay of the HGN 1990 and HGN 2000 maps (described in chapter 4) with a soil carbon (class) map for The Netherlands. The latter is based on the recent National Soil Sampling Programme (NSSP). The NSSP was carried out to quantify the Soil Map of the Netherlands scale 1:50,000 with statistical features between 1990 and 2000. The NSSP resulted in a representative dataset, providing map units with statistically determined values for organic matter. Organic matter content has been determined for all sample elements. The sample locations are geographically fixed and by means of the soil map the measurements are extrapolated to the areas which they represent. This data set provides the most recent and accurate estimate of carbon contents of soils in The Netherlands. Analysis of the data from the NSSP indicated that groundwater level was more decisive for soil C stock than land use was.

The overlay between the three maps results in a three dimensional matrix consisting of one complete land use matrix for each soil carbon class. Soil C stocks are summed to yield totals for each land use (change) category. As a consequence, the total carbon per land use category may change as land use changes without assuming that the C stock in the actual locations will be changing. The reported soil C stocks per land use category will change as land use is relocated to other areas with their specific but different soil C contents. As soil carbon is not reported for the category “Other Land”, changes to and from this category lead to reported changes in soil C stock. (de Groot et al., 2005). Soil C fluxes resulting from changes between “Other land” and “Forest Land” have been corrected for the adaptations in annual rates following the field validation.

7 Calculation of carbon emissions from cultivation of organic soils

For carbon emissions from cultivated organic soils[6] the methodology is described in Kuikman et al. (2005). This method is based on subsidence as a consequence of oxidation of organic matter. Oxidation typically is caused by a low groundwater table, which also causes two other types of subsidence: (irreversible) shrinking of the peat as a consequence of drying and compaction due to changes in hydrostatic pressure (consolidation). However, the last two processes are of importance only a few years after a sudden decrease in groundwater level. Based on many series of long-term measurements, a relation was established between subsidence and either ditch water level or mean lowest groundwater level (Kuikman et al., 2005). For all peat soils in The Netherlands, the estimated subsidence could thus be predicted. The occurrence of peat soils was based on the application of the IPCC definition to the (updated) Dutch soil map (de Vries, 2003, 2004). This yielded 223147 ha of relevant peat soils in The Netherlands in a matrix defined by upper soil type and drainage (*Table 7-1).*

Table 7-1: Carbom emissions as resulting from classification of peat soils in The Netherlands, estimated mean ground surface lowering (gsl) and surface (in ha)

Upper soil		Bad drainage		Reasonable drainage		Good drainage		Total	C emission
		gsl	Surface (ha)	gsl	Surface (ha)	gsl	Surface (ha)	Surface (ha)	ton year^{-1}
Clay	Eutrophic	3	16149	8	17250	13	531	33929	119100
	Mesotrophic	3	12780	8	22294	13	2863	37935	156403
	Oligotrophic	3	9421	8	10480	13	416	20315	72380
Peat	Eutrophic	6	16668	12	16846	18	206	33719	188415
	Mesotrophic	6	18668	12	31607	18	7169	57443	382118
	Oligotrophic	6	8688	12	10054	18	1168	19911	119381
Humous sand	Mesotrophic	3	148	8	3184	13	4771	8102	54167
	Oligotrophic	3	27	8	760	13	2256	3041	21856
Sand	Mesotrophic	3	1365	8	3370	13	1318	6051	29681
	Oligotrophic	3	415	8	1450	13	836	2700	14604
Total			84325		117291		21531	223147	1158105

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[6] N_2O is reported under land use category 4 Agriculture and not further considered here.

The carbon emissions per ha are calculated from the mean ground surface lowering using the following general equation:

$$C_{em} = R_{GSL} \cdot \rho_{peat} \cdot f_{ox} \cdot [OM] \cdot [C_{OM}] \cdot f_{conv} \qquad (1)$$

With

C_{em}	Carbon emission from oxidation of peat (Gg C ha^{-1} year^{-1})
R_{GSL}	Rate of ground surface lowering (mm year^{-1})
ρ_{peat}	Bulk density of lowest peat layer (kg soil m^{-3})
f_{ox}	Oxidation status of the peat (-)
$[OM]$	Organic matter content of peat (kg OM kg^{-1} soil)
$[C_{OM}]$	Carbon content of organic matter (0.55 kg C kg^{-1} OM)
f_{conv}	Conversion from kg m^{-2} year^{-1} to Gg C ha^{-1} year^{-1} (10^{4})

For deep peats (> 120 cm), the calculation is based on the properties of raw peat (bulk density of 140 kg soil m^{-3} , oxidation status of 1, and organic matter content of 0.80 kg OM kg^{-1} soil), which results in an emission of 616 Gg C ha^{-1} year^{-1} for each mm of annual ground surface lowering.

For shallow peat soils (40 < depth < 120 cm), the (higher) bulk density of half ripened peat should be used. During the process of oxidation of the peat and further ground surface lowering, the decomposability of the remaining peat decreases, resulting in a decreasing rate of ground surface lowering, an increasing bulk density and a decreasing organic matter content. Up to a peat layer depth of about 80 cm all values in equation (1) can be the same as for a deep peat soil, because the change in subsidence and bulk density of the raw peat below 60 cm depth is negligible. Also for peat soils thinner than 80 cm all values in equation (1) were used. This estimation is done because there is no data on subsidence of such shallow peat soils and because this with just cause a small error, because the fast majority of the Dutch peat soils are thicker than 80 cm. Moreover the underestimation of the bulk density will be compensated more or less by the overestimation of the subsidence.

8 The submission 2005-2008

8.1 Changes in calculated emissions in time series

In 2005 the first calculated emissions were submitted following the then newly implemented National System for Greenhouse gas Emissions for LULUCF. Since then, several improvements have been made to the LULUCF section of the system, each resulting in changes to the calculated values for the time series 1990-most recent year. In the following paragraphs an overview is presented for 2005 (old method) and 2006 (new method, resubmitted data after review) and the 2008 submission As the 2007 submission is in line with the original 2006 we will not elaborate these two datasets as these are outdated. Almost all submitted values with references to the corresponding methodologies and changes therein are for this three submissions presented in this chapter..

8.1.1 Comparison of submissions

The changes in calculated values between 2005, 2006 resubmission and 2008 are shown for 1990 in Table 8-1. This table holds no data for the 2007 submission data as these are in line with the original 2006 submission. As the 2006 resubmission was done in the course of the in-country review during 2007, it was decided not to resubmit, as this only would result in a change for the last year, while this would also be presented in the 2008 submission. Further analyses confirmed that no (sub)categories were subject to changing values for CO_2 emissions if they were not for 1990. Therefore values for later years will be shown only if motivated by a type of change that is not adequately illustrated from 1990 alone.

Major changes in value occurred in subcategories “Land converted to Forest Land”, “Land converted to Grassland” and “Land converted to Other Land”. Minor changes in value occurred in subcategories “Land converted to Cropland” and “Land Converted to Settlements”. Thus, only emission values related to land use changes have been updated. These subcategories are analysed in more detail in Annex E and discussed below.

Table 8-1: Submitted values for 1990 for main land use categories between the implementation of the current system in 2005 and now. Values are rounded to 1 decimal. Subcategories subject to changing values are printed in bold.

			Submission year
	2005	2006 r	2008
Total Land-Use Categories	2894.3	2667.3	2667.3
A. Forest Land	-2594.6	-2518.4	-2518.4
1. Forest Land remaining Forest Land	-2505.4	-2505.4	-2505.4
2. Land converted to Forest Land	**-89.1**	**-13.0**	**-13.0**
B. Cropland	-35.2	-35.6	-35.6
1. Cropland remaining Cropland	0.0	NA,NE	NA,NE
2. Land converted to Cropland	**-35.2**	**-35.6**	**-35.6**
C. Grassland	4782.2	4440.0	4440.0
1. Grassland remaining Grassland	4246.0	4246.0	4246.0
2. Land converted to Grassland	**536.2**	**194.0**	**194.0**
D. Wetlands(3)	0.0	NE	NE
1. Wetlands remaining Wetlands	0.0	NE	NE
2. Land converted to Wetlands	0.0	NE	NE
E. Settlements (3)	-151.4	-151.5	-151.5
1. Settlements remaining Settlements	0.0	NE	NE
2. Land converted to Settlements	**-151.4**	**-151.5**	**-151.5**
F. Other Land(4)	710.2	749.7	749.7
1. Other Land remaining Other Land			
2. Land converted to Other Land	**710.2**	**749.7**	**749.7**
G. Other (please specify) (5)	183.2	183.2	183.2
Harvested Wood Products (6)	NE	NE	NE
Agricultural lime application		183.2	183.2
Information items(7)			
Forest Land converted to Other Land-Use Categories	236.1	369.7	487.6
Grassland converted to Other Land-Use Categories	n.a.	NA	378.8

Table 8-2: data & calculations used fro different submissions for subcategory Land converted to Forest land

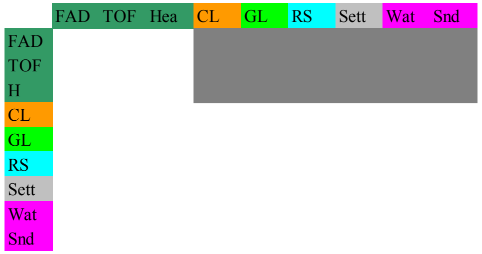
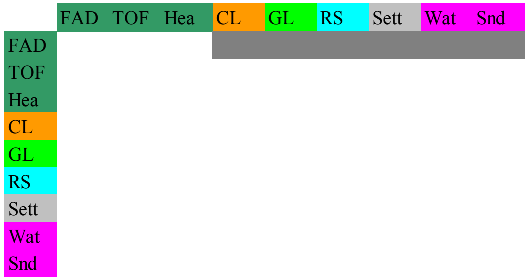
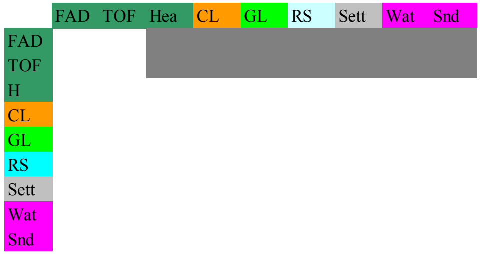
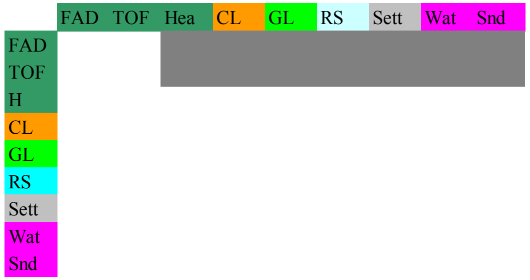
	Submissie 2005	Resubmissie 2006 & submissie 2008*
Activity Data:Area		
LU conversion categories summed		
Time interval	11 years	10 years
Correction factors	-	CorrectionByPatchSize_aff = 0,781
C Emission: Biomass Increase		
Area		
Time Interval	10 years	10 years
Correction factors	-	CorrectionByPatchSize_aff = 0,781
Emission factors	IncreaseInLivingBiomass_MFV / AreaForest_MFV * 0,5 = 1,457 Gg C kha^{-1}	IncreaseInLivingBiomass_MFV / AreaForest_MFV * 0,5 = 1,457 Gg C kha^{-1}

Table 8-3: data & calculations used fro different submissions for subcategory Forest Land converted to land

	Submissie 2005	**Resubmissie 2006 & submissie 2008***
Activity Data: Area *LU conversion categories summed*		
Time interval	11 years	10 years
Correction factors	-	CorrectionByPatchSize_def = 0,614
C Emission: Biomass Increase *Area*		
Time Interval	10 years	10 years
Correction factors	-	CorrectionByPatchSize_def = 0,614
Emission factors	Mean(GrowingStockVolume_Hosp) * WoodDensity * [Carbon] * EF = 71 Gg C kha^{-1}	Mean(GrowingStockVolume_Hosp) * WoodDensity * [Carbon] * EF = 71 Gg C kha^{-1}

Subcategory “Land converted to Forest Land”

The carbon emission associated with Land converted to Forest Land is the sum of the change in carbon as a result of an increase in living biomass, and the change in soil carbon as Other Land is converted to Forest Land. In 2005 those were reported separately, but from 2006 on they were summed before reporting, as indicated by notes in the CRF. However, the values indicate that the change in soil carbon as Other land is converted to Forest Land is omitted rather than included (Annex E).

One of the main causes for changes in emissions is changes in area of Land converted to Forest Land. In 2005, the uncorrected land use change matrix was used. In 2006, application of the corrections of the field validation calculated by patch occurrence resulted in lower estimates for all land use categories converted to Forest Land. However, as the correction factor mistakenly also corrected for the ratio between FAD and (FAD + TOF), the actual applied correction factors were too low. This was later (2006 review) corrected, when a new correction factors by patch size was introduced.

Subcategory “Land converted to Cropland”

The only flux contributing to the carbon emissions of Land converted to Cropland is the change in soil carbon associated with Other Land converted to Cropland. Between the 2005 and the 2006 submission, this flux showed a marginal increase from 35.20 Gg CO_2 to 35.57 Gg CO_2. In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007). This change in methodology resulted in slight changes in carbon stock. As carbon stock of Other Land is not reported, changes to and from Other Land are associated with loss and gain of soil carbon stock (chapter 6). Thus, changes in carbon stock are reflected in changes in soil carbon emissions associated with conversion of Other Land.

Subcategory “Land converted to Grassland”

The carbon emission associated with Land converted to Grassland is the sum of the change in carbon as a result of a decrease in living biomass, and the change in soil carbon as Other Land is converted to Grassland. All emissions from Forest Land changing to other land use categories are reported under land converted to Grassland and this changes as the area of Forest land converted changes. In 2005, the uncorrected land use change matrix was used. In 2006, application of the corrections of the field validation calculated by patch occurrence resulted in lower estimates for Forest land converted to all other land use categories. However, as the correction factor mistakenly also corrected for the ratio between FAD and (FAD + TOF), the actual applied correction factors were too low. This was later corrected, when a new correction factors by patch size was introduced.

The other flux contributing to the carbon emissions of Land converted to Cropland is the change in soil carbon associated with Other Land converted to Cropland. Between the 2005 and the 2006 submission, this flux showed a marginal increase from 329,50 Gg CO_2 to 337,05 Gg CO_2. In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007). This change in methodology resulted in slight changes in carbon stock. As carbon stock of Other Land is not reported, changes to and from Other Land are associated with loss and gain of soil carbon stock (chapter 6). Thus, changes in carbon stock are reflected in changes in soil carbon emissions associated with conversion of Other Land.

Subcategory "Land converted to Settlement"

The only flux contributing to the carbon emissions of Land converted to Settlement is the change in soil carbon associated with Other Land converted to Settlement. Between the 2005 and the 2006 submission, this flux remained stable with 151,43 Gg CO_2 in 2005 and 151,54 Gg CO_2 in 2006. In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007). This change in methodology resulted in slight changes in carbon stock. As carbon stock of Other Land is not reported, changes to and from Other Land are associated with loss and gain of soil carbon stock (chapter 6). Thus, changes in carbon stock are reflected in changes in soil carbon emissions associated with conversion of Other Land.

Subcategory "Land converted to Other Land"

Carbon stock of Other Land is not reported, thus changes to Other Land are associated with loss of soil carbon stock (chapter 6). Part of the land changing to Other Land comes from Forest Land. The surface of this varies between different submissions as the total surface of Forest land converted to land changes (see also "Land converted to Grassland"). In 2005, the amount of carbon involved in soils converted from Forest Land to Other Land was -82,54 Gg CO2. In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007). This resulted in a flux of -83,31 Gg CO2. No correction was applied at that time on the changes in soil carbon from Forest Land converted to Other Land, i.e. the results of the field validation were applied to the emissions related to changes in biomass but not to the emissions related to soil carbon.

For the resubmission during the review, this fact was not acknowledged and as the correction factor on the area of Forest Land converted to other land use categories was adapted, so was the soil carbon flux associated with Forest Land converted to Other Land, i.e. it increased to 115,99 Gg CO2.

The other land categories converted to Other Land also cause a flux of soil carbon. Between the 2005 and the 2006 submission, this flux showed a marginal increase from 627,66 Gg CO_2 to 633,67 Gg CO_2. In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007). This change in methodology resulted in slight changes in carbon stock, which are reflected in changes in soil carbon emissions associated with conversion to Other Land.

8.2 Calculated values for the submission 1990-2008

Table 8-4 shows the integral set of values reported for main land use categories in the NIR 2008, including activity data, for 1990 (baseline year) and 2006 (t-2 year). The values for 1990 were already included in the comparison between different submissions in the previous paragraph, and paragraph 8.3 compares this submission to the last one. Changes are motivated and related to the review reports.

Table 8-4: Sectoral report for land use, land-use change and forestry of Net CO_2 emissions or removals in 1990 and 2006 as submitted in the NIR2008. NE: not estimated. NA: not applicable

Land-Use Category	Area estimates in		Net CO_2 emissions/removals in (1), (2)	
	1990	2006	1990	2006
Total Land-Use Categories			**2,667.30**	**2,574.36**
A. Forest Land	**435.35**	**478.8**	**-2,518.38**	**-2,509.28**
1. Forest Land remaining Forest Land	432.4	35.15	-2,505.43	-2,289.10
2. Land converted to Forest Land	2.95	39.65	-12.95	-220.18
B. Cropland	**976.51**	**972.21**	**-35.57**	**-35.57**
1. Cropland remaining Cropland	957.11	952.81	NA,NE	NA,NE
2. Land converted to Cropland	19.40	19.40	-35.57	-35.57
C. Grassland	**1480.02**	**1315.51**	**4,439.99**	**4,439.99**
1. Grassland remaining Grassland	1460.21	1295.7	4,246.00	4,246.00
2. Land converted to Grassland	19.81	19.81	193.99	193.99
D. Wetlands(3)	**2.59**	**IE, NE**	**NE**	**NE**
1. Wetlands remaining Wetlands	2.59	NE	NE	NE
2. Land converted to Wetlands	IE,NE	NE	NE	NE
E. Settlements(3)	**438.05**	**599.23**	**-151.54**	**-151.54**
1. Settlements remaining Settlements	425.42	586.60	NE	NE
2. Land converted to Settlements	12.63	12.63	-151.54	-151.54
F. Other Land(4)	**815.33**	**820.35**	**749.65**	**749.65**
1. Other Land remaining Other Land	813.84	818.86		
2. Land converted to Other Land	1.49	1.49	749.65	749.65
G. Other(5)			**183.15**	**81.12**
Harvested Wood Products(6)			NE	NE
Liming			183.15	81.12
Information items(7)				
Forest Land converted to Other Land-Use Categories			487.55	487.55
Grassland converted to Other Land-Use Categories			378.84	378.84

8.3 Explanation of the differences with the previous submission

The resubmission 2006 was taken as the last submission, as this has been the result after the review. Time between the final result of the review and the actual submission 2008 was too short to implement and double-check changes, so it was decided to postpone all major improvements to the submission of 2009. Some minor changes, mostly related to annotation keys, were carried out in response to comments of the review team and the demand for new variables (see also par 10.12).

- the area of organic soils was asked for categories 5A (Forest Land), 5B (Cropland) and 5C (Grassland), this was set as "IE" as included in the total area estimate
- renaming category "other" under 5G to "lime application to all land uses"
- "NO" for wildfire occurrence changes to "NE" in response to comments of the review team (ARR comment 119)
- as the cumulative carbon stock change caused by afforestation was reported and the annual area change, this resulted in extremely high implied emission factors, and this was adapted by also reporting the cumulative area change. In this process, however, a copying mistake was made resulting in wrong values for Settlement converted to Forest Land and non-cumulative values for Other Land reported to Forest Land.

9 The QA/QC process

To improve the transparency and the quality of the LULUCF data a working document is drafted for discussion, dealing with track of planning as well as decisions, milestones and outputs (Annex F, in Dutch). As part of a more thorough quality control of the values and calculations, a series of checks is proposed based on preliminary CRF tables. This will be dealt with in more detail when the use of it can be evaluated after the submission of 2009.

10 Foreseen improvements and updates

10.1 Introduction: summary of planned improvements

When the current system was implemented for the LULUCF sector, it was already envisaged that there would be regular improvements over time. In paragraph 8.1.1 it is described how the calculation of certain fluxes has changed with the different submissions. In the current chapter, an overview is given of the improvements that are planned for the next submission or discussed for the near future. Some of these are the result from the review process discussed in chapter 3, while others have been planned already for some years.

Summarizing the plans for the near future, the following improvements are expected for the NIR 2009:

- improvements to land use and land use change area estimates (par 10.2)
- soil carbon emissions when land use changes to and from forest (par 10.3)
- soil carbon emissions in Forest Land remaining Forest Land (par 10.4)
- a series of improvements to carbon emissions from biomass changes to Forest Land remaining Forest Land (par 10.7, 10.8, 10.11)
- improved emission factor for land changing to Forest Land (par 10.9)
- reporting of areas organic soils for categories 5A Forest Land, 5B Cropland and 5C Grassland (par 10.12)
-

The following improvements are envisaged for the NIR 2010 or later, either because they are still under discussion, still under development or need data that will become available only at a point further in time:

- periodic updating of carbon emission from change in biomass in Forest land remaining Forest land as new data become available (new MFV cycles) (par 10.10)
-

The following subjects have been discussed in relation to the need of updating, and will remain as they are now:

- soil carbon emissions in relation to land use changes to and from agricultural soils (especially rotation between cropland and grassland) (par 10.5)
- inherited emissions 1970-1990 (par 10.6)

10.2 Improvements to land use and land use change area estimates

The development of the land use change matrix is described in chapter 4. The land use change matrix was based on a comparison of the topographic maps of 1990 and 2000. The review team commented the following:

“The ERT noted that the data in the land-use change matrix reported by the Party are inconsistent since the methodologies of classification applied to the two maps (1990 and 2000) differ. This inconsistency is clearly shown by the area (9.7 per cent in 10 years) which, according to the matrix reported by the Netherlands, has been converted from settlements to all the other uses (mainly grassland – 6.3 per cent); in practice, this would imply that the country’s cities and infrastructure are being abandoned or disrupted by the inhabitants. The ERT recommends that the Party apply the same methodology of classification to each set of land-referred data in order to make it possible to compare them in a consistent manner and thus estimate land-use changes accurately.”

An overestimate of rates of change had already been observed during the field validation. The use of correction factors was the basis of both calculation errors and conceptual errors (the changes in the carbon soil fluxes from Forest land converted to Other Land for both the original and the resubmission of 2006; see par 8.1.1). It also can violates GPG-LULUCF in case that the total surface of the country does not remain the same as the correction factors influences the areas of all landuse categories. It is therefore required that future calculations are based on the land use change matrix as a result of a map overlay.

Since the development of the 1990 and 2000 maps in 2004, an improved version of the HGN 1990 was developed for comparison with the HGN 2004, based on the same type of topographic maps as the HGN 2000. The purpose of this comparison was to evaluate the occurrence of natural ecosystems. Several methodological improvements were used to construct the 2004 map, as reported in Kramer et al., 2007. The same improvements can be used for the 1990 map. Additionally, part of the differences between the maps which are not really land use changes can be removed manually by checking the 1990 maps. An example is when planned land use changes are already indicated on the 1990 map, but did not succeed. The forest roads will be distinguished from other settlements in the forest based on a national road database. Adding them to the Forested Land category is in line with the current forest definition and is expected to reduce the large uncertainty associated with single or few pixel afforestation and deforestation in the forest. It is foreseen to use the 2004 map too in the next submission.

Apart from the improvements to the maps, a separate analysis is based on the CORINE land cover maps to illustrate the problems associated with application in a small and heterogeneous country like The Netherlands.

Both the update of the maps and matrix and the analysis based on the CORINE land cover maps will be finished in time for inclusion in the NIR 2009.

10.3 Carbon emissions from soil as land use changes

The ERT noted that : “the time series from 1971 for each land-use change has not been reconstructed, although the Party agreed a 20-year period for stabilization of carbon stocks after conversion. Moreover, the Netherlands reports on page 146 of the NIR that “for soil carbon stock changes after land use change it is assumed that the average carbon stock in the soil under the new and old land use are the same (de Groot et al., 2005)”. However, the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (hereinafter referred to as the IPCC good practice guidance for LULUCF) on page 3.14 states that “the basic default assumption is that land use changes have a linear impact on soil organic matter for 20 years before a new equilibrium is reached (Tier 1). This means that, when a piece of land changes use, then it is followed in that “changed status” (“land converted to . . . ” categories) for 20 years, with each year 1/20 of the CO2 and non-CO2 effects reported.” (ARR final version, comment 108).

The underlying assumption here is that for many countries, land use changes result in a net loss of carbon from soils. In the specific case of the Netherlands, however, it is shown that soil organic matter contents of agricultural soils do not decrease in the majority of soils (see par 10.5), and thus soils are unlikely to be a source of CO_2. Land use change in the Netherlands between use for grassland and cropland has never been documented at the plot level and cannot be reconstructed easily. We know that land use is frequent, given the widespread implementation of crop rotations with intermediate periods of grassland. On the sandy soils in the Netherlands more than 50% of the land use has changed at least once in 5 observations over a period of 10 consecutive years. Exceptions are specific locations with continuous maize on sandy soils (see Hanegraaf et al., 2008). In a national analysis, there were no systematic differences between different land use classes for soil carbon content (de Groot et al., 2005).

One solution would be to distinguish between permanent grassland and rotational grassland and non-permanent (5 or more years). The latter could be included under cropland. This would better reflect the actual land use according to the concept by IPCC. This is worked out further in the course of this year, but ant changes resulting from these discussions will be implemented only in 2010 or later.

However, the status quo for soil carbon is difficult to hold for changes to and from forest. In line with IPCC recommendations, a system is developed to predict soil carbon under forests more accurately. A comparison of soil carbon under different forest types and non-forest land use will provide the basis for estimating the loss and gain of soil carbon associated with land use changes to and from Forested Land. The implementation of this system will be in time for the 2009 submission of values and will be included in the NIR 2009.

10.4 Change in carbon stored in forest soils as land use does not change (from Tier 1 to Tier 2)

Currently only carbon stocks are reported for forest soils. Preparatory work in 2006 and 2007 was done to allow a more dynamic reporting of soil carbon in the total forest carbon balance of forests remaining forests. The emphasis is on the litter layer, it being the component that is most affected by management (changes). For the MFV plots, litter layer thickness is measured in 1484 out of 3622 plots. Of these 1484 plots, only 960 have non-zero data for all of the three distinguished layers. Based on soil samples taken in 2006 and 2007, regressions were developed to convert litter layers thickness into soil carbon.

The envisaged procedure to calculate changes in soil carbon based on the MFV litter values is based on repeated sampling, with values of the second MFV cycle becoming available in a few years. Sequential litter thickness measurements will allow a detailed and precise analysis of soil carbon changes in the Dutch forest soils based on stock changes. However, with only part of the plots measured in the previous cycle, it will take at least one full cycle to have the first reliable results based on this scheme, and another (2nd) full cycle to have this picture complete.

In the mean time, a complementary calculation scheme is developed, based on data from other sources, to fill gaps where stock change estimates are not yet possible. This complementary scheme is based on the relation between standing species (composition), forest age and carbon stock in the soil (Figure 10-2). Preliminary results show that some additional parameters are needed to define the relation between stand age and soil carbon (Figure 10-2).

A simple scheme will be ready for implementation in the NIR 2009. The results for the 2009 submission will be based entirely on the non-stock change methods, with the stock change method gaining importance as available data increase.

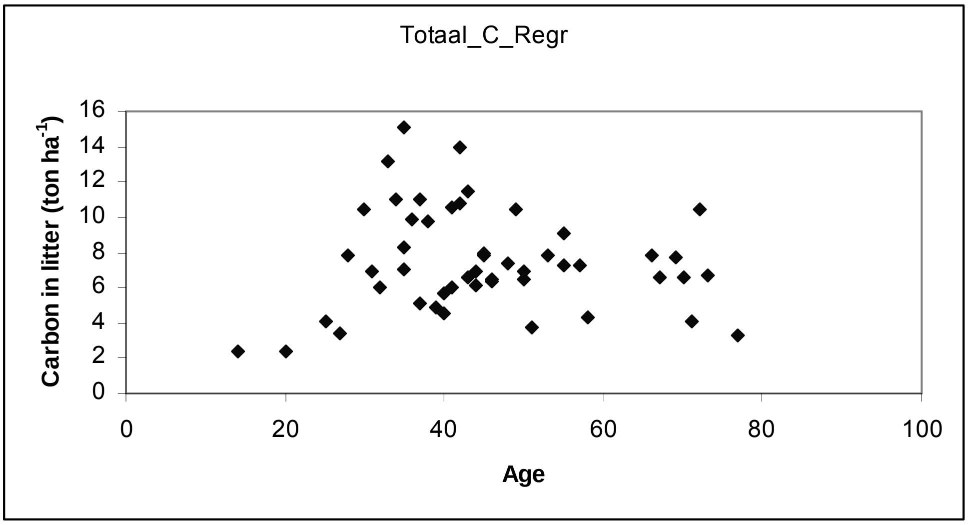


Figure 10-1: Relation between organic carbon in litter and age of the forest vegetation for Picea abies

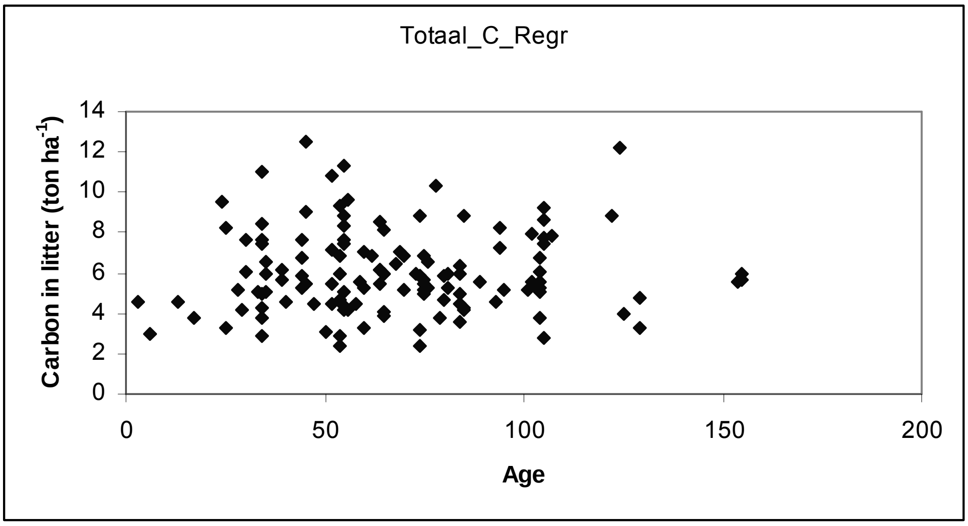


Figure 10-2: Relation between organic carbon in litter and age of the forest vegetation for Quercus robur + petreae

10.5 Agricultural soil from Tier 1 (no stock change assumed) to Tier 2 and rotation of grassland

Assessments of field data on soil C and results from simulation modeling in some cases show or predict a gradual decrease with time in C content of agricultural soils: in Flanders (Sleutel et al., 2003) and in the UK (Bellamy et al., 2005). The relatively large decrease in Flanders was ascribed to the restrictions by law on the quantity of using animal manure on cropland, starting in 1990 (Sleutel et al., 2003); another plausible explanation for the loss of soil C is that part of the cropland in 1990 was previously pasture, which had been brought into cultivation in the two preceding decades (Sleutel et al., 2007a). However, in other cases no decrease in SOC was reported for agricultural soils, e.g. for Danish croplands and for Austrian soils (Smith et al., 2007).

For the Netherlands, estimations of changes in soil carbon (SOC) content were made in papers prepared and submitted by Reijneveld et al. (2008) and Hanegraaf et al. (2008). Reijneveld et al. (2008) used data from a data base with 2 million results of soil analysis on SOC from farmers' fields. All samples were taken and analyzed by one single laboratory (BLGG in Oosterbeek) during the period 1984-2004. Three land use types were distinguished: arable land, grassland and maize land. All data were grouped in nine specific regions and were analyzed for trends in SOC over time and for differences between regions. Figure 10-3 shows the trends for the 13 combinations of region and land use type. From this figure it can be seen that 10 combinations fall in the initial SOC range of 0-70 g/kg, and 9 out of these 10 (94% of the samples) show either no change or an increase in SOC during the period 1984-2004; only 1 combination (grassland on marine clay, 6% of the samples) shows a decrease in SOC.

Hanegraaf et al. (2008) performed a trend analysis of SOM contents in sandy soils, using historic data from routine agricultural soil analyses. They found that in more than 75% of all soils the level of SOM remained stable or increased, whether used for permanent grass or continuous maize. They concluded that their analysis does not support the prevailing opinion in Europe that SOM content in agricultural land is declining. Another conclusion was that no uniform trend was present in grassland sandy soils, and that this cannot be expected in the near future; in each of four different regions, SOM trends were diverse (i.e. decreasing, stable or increasing) (Hanegraaf et al., 2008).

It is thus concluded that for the majority of the mineral and non-organic agricultural soils the SOC content is either constant or even increases and in a few cases (soil type with specific land use) may decrease a little. In the absence of a detailed monitoring system, we consider it fair and conservative to conclude that the SOC content of the Dutch agricultural soils overall does not change, so no net emission of CO_2 takes place due to a decrease in SOC in the soils in the Netherlands. The fact that agricultural soils in the Netherlands by and large maintain or even increase their SOC content is probably best explained by the relatively high amounts of animal manure and mineral fertilizer that is applied on these soils. This application leads to a build-up of SOC (Smith et al., 1997; Sleutel et al., 2006).

Three combinations (grassland on reclaimed peat and arable land on peaty clay in North and West NL) had an initial SOC of 70 g/kg and higher. These 3 combinations show a decrease in SOC during this period, the effect is stronger when initial SOC was larger (see also chapter 7 on organic soils).

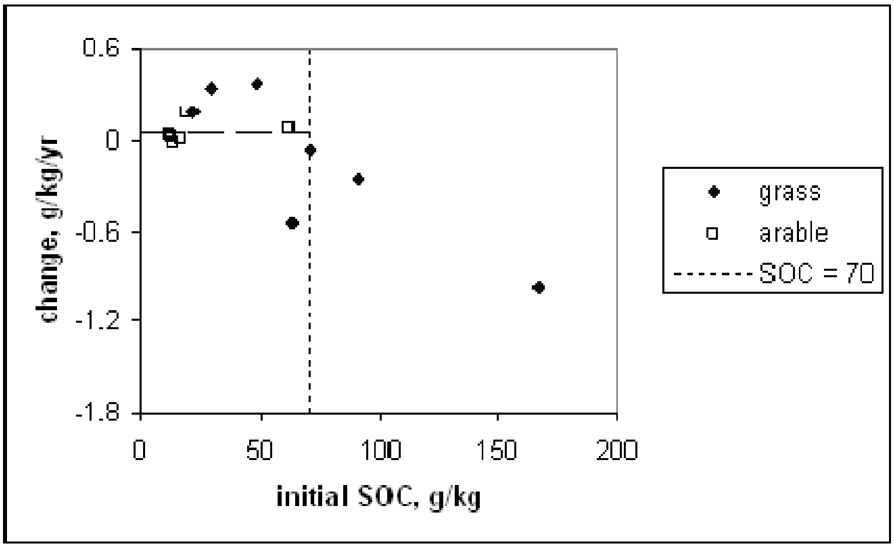


Figure 10-3: Annual change in soil organic carbon (SOC) in agricultural soils in The Netherlands (data Reijneveld et al., 2008). Horizontal line shows weighted average trend for categories with initial SOC < 7 g kg^{-1}

10.6 Inherited emissions 1970-1990

In the current system, no inherited emissions from land use change between 1971 and 1990 are reported. This was one of the major critiques of the review team. Though The Netherlands do not agree that this is an obligation under the Convention on Climate Change or the Kyoto Protocol, it was still decided to review what other countries had done in practice. Following the principle of being on the conservative side, the demand for inherited emissions is only relevant for countries where the LULUCF sector is a net source of greenhouse gas emissions and article 3.7 of the Kyoto protocol applies. These are the United Kingdom and Portugal. For these countries the National Inventory reports were studied with respect to the reporting of land use changes between 1971 and 1990 (Annex G). Whereas the UK reported all forests planted since 1920 under land use change, Portugal reported only the last year. However, both countries calculated fluxes in a similar way as The Netherlands, by taking into account age (class). It was concluded that there was no reason to change the current practice of dealing with inherited emissions.

10.7 Improvements in dealing with missing data for "Forest remaining forest"

Not all plots in the NFI inventories had a complete set of data. Four types of "data completeness" was found:
(1) plots with al data
(2) plots with volume and increment data, but missing variables like height, diameter or recording year
(3) plots with no volume or increment data
(4) plots with no volume and increment data but with the designation "clearcut area"

The calculations as described in Annex D were performed for plots with all data only. Until now these were scaled to national coverage on an area basis, i.e.

$$\Delta C_{NL} = \Delta C_{(1)} \cdot \frac{\sum_{x=1}^{4} Area_{(x)}}{Area_{(1)}}$$

ΔC_{NL}	carbon budget for the Netherlands in Gg C (plot categories (1) – (4))
$\Delta C_{(1)}$	carbon budget for plots with no missing data in Gg C (plot category 1)
$\sum Area_{(1)}$	total representative area for plots with no missing data (plot category 1)
$\sum_{x=1}^{4} Area_{(x)}$	total representative area for the Netherlands (sum of plot categories (1) – 4))

However, when the mean volume was calculated from these plots, it appeared that for the Hosp data this was higher (186 m^3 ha^{-1}) and further from official estimates (Daamen,) than if all plots with volume data (but e.g. missing age,…) were taken into account (173 m^3 ha^{-1}). Therefore a more detailed way of gapfilling was designed as described in the next paragraph.

Again calculations as described in Annex D were only performed on plots with all data, i.e. category (1). From these a mean BEF2 (= carbon flux due to biomass increase / increment) was calculated that was used to convert increment data from plots with missing variables to carbon fluxes. Carbon flux from dead wood for plots with missing variables was scaled using growing stock volume. Plots subject to clearcut were assumed to have no volume and no increment, and no carbon flux from live or dead wood. Plots with no data at all were extrapolated using the area corrected average for the other three categories. Thus the following calculation is proposed to correct for missing data:

$$\Delta C_{(2)} = I_{(2)} \frac{\Delta C_{(1)}}{I_{(1)}}$$

$$\Delta C_{(4)} = 0$$

$$\Delta C_{(3)} = \left(\Delta C_{(1)} + \Delta C_{(2)} + \Delta C_{(4)}\right) \cdot \frac{Area_{(3)}}{\sum_{x=1,2,4} Area_{(x)}}$$

$$\Delta C_{NL} = \Delta C_{(1)} + \Delta C_{(2)} + \Delta C_{(3)} + \Delta C_{(4)}$$

With

$\Delta C_{(x)}$	carbon budget in Gg C for
$Area_{(x)}$	total representative area for plots with missing data category x
$I_{(x)}$	total increment in m^3 $year^{-1}$ for area represented by plots with missing data category x

For the Hosp and MFV datasets the consequences of the new gapfilling method have been summarized in Figure 10-4 and Table 10-1. As the MFV dataset has no plots in category (2), the impact on calculations is much less from 2000 on. This new method will be implemented in the 2009 submission.

Table 10-1: Effcet of gapfilling method on mean values for volume, carbon mass (EF deforestation) and carbon fluxes in forest plots

Variable	1990 Hosp		2000 MFV	
	Gapfilling 2005	Gapfilling 2008	Gapfilling 2005	Gapfilling 2008
Mean volume (m^3 ha^{-1})	186.9	173.8	198.3	197.6
Mean increment (m^3 ha^{-1} $year^{-1}$)	9.03	8.39	8.14	8.12
Mean C mass in biomass (Mg C ha^{-1})	65.0	60.4	72.0	71.7
Mean C flux in biomass (Mg C ha^{-1} $year^{-1}$)	3.060	2.842	2.803	2.795
Mean C flux in dead mass (Mg C ha^{-1} $year^{-1}$)	0.251	0.233	0.273	0.272
Mean C flux from harvest (Mg C ha^{-1} $year^{-1}$)	1.611	1.589	1.547	1.541
Mean net balance (Mg C ha^{-1} $year^{-1}$)	1.699	1.486	1.529	1.525

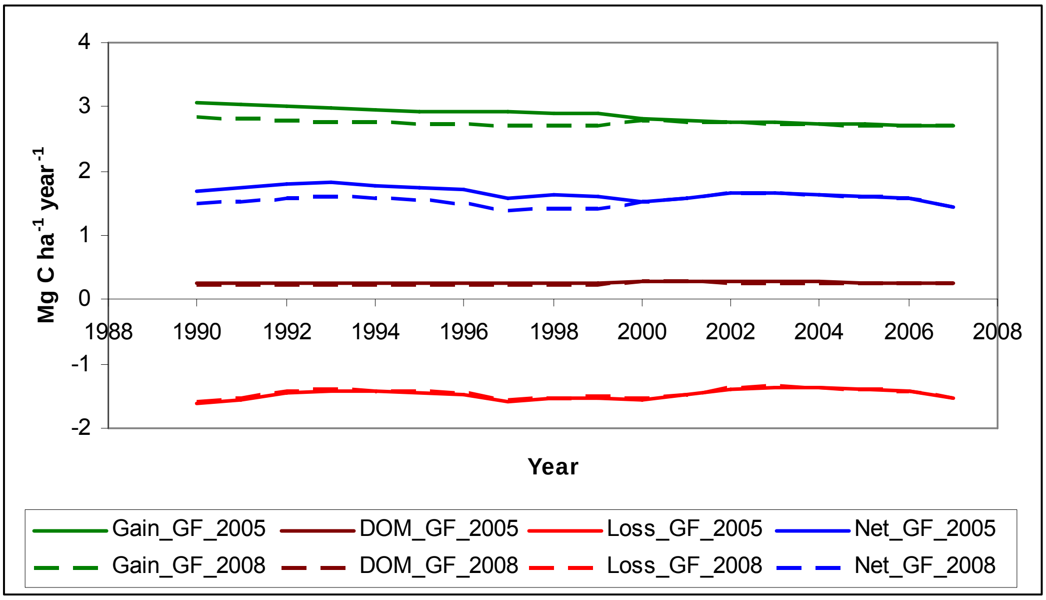


Figure 10-4: Effcet of gapfilling method on mean plot carbon flux values.

10.8 Emission factor Forest and other wooded land changing to other land use classes

The total emissions from the tree component after deforestation is calculated by multiplying the total area deforested with the average carbon stock in living biomass, above- as well as below ground (Nabuurs et al., 2005). Until now this average carbon stock is calculated from the average volume using default biomass expansion factors (par 5.2). It is proposed to take instead the average carbon contained in living biomass from that year as calculated from the NFI data (see par 5.1.1). Assuming that the gapfilling method proposed in par 10.5 is accepted and that harvest from deforestation is subtracted from harvest from plots, this will lead to the Emission Factors (in Mg C ha-1) as given in Table 10-2. This will be implemented already for the 2009 submission.

Table 10-2: Emission Factor for deforestation in Mg C ha^{-1}

NFI	Year	EF
Hosp	1990	60.4
Hosp	1991	61.5
Hosp	1992	62.6
Hosp	1993	63.8
Hosp	1994	64.9
Hosp	1995	66.1
Hosp	1996	67.2
Hosp	1997	68.3
Hosp	1998	69.2
Hosp	1999	70.2
MFV	2000	71.7
MFV	2001	73.0
MFV	2002	74.3
MFV	2003	75.7
MFV	2004	77.1
MFV	2005	78.4
MFV	2006	79.8
MFV	2007	81.1

10.9 Emission factor Land use changes towards forest and other wooded land

The total carbon emission from the tree component after afforestation is calculated at national level and including an inherited period. The National Forest Inventories are assumed to represent the state of the forest of that year, including young, recently planted forests. Thus for the years of the NFI themselves, no inherited emissions for biomass are added. As forward calculations are used to interpolate between NFI's, the forests age and recently afforested areas are not included anymore. These are included in a cumulative way in "areas converted to forests", and set to zero again when a new NFI is adopted which on its turn is representative of the state of all forests from then on. Until now the carbon emissions from recently afforested areas was derived from linearly interpolating and averaging over a 20 years period to reach carbon emissions at the level of forests remaining forests. Thus, the mean carbon emission for afforested areas, averaged over all ages, was assumed to be half that of forests remaining forests (Nabuurs et al., 2005). The NFI data show, however, that carbon fluxes with tree growth do not increase linearly to an average with age. Instead, the period of zero to 20 years coincides with the very fast growth and high rates of carbon uptake. (Figure 10-5).

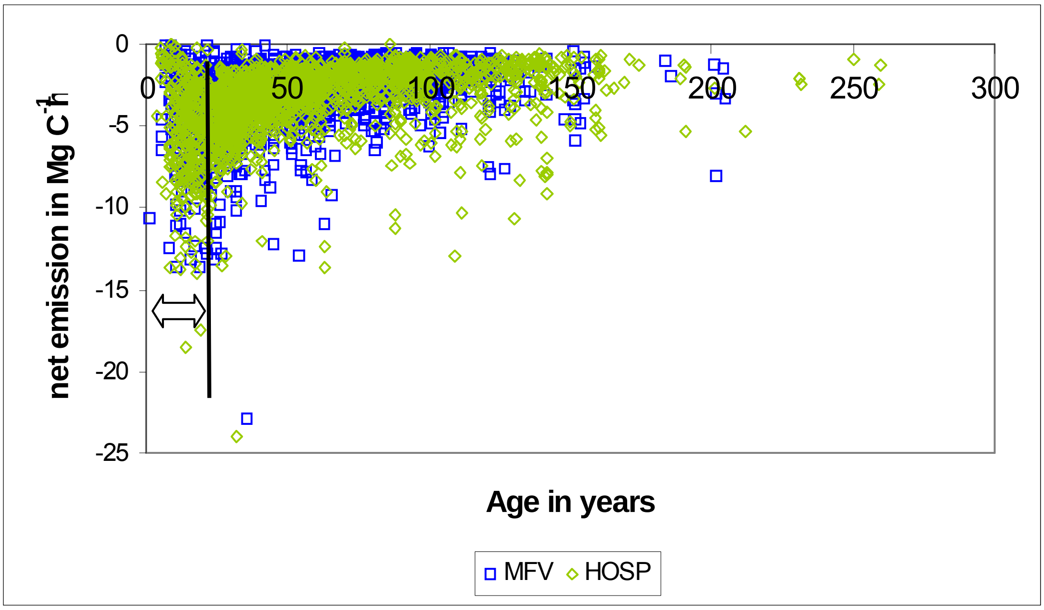


Figure 10-5: Carbon emission associated with three growth for plots of different age. The dark line and arrow indicate the age/period during which afforested plots are kept separately before being included into Forest Land remaining Forest land

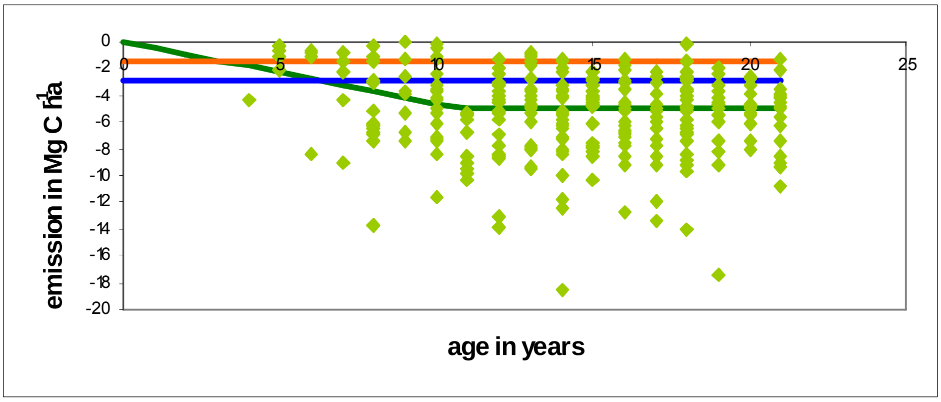


Figure 10-6: Carbon fluxes associated with three growth for plots up to 21 years. Green dots are plot data, the blue line represents the mean of all plots of all ages, the orange line represents the current carbon flux associated with afforested plots, the dark green line represents the proposed change towards an average between 11 and 20 years with a linear increase towards this average for younger plots.

From the plot data with an age up to 20 years a general high carbon storage rate for plots over 10 years old is noted, with lower values for younger plots. This is corroborated by the increase of the average value with age up to an age of 11 years for the HOSP plots (same general pattern but less consistent for MFV). It is proposed to take the average values between 11 and 20 years and interpolate linearly between this value and 0 for younger plots (Figure 10-6). The effect of this change depends on the time period after the start of the inventory (Figure 10-7). Shortly after the start of an inventory, plots that are not included are all very young and the current methodology overestimates the total carbon uptake. Later, the effect of rapid carbon accumulation in young plots is more important and the current methodology underestimates the total carbon uptake.

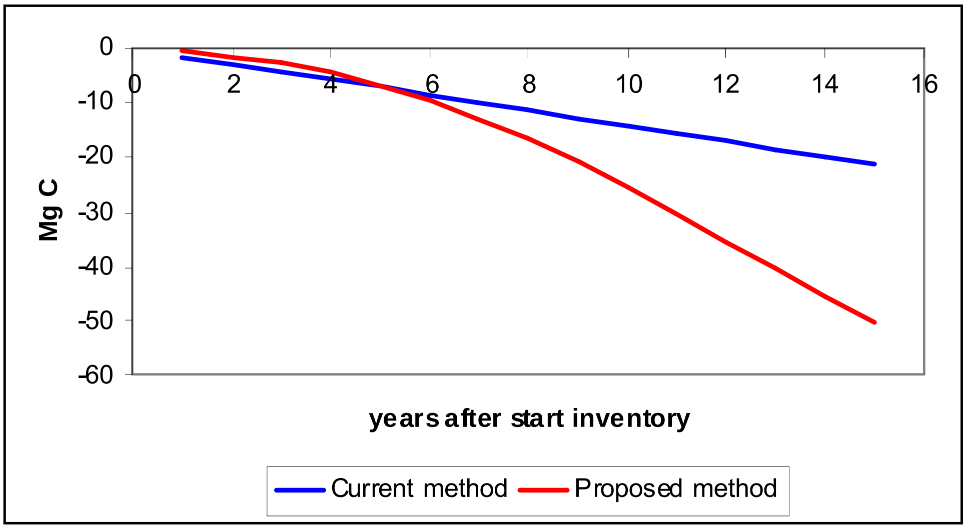


Figure 10-7: Annual carbon flux associated with tree growth in afforested plots for the cumulative area of afforestation over the years after the start of a forest inventory. The result of the current and proposed calculation method are shown.

10.10 Periodic updating of estimates for "Forest remaining forest" with new NFI data

The Dutch National Forest Inventory is a cyclic inventory. During a number of consecutive years, a country-wide subset of the total number of inventory plots is recorded. After a time lag, this is repeated for the permanent plots and a new selection of temporary plots is made to complement the set. Thus, a situation exists where only a small subset of plots is actually recorded for a certain year and for some years none.

Currently, the NFI data, though recorded over several years, are assigned to one year of NFI design. The calculations between 1990 and 2000 are based on 1990 data only, with additional year specific harvest data. When extrapolated one more year, this yielded estimates for 2000 which were in good accordance to the emissions based on data from MFV, collected in 2001 and 2002. In 2009 a recalculation will be submitted based on the whole set of 3622 plots collected between 2001 and 2005.

From 2010 on new plot data will be collected, which will at first cover the whole country with a grid of low density, density increasing as the NFI cycle continues.

A strategy is developed how to incorporate the slowly becoming available of plot data for a cyclic NFI in the reporting system based on an overview of European reporting practices in this aspect. This will be available for the NIR 2010.

10.11 Harvest data before and after 2000: consistency of estimates

The current harvest data are based on reports from Daamen between 1991 and 2000 (Table 10-3). In the new forest inventory design less emphasis is placed on harvest and from 2000 on national harvest data were not available from the same source types. As a consequence, until now the values for 2000 were copied for the following years. This was probably a reasonable estimate for the first years but is not a sustainable option (see ARR comment 114). The IPCC guidelines state that country submissions need to be consistent with (inter-)national statistics.

It is proposed to base the harvest data, therefore, on the FAO harvest statistics (www.fao.org). The wood production is given as production roundwood in m^3 underbark. The total volume removed from the forest includes bark as well as losses during harvesting and is calculated as:

$$V_{HV}^{NL} = V_{RU}^{NL} \cdot 1{,}136 \frac{V_{Overbark}}{V_{Underbark}} \cdot 1{,}06 \frac{V_{\mathrm{Re}\,moved}}{V_{Roundwood}}$$

Both the previously used values derived from Daamen (1991; 1994; 1996; 1997; 1998; 2000) as the values derived from FAO statistics are shown in Figure 10-8

For matter of consistency, a recalculation should then be carried out for the years 1990-2007 with the harvest data derived from FAO statistics. The difference between the values used until now and the FAO statistics are visualised in Figure 10-8.

Table 10-3 National level wood production data: sources

Year /period	1000 m3/y	Type of felling	Reference
1990	313	Final cut	Daamen. 1991.
1990-1994	1196	Thinning	Daamen. 1994.
1991-1995	1568	Thinning and final cut from production forest plus outgrown coppice, and other	Daamen. 1996.
1992-1996	1339	production forest plus outgrown coppice, and other	Daamen. 1997.
1993-1997	1455	production forest plus outgrown coppice, and other	Daamen. 1998.
1995- 1999	1397	HOSP forest plus additional forest	Daamen. 2000.

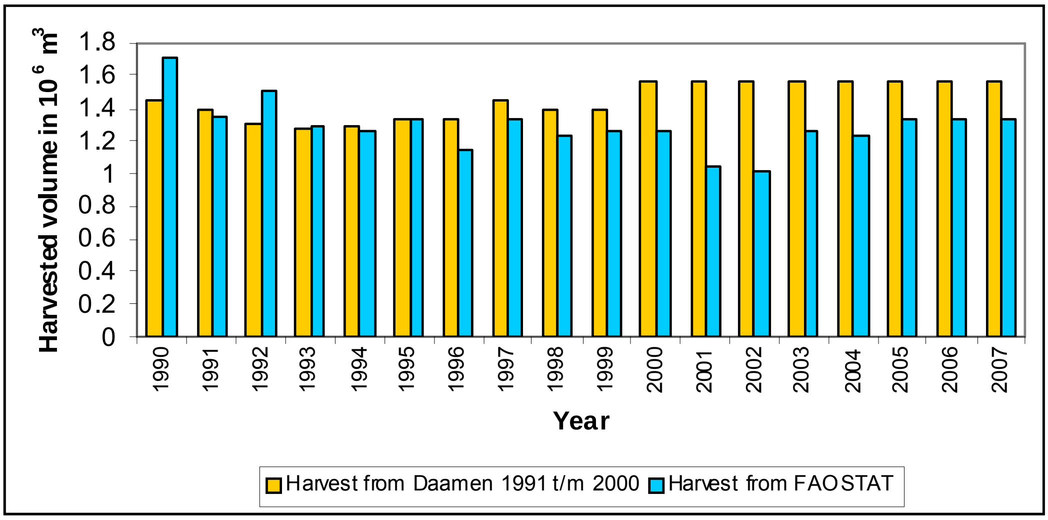


Figure 10-8: Total amount of wood harvested from the forest (forest remaining forest + deforestation) from Daamen 1991 t/m 2000 (orange) and based don FAO statistics (blue).

Part of this annual harvest is the result of deforestation, while another part is derived from intentional harvesting of wood. To distinguish between these, and to avoid counting double wood removals, the total volume removed from the area deforested is estimated first. This is then subtracted from the national harvest. The remaining volume is then the result of a series of management practices and harvests in the existing forest. Assuming that the amount of wood harvested from TOF is negligible, this remaining harvested volume is attributed completely to FAD and used for the calculation of carbon decrease (by wood removal).

This will be implemented in the NIR 2009 and the 2009 submission.

10.12 Reporting of new variables

For a number of variables has of the sector LULUCF no values were reported until now. New variables to be reported in the CRF from the 2008 submission onwards are:

- for categories 5A, 5B and 5C: previously, the total area of land in these categories was reported, now both the total area and the area organic soils in these land use categories should be reported
- for categories 5A-5F the emission of non-methane volatile compounds should be reported
- the emission of CH_4 and N_2O associated to drainage of forest soils and wetlands should be reported

The area of organic soils in the Netherlands changes as cultivated organic soil degenerate and peat and organic matter is oxidized to such an extent that the soils no longer meet the criteria for organic soil. Such soils then are classified as mineral soils and should be reported as such. In the current methodology we can only estimate where the above applies and we cannot provide an adequately good estimate for the loss of organic soils. Thus, the area of organic soils can be reported for any of these categories based on the soil map, but any changes in the area of organic soil, though it is acknowledged this occurs, cannot be quantified.

The Netherlands reports on CO_2 and N_2O from cultivation of organic soils; the CO_2 is included in Land Use whereas the N_2O is reported under agriculture. These emissions have been calculated with a country specific methodology and is based on actual measurements of loss of peat for CO2; measurements for N2O are scarce. Recent measurements (2006-2007) provide the first evidence that the reported emissions of nitrous oxide correspond well (van Beek et al., in preparation). The Netherlands does not report on emissions of methane (CH_4) from cultivated organic soils as evidence from literature (van den Pol-van Dasselaar et al., 1998) indicated that from cultivated grassland such emissions are absent or extremely low. It is wise to consider publication of the data that support the country specific methodology to calculate emissions from cultivation of organic soils. This is important as we report a lower emission for N2O and a (much) higher emission for CO2 from cultivated grassland.

10.13 Revision of notation keys

There were five comments on the use of notation keys, correct syntax or CRF titles in the ARR (comments 109, 110, 117, 1189, 119). In view of this, there will be a re-examination of all notation keys and self-defined titles with the recommendations of the review team in mind. The re-examination of notation keys and other syntax issues has been done already for the submission of 2008.

11 Revision and updates of the Kyoto estimates: framework and definitions

Related to the Kyoto protocol there are additional reporting obligations for LULUCF. One of these is the selection of LULUCF parameters and election of activities under article 3.4. The other is the reporting (voluntary and obligatory) for activities under article 3.3 and 3.4.

In the Initial Report the selection of the LULUCF parameters and the non-election of article 3.4 and the election of the accounting period is included. In

Table 11-1 the relevant information from the summary table in the Review of the Initial Report (IRR)(FCCC/IRR/2006/NLD) is presented.

Table 11-1: Information taken from the summary table IRR 2006

Item	**Provided**	**Value/year/comment**
LULUCF parameters	Yes	Minimum tree crown cover: 20% Minimum land area: 0.5 ha Minimum tree height: 5 m
Election of and accounting period for Article 3, paragraphs 3 and 4, activities	Yes	The Netherlands has not elected activities under Article 3, paragraph 4 and will account for each activity under Article 3, paragraph 3 for the entire commitment period.
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8, as originally submitted by Party	Yes	1,008,565,720 tonnes CO_2 eq.
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8, revised estimate	Yes	1,003,371,907 tonnes CO_2 eq.
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8, adjusted estimate	–	1,001,262,141 tonnes CO_2 eq.
Description of national registry in accordance with the requirements contained in the annex to decision 13/CMP.1, the annex to decision 5/CMP.1 and the technical standards for data exchange between registry systems adopted by the CMP	Yes	See section F

Section 178 of the IRR holds the judgment of the LULUCF section of the national system; "The ERT judges the national system for LULUCF reporting to be in line with the Kyoto Protocol requirements even though the ERT found an inconsistency in the land-use change matrix and errors in some calculations in the LULUCF sector. The ERT judgement is based on the fact that data collection and management seems to be properly done. However, some problems exist in data elaboration for the LULUCF accounting, which is not in line with IPCC good practice guidance for LULUCF."

In 15/CP.10 Parties are encouraged to submit on a voluntary basis with their submission 2007 estimates of GHG emissions by sources and removals by sinks resulting from activities under Article 3, paragraphs 3 and 4, using the tables contained in Annex II to that decision and supplementary information to be included in an annex to the NIR.

We decided **not** to voluntary report on the Kyoto tables for LULUCF together with the NIR 2008. As several improvements are planned in the LULUCF sector for the 2009 submissions (see chapter 10) it would make no sense to report now on Kyoto tables. But it will be investigated whether it will be possible to report Kyoto tables prior to the 2010 submission.

For the UNFCCC reporting the Netherlands use the wall-to-wall approach and has chosen to define the land use category "Forest Land" as all land with woody vegetation. This is further subdivided in:
"Forest" or "Forest according to definition" (FAD), i.e. all forest land which complies to the following (more strict) definition: forests are patches of land exceeding 0.5 ha with a minimum width of 30 m, with tree crown cover at least 20% and tree height at least 5 meters, or, if this is not the case, these thresholds are likely to be achieved at the particular site. Roads in the forest less than 6 meters wide are also considered to be forest. This definition is used for the Kyoto protocol article 3.3 and as requested by 16/CPM.1, Annex E, section 16, included in the Initial Report.

"Trees outside Forests" (TOF), i.e. wooded areas that comply with the forest definition except for their surface (=< 0.5 ha). These represent fragmented forest plots as well as groups of trees in parks and nature terrains and most woody vegetation lining roads, fields etc…

"Nature", i.e. all natural areas excluding grassland (natural grasslands and grasslands used for recreation purposes). It mainly consists of heath land, peat moors and other nature areas.

The future KP reporting in the CRF tables and additional information as an annex to the NIR as agreed in 15/CP.10 will be restricted to activities under article 3.3 as no activities under article 3.4 are selected. These activities have to be in line with definition on forest as presented in the Initial Report; so the report will deal with the "forest according to definition" category of the UNFCCC "Forest Land" only.[7] Taking this difference with the broader land-use category Forest Land for the UNFCCC reporting into account, it is obvious that in the future Annex to the NIR special attention has to be given to this difference. Research is ongoing to improve transparency in this field. This research is conducted in combination with the activities as presented in chapter 10 ahead.

Especially as the ERT conducted an adjustment and Annex II Calculation of the adjustment of the IRR, holds in section 15 following: "Since the estimate of net CO_2

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[7] The Dutch forest definition under the KP as lied down in the Dutch Initial Report (2007) has been approved of by the Expert Review Team in November 2007.

emissions from deforestation is a sum of many LULUCF subcategories, the ERT decided that the adjusted estimate for CO_2 net emissions should be provided at the level of the category forest land converted to other land-use categories, as reported in CRF table 5 (column B, row 30).” Later on in this Annex (section 20) “The ERT noted that “water” and “sand/dunes” are reported in the Netherlands’ GHG inventory under the category other land. The ERT further noted that “heather and other nature terrains” and “trees outside forest” are erroneously reported under the category forest land. They should not be, since the Netherlands declared that neither matches the country’s definition of forest; therefore, to ensure conservativeness for the adjustment calculation, the ERT considered these two types of land to be part of a virtual additional land-use category – 5.A*bis* – which does not belong to the category forest land although the same rules are applied.”

While it was stated clearly in the Initial Report that the forest under the KP is a more restricted definition/area than the land use category forest land used for reporting under the Convention, the report from the ERT shows that also in future reporting attention has to be given to this difference.

Selection from the Kyoto Protocol

Kyoto Protocol Article 3

3. The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation,reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks ineach commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. The greenhouse gas emissions by sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 and 8.

4. Prior to the first session of the Conference of the Parties serving as the meeting of the Parties to this Protocol, each Party included in Annex I shall provide, for consideration by the Subsidiary Body for Scientific and Technological Advice, data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session or as soon as practicable thereafter, decide upon modalities, rules and guidelines as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soilsand the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I, taking into account uncertainties, transparency in reporting, verifiability, the methodological work of the Intergovernmental Panel on Climate Change, the advice provided by the Subsidiary Body for Scientific and Technological Advice inaccordance with Article 5 and the decisions of the Conference of the Parties. Such a decision shall apply in the second and subsequent commitment periods. A Party may choose to apply such a decision on these additional human-induced activities for its first commitment period, provided that these activities have taken place since 1990.

Selections taken from Decision 16/CMP.1, Land use, land-use change and forestry, Annex

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B. Article 3, paragraph 3

2. For the purposes of Article 3, paragraph 3, eligible activities are those direct human-induced afforestation, reforestation and/or deforestation activities that meet the requirements set forth in this annex and that started on or after 1 January 1990 and before 31 December of the last year of the commitment period.
3. For the purposes of determining the area of deforestation to come into the accounting system under Article 3, paragraph 3, each Party shall determine the forest area using the same spatial assessment unit as is used for the determination of afforestation and reforestation, but not larger than 1 hectare.
4. For the first commitment period, debits2 resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than credits3 accounted for on that unit of land.
5. Each Party included in Annex I shall report, in accordance with Article 7, on how harvesting or forest disturbance that is followed by the re-establishment of a forest is distinguished from deforestation. This information will be subject to review in accordance with Article 8.

C. Article 3, paragraph 4

6. A Party included in Annex I may choose to account for anthropogenic greenhouse gas emissions by sources and removals by sinks resulting from any or all of the following human-induced activities, other than afforestation, reforestation and deforestation, under Article 3, paragraph 4, in the first commitment period: revegetation, forest management, cropland management and grazing land management.

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E. General

16. Each Party included in Annex I shall, for the purposes of applying the definition of "forest" as contained in paragraph 1 (a) above, select a single minimum tree crown cover value between 10 and 30 per cent, a single minimum land area value between 0.05 and 1 hectare and a single minimum tree height value between 2 and 5 metres. The selection of a Party shall be fixed for the duration of the first commitment period. The selection shall be included as an integral part of its report to enable the calculation of its assigned amount pursuant to Article 3, paragraphs 7 and 8, in accordance with decision 19/CP.7, and shall include the values for tree crown cover, tree height and the minimum land area. Each Party shall justify in its reporting that such values are consistent with the information that has historically been reported to the Food and Agriculture Organization of the United Nations or other international bodies, and if they differ, explain why and how such values were chosen.

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20. National inventory systems under Article 5, paragraph 1, shall ensure that areas of land subject to land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, are identifiable, and information about these areas should be provided by each Party included in Annex I in their national inventories in accordance with Article 7. Such information will be reviewed in accordance with Article 8.

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Annex A: Comments on the LULUCF sector from the review team in the Annual Review Report (ARR) for the UNFCCC

II. Land use, land-use change and forestry

A. Sector overview

106.In 2004, the LULUCF sector in the Netherlands was a net source of 2,598.1 Gg of CO_2, which represents 1.2 per cent of total national CO_2 emissions. The sector has been a net source since 1990, when net CO_2 emissions amounted to 2,667.3 Gg. From 1990 to 2004, net CO_2 emissions by LULUCF decreased slightly, by 2.6 per cent; from 2003 to 2004, these emissions decreased by 0.8 per cent.

107.The Netherlands has reported carbon stock changes in living biomass only for the forest-related categories and net changes in dead organic matter only for the category forest land remaining forest land, although litter has been assumed to be constant. Net carbon stock changes in mineral soil consequent to land-use changes have been estimated only for conversion to and from other land. N_2O and CH_4 emissions have not been estimated.

108.The ERT noted that the time series from 1971 for each land-use change has not been reconstructed, although the Party agreed a 20-year period for stabilization of carbon stocks after conversion. Moreover, the Netherlands reports on page 146 of the NIR that "for soil carbon stock changes after land use change it is assumed that the average carbon stock in the soil under the new and old land use are the same (Groot et al., 2005)". However, the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) on page 3.14 states that "the basic default assumption is that land use changes have a linear impact on soil organic matter for 20 years before a new equilibrium is reached (Tier 1). This means that, when a piece of land changes use, then it is followed in that "changed status" ("land converted to . . . " categories) for 20 years, with each year 1/20 of the CO_2 and non-CO_2 effects reported. Tier 3 modelling approaches may utilize different assumptions". The ERT encourages the Party to make additional efforts to reconstruct the time series of each land-use change and recommends that the Party use linear extrapolation until additional data become available. The ERT also recommends that the Party report carbon stock changes in mineral soils where a land-use change occurs, or report in the NIR data and scientific evidence to show that such a change does not occur.

109.In CRF table 5 the Netherlands reports the notation key "not applicable" ("NA") for net CO_2 emissions/removals in the information item grassland converted to other land-use categories, although data on carbon stock changes are reported under the category grassland converted to other land. The ERT considers this to be an error and recommends that the Party correct table 5, to cover net CO_2 emissions/removals resulting from the sum of all the carbon stock changes reported in the categories relating to grassland converted to other land uses.

110.Also in CRF table 5 the Netherlands defines a category called "carbon stock change" as a subdivision of category G, although the CO_2 emissions reported there are related to lime application. The ERT therefore recommends that the Party change this text, making clear the origin of the emissions reported; for instance, the term "total emissions from lime application to all land uses" could be used.

111.The ERT noted that the data in the land-use change matrix reported by the Party are inconsistent since the methodologies of classification applied to the two maps (1990 and 2000) differ. This inconsistency is clearly shown by the area (9.7 per cent in 10 years) which, according to the matrix reported by the Netherlands, has been converted from settlements to all the other uses (mainly grassland – 6.3 per cent); in practice, this would imply that the country's cities and infrastructure are being abandoned or disrupted by the inhabitants. The ERT recommends that the Party apply the same methodology of classification to each set of land-referred data in order to make it possible to compare them in a consistent manner and thus estimate land-use changes accurately.

B. Key categories

1. Forest land remaining forest land – CO_2

112.The Netherlands has estimated net carbon stock changes in litter and in soil organic matter using a tier 1 method (i.e., assuming that the stocks do not change) although the category has been identified as a key category. The ERT encourages the Party to estimate net carbon stock changes for these pools using a higher-tier method.

113.The Netherlands reports the areas of "trees outside forest" and "heather" as subdivisions of the forest land category; however, it reports in the NIR that the areas of "trees outside forest" and "heather" do not match the definition of forest land of the IPCC good practice guidance for LULUCF. The ERT therefore recommends that the Party allocate these areas to an appropriate category.

114.The ERT noted that the data on carbon stock changes in living biomass from 1990 to 2000 have been estimated using a model based on the data from two consecutive forest inventories (HOSP[8] 1990 and MFV[9] 2000), whereas the data from 2001 onwards are linearly extrapolated from 2000. As it is good practice to apply the same methodology throughout the whole time series, the ERT recommends that the Party use the data provided by the model for the years 2001 onwards.

2. Grassland remaining grassland – CO_2

115.The ERT noted that the emission factor for organic soils applied by the Netherlands (page 149 of the NIR) is 5.19 tonnes of carbon per year, whereas the EF reported in table 3.4.6 of the IPCC good practice guidance for LULUCF is either 0.25 (cold temperate climate) or 2.5 (warm temperate climate). Moreover, the good practice guidance for LULUCF (page 3.116) states that the contributions to subsidence of soil include erosion, compaction, burning, leaching and decomposition. Considering the inconsistency between the Dutch data and data suggested by the IPCC good practice guidance for LULUCF and the uncertainties related to the applied methodology, the ERT recommends that the Party check the methodology used in order to exclude from the net measure of subsidence all effects that are not related to the mineralization of the organic matter, by means of discount factors if necessary. Moreover, the Party is recommended to include in the NIR information on the data and methodology used and to complement the website with a dedicated document (in English) on the technical protocol applied for collecting data in order to demonstrate that the measurements have not been affected by any bias.

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[8] HOSP = Timber Production Statistics and Forecast (in Dutch: 'Hout Oogst Statistiek en Prognose oogstbaar hout').

[9] MFV = Measuring Network Functions (in Dutch: Meetnet Functievervulling).

C. Non-key categories

1. Land converted to forest land – CO_2

116.The ERT noted that the IEF reported for increases in carbon stock in living biomass grows continuously and rapidly along the time series up to the unrealistic value of 20.25 tonnes of carbon per hectare (i.e., circa 80 m^3 of wood increment per hectare!) for the year 2004. The ERT requests the Netherlands to revise its carbon stock change estimates for living biomass in afforested land.

2. Cropland remaining cropland – CO_2

117.The ERT noted that the Netherlands' 2006 inventory reports net carbon stock change in soil as "NE", while during the review data were presented demonstrating that carbon content in mineral soil under the category cropland remaining cropland remains constant due to the high level of organic fertilization (manure). The ERT therefore recommends that the Party use the notation key "NO" for reporting net carbon stock changes in soil organic matter and substantiate in the NIR the use of the notation key "NO".

3. Carbon emissions from agricultural lime application – CO_2

118.The ERT noted that carbon emissions from agricultural lime application are reported as "NE" for cropland and grassland, although these emissions are actually reported together under other. Moreover, the ERT noted that in this category emissions decreased between 1990 and 2004 by 56.8 per cent. Since the Party reports that the methodology applied for collecting data is not able to discriminate among final uses, the ERT recommends that the Party use the notation key "NA". The ERT also recommends the Netherlands to provide in the NIR data and other relevant information that could justify the trend.

3. Biomass burning – CH_4, N_2O

119.The ERT noted that CH_4 and N_2O emissions are reported as "NO" for forest land. Considering that some small forest fires have occurred, the ERT recommends that the Party either report estimated data or use the notation key "NE".

4. Forest land converted to other land uses – CO_2

120.The ERT noted that in the revised CRF tables the Netherlands has increased its emission factor for losses in living biomass, from –55.79 MgC/ha to –70.99 MgC/ha. The ERT considers this new EF too high in the light, for instance, of the data reported by the Netherlands to the Food and Agriculture Organization of the United Nations (FAO) for the Forest Resource Assessment (FRA) 2005[10] and those contained in the *Bosdata* report entitled *Aspecten van bos en bosbeheer in Nederland: Resultaten Houtoogststatistiek 1995–1999.*[11] The ERT therefore requests the Netherlands to reconsider the new EF.

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[10] Global Forest Resource Assessment 2005, Netherlands, Country Report 028 – Rome, 2004.

[11] HOSP, Bosdata nr 4, 2000.

Annex B: Harvested volumes as used for the Netherlands 1990-2006

Year	Harvest (million m^3)
1990	1,452
1991	1,384
1992	1,303
1993	1,277
1994	1,292
1995	1,324
1996	1,339
1997	1,455
1998	1,400
1999	1,400
2000	1,561
2001	1,561
2002	1,561
2003	1,561
2004	1,561
2005	1,561
2006	1,561
2007	1,561

Based on Daamen (1991; 1994; 1996; 1997; 1998; 2000)

Annex C: Biomass expansion equations selected from the COST21 database (from Nabuurs et al., 2005)

Table 11-2: Allometric equations used to calculate aboveground biomass (in kg) from inventory data (D in cm, H in m)

Species group	Equation	Developed for	Country	Reference
Acer spp	$0.00029*(D*10)^{2.50038}$	Betula pubescens	Sweden	Johansson 1999a
Alnus spp	$0.00309*(D*10)^{2.022126}$	Alnus glutinosa	Sweden	Johansson 1999b
Betula spp	$0.00029*(D*10)^{2.50038}$	Betula pubescens	Sweden	Johansson 1999a
Fagus sylvatica	$0.0798*D^{2.601}$	Fagus sylvatica	The Netherlands	Bartelink 1997
Fraxinus excelsior	$0.41354*D^{2.14}$	Quercus robur & Quercus petraea	Austria	Hochbichler 2002
Larix spp	$0.0533*(D^2*H)^{0.8955}$	Picea abies	European Russia	Hamburg et al. 1997
Picea spp	$0.0533*(D^2*H)^{0.8955}$	Picea abies	European Russia	Hamburg et al. 1997
Pinus other	$0.0217*(D^2*H)^{0.9817}$	Pinus sylvestris	European Russia	Hamburg et al. 1997
Pinus sylvestris	$0.0217*(D^2*H)^{0.9817}$	Pinus sylvestris	European Russia	Hamburg et al. 1997
Populus spp	$0.0208*(D^2*H)^{0.9856}$	Populus tremula	European Russia	Hamburg et al. 1997
Pseudotsuga menziesii	$0.111*D^{2.397}$	Pseudotsuga menziesii	The Netherlands	Van Hees 2001
Quercus spp	$0.41354*D^{2.14}$	Quercus robur & Quercus petraea	Austria	Hochbichler 2002
Coniferous other	$0.0533*(D^2*H)^{0.8955}$	Picea abies	European Russia	Hamburg et al. 1997
Broadleaved other	$0.41354*D^{2.14}$	Quercus robur & Quercus petraea	Austria	Hochbichler 2002

Table 11-3: Allometric equations used to calculate belowground biomass (in kg) from inventory data (D in cm, H in m)

Species group	Equation	Species	Country	Reference
Acer spp	$0.0607*D^{2.6748}*H^{-0.561}$	Betula pubescens	European Russia	Hamburg et al. 1997
Alnus spp	$0.0607*D^{2.6748}*H^{-0.561}$	Betula pubescens	European Russia	Hamburg et al. 1997
Betula spp	$0.0607*D^{2.6748}*H^{-0.561}$	Betula pubescens	European Russia	Hamburg et al. 1997
Fagus sylvatica	$e^{-3.8219}*D^{2.5382}$	Fagus sylvatica	France	Le Goff & Ottorini 2001
Fraxinus excelsior	$-1.551*0.099*D^2$	Quercus petraea	France	Drexhage et al. 1999
Larix spp	$0.0239*(D^2*H)^{0.8408}$	Picea abies	European Russia	Hamburg et al., 1997
Picea spp	$0.0239*(D^2*H)^{0.8408}$	Picea abies	European Russia	Hamburg et al., 1997
Pinus other	$0.0144*(D^2*H)^{0.8569}$	Pinus sylvestris	European Russia	Hamburg et al., 1997
Pinus sylvestris	$0.0144*(D^2*H)^{0.8569}$	Pinus sylvestris	European Russia	Hamburg et al., 1997
Populus spp	$0.0145*(D^2*H)^{0.8749}$	Populus tremula	European Russia	Hamburg et al., 1997
Pseudotsuga menziesii	$0.0239*(D^2*H)^{0.8408}$	Picea abies	European Russia	Hamburg et al., 1997
Quercus spp	$-1.551*0.099*D^2$	Quercus petraea	France	Drexhage et al. 1999
Coniferous other	$0.0239*(D^2*H)^{0.8408}$	Picea abies	European Russia	Hamburg et al., 1997
Broadleaved other	$-1.551*0.099*D^2$	Quercus petraea	France	Drexhage et al. 1999

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Annex D: Carbon emission calculations for Forest Land remaining Forest Land (A) and fluxes associated with changes in biomass associated with the conversion of land to and from Forest (B)

Abbr	Description	Unit
c_1,c_2,c_3	Species specific constants describing the relation between tree volume and tree diameter and height (Jansen et al.,)	-
c_7,c_8	Species specific constants describing the relation between plot height and maximal height and age (Jansen et al.,)	-
A_{Rep}	Representative area of a plot	ha
BEF	Biomass expansion factor from stem to whole tree	-
$[C]$	Carbon concentration	kg C kg^{-1} DM
C_{dec}	Carbon lost through decomposition of dead wood	kg C ha^{-1}
C_{mort}	Carbon input into dead wood from tree mortality	kg C ha^{-1}
ΔC_{LT}	Carbon stock change in live trees	kg C ha^{-1} $year^{-1}$
ΔC_{DW}	Carbon stock change in dead wood	kg C ha^{-1} $year^{-1}$
$\Delta C_{Y,aff}$	Carbon stock change from afforestation at year Y	kg C ha^{-1} $year^{-1}$
$\Delta C_{Y,def}$	Carbon stock change from deforestation at year Y	kg C ha^{-1} $year^{-1}$
D_{DW}	Wood density of dead wood	kg DM m^{-3}
D_{LW}	Wood density of live wood	kg DM m^{-3}
$\overline{DBH}_t$	Mean diameter at breast height at time t	cm
fr_{mort}	Annual mortality fraction	# $year^{-1}$
H	Height	m
I_t	Annual volume increment at time t	m^3 ha^{-1} $year^{-1}$
L_{SD}	Species specific decay period of standing dead wood	year
L_{LD}	Species specific decay period of lying dead wood	year
$\overline{M}_{t,AG}$	Mean tree aboveground biomass at time t	kg DM
$\overline{M}_{t,BG}$	Mean tree belowground biomass at time t	kg DM
M_t	Total biomass at time t	kg DM ha^{-1}
N_t	Tree density at time t	# ha^{-1}
S	Site – index (= maximal height)	m
T	Age	year
V_t	Total volume at time t	m^3 ha^{-1}
$\overline{V}_t$	Mean tree volume at time t	m^3
V_{SD}	Total volume standing dead wood	m^3 ha^{-1}
V_{LD}	Total volume lying dead wood	m^3 ha^{-1}
Y_{rcd}	Year of recording	-
Y_{reg}	Regeneration year	-

D(I). Forest remaining forest

Following calculations are carried out to derive the annual carbon balance from the HOSP and MFV data and to forward calculate the balance.

1. Calculation of variables at initial plot age T

$$T = Y_{rcd} - Y_{reg}$$

$$S = H_T \cdot \left(1 - e^{-c_7 \cdot T}\right)^{-c_8}$$

$$\overline{V}_T = V_T \,/\, N_T$$

$$\ln\left(\overline{DBH}_T\right) = \frac{1}{c_1} \times (\ln(\overline{V}_T) - c_2 \times \ln(H_T) - c_3)$$

$$\overline{M}_{T,AG} = f_1\left(\overline{DBH}_T, H_T\right)$$

$$\overline{M}_{T,BG} = f_2\left(\overline{DBH}_T, H_T\right)$$

$$M_T = \left(\overline{M}_{AG} + \overline{M}_{BG}\right) \cdot N_T$$

2. Calculation of variables at T+1

$$H_{T+1} = S \cdot \left(1 - e^{-c_7 \cdot T}\right)^{c_8}$$

$$V_{T+1} = V_T + I_T$$

$$N_{T+1} = \left(1 - fr_{mort}\right) \cdot N_T$$

$$\overline{V}_{T+1} = V_{T+1} \,/\, N_{T+1}$$

$$\ln\left(\overline{DBH}_{T+1}\right) = \frac{1}{c_1} \times (\ln(\overline{V}_{T+1}) - c_2 \times \ln(H_{T+1}) - c_3)$$

$$\overline{M}_{T+1,AG} = f_1\left(\overline{DBH}_{T+1}, H_{T+1}\right)$$

$$\overline{M}_{T+1,BG} = f_2\left(\overline{DBH}_{T+1}, H_{T+1}\right)$$

$$M_{T+1} = \left(\overline{M}_{T+1,AG} + \overline{M}_{T+1,BG}\right) \cdot N_{T+1}$$

3. Storage of carbon in live trees

$$\Delta C_{LT} = \left(M_{T+1} - M_T\right) \cdot [C]$$

4. Storage of carbon in dead wood

$$C_{mort} = M_T \cdot fr_{mort}$$

$$C_{dec} = \left(\frac{V_{SD}}{L_{SD}} + \frac{V_{LD}}{L_{LD}}\right) \times D_{DW} \times [C]$$

$$\Delta C_{DW} = C_{mort} - C_{dec}$$

5. Loss of carbon in harvested wood

$$P(HV) = \langle \begin{array}{ll} 0 & V_t < 300 \wedge T < 110 \\ 1 & V_t > 300 \vee T > 110 \end{array}$$

$$f_{HV} = \frac{V_{HV}^{NL}}{\sum P(HV) \cdot V_t}$$

$$\Delta C_{HV} = f_{HV} \cdot N_T \cdot \left(\overline{M}_{T,AG} + \overline{M}_{T,BG}\right) \cdot [C]$$

D(II). Afforestation & deforestation

Following calculations are carried out to derive the annual carbon balance from the live tree compartment through afforestation and deforestation

1. Afforestation (to be updated)

$$\Delta C_{Y,aff} = \frac{\Delta C_{LT}}{2}$$

2. Deforestation

$$\Delta C_{Y,def} = Vm_Y \cdot \frac{\sum\left(M_t \cdot A_{\mathrm{Re}\,p}\right)}{\sum\left(V_t \cdot A_{\mathrm{Re}\,p}\right)} \cdot [C]$$

Annex E: Explicit calculations for categories with changing emissions between submissions

Category A2: Land converted to Forest Land

Cropland Converted to Forest Land
Area:
Submission 2005:
(CropToFAD + CropToTOF + CropToNature) / (2000 – 1990 + 1)
= (10356 ha + 1584 ha + 671 ha) / (11 year) * (0,001 kha / ha)
= 1,15 kha

ReSubmission 2006:
(CropToFAD) / (2000 – 1990) * CorrectionByPatchSize
= (10356 ha) / (10 year) * 0,781 * (0,001 kha / ha)
= 0,809 kha

Submission 2008:
See Resubmission 2006

Grassland Converted to Forest Land
Area:
Submission 2005:
(GrassToFAD + GrassToTOF + GrassToNature) / (2000 – 1990 + 1)
= (10588 ha + 3821 ha + 854 ha) / (11 year) * (0,001 kha / ha)
= 1,39 kha

ReSubmission 2006:
(GrassToFAD) / (2000 – 1990) * CorrectionByPatchSize
= (10588 ha) / (10 year) * 0,781 * (0,001 kha / ha)
= 0,827 kha

Submission 2008:
See Resubmission 2006

Wetland Converted to Forest Land
Area:
Submission 2005:
(WetToFAD + WetToTOF + WetToNature) / (2000 – 1990 + 1)
= (87 ha + 22 ha + 19 ha) / (11 year) * (0,001 kha / ha)
= 0,01 kha

ReSubmission 2006:
(WetToFAD) / (2000 – 1990) * CorrectionByPatchSize
= (87 ha) / (10 year) * 0,781 * (0,001 kha / ha)
= 0,007 kha

Submission 2008:
See Resubmission 2006

Settlement Converted to Forest Land
Area:
Submission 2005:

(SettToFAD + SettToTOF + SettToHeather) / (2000 – 1990 + 1)
= (4125 ha + 2168 ha + 280 ha) / (11 year) * (0,001 kha / ha)
= 0,60 kha

ReSubmission 2006:
(SettToFAD) / (2000 – 1990) * CorrectionByPatchSize
= (4125 ha) / (10 year) * 0,781 * (0,001 kha / ha)
= 0,322 kha

Submission 2008:
See Resubmission 2006

Other Land Converted to Forest Land
Area:
Submission 2005:
(WaterToFAD + WaterToTOF + WaterToHeather + SandToFAD + SandToTOF + SandToHeather) / (2000 – 1990 + 1)
= (620 ha + 302 ha+ 272 ha + 555 ha + 101 ha+ 647 ha) / (11 year) * (0,001 kha / ha)
= 0,23 kha

ReSubmission 2006:
(WaterToFAD + SandToFAD) / (2000 – 1990) * CorrectionByPatchSize
= (620 ha + 555 ha) / (10 year) * 0,781 * (0,001 kha / ha)
= 0,092 kha

Submission 2008:
See Resubmission 2006

Soil carbon stock change:
Submission 2005:
derived from overlay land use change map and soil carbon map
= 68,24 Gg CO_2
Resubmission 2006 and Submission 2008:
Not distinguished separately (note in CRF: included in living tree carbon flux, however, this does not show in calculations for living tree carbon flux)

Land Converted to Forest Land : all afforestations together

Increase in living biomass:
Submission 2005:
EFaff = IncreaseInLivingBiomass_MFV / AreaForest_MFV * 0,5
= 1079,6 Gg C / 366 kha * 0,5
= 1,457 Gg C

EFaff * (HeatherToFAD + CropToFAD + GrassToFAD + WetToFAD + SettToFAD + WaterToFAD + SandToFAD + HeatherToTOF + CropToTOF + GrassToTOF + WetToTOF + SettToTOF + WaterToTOF + SandToTOF) / (2000 – 1990)
= 1,457 Gg C * (4906 + 10356 ha + 10588 ha + 87 ha + 4125 ha + 620 ha + 555 ha + 1584 ha + 3821 ha + 22 ha + 226 + 2168 ha + 302 ha + 101 ha) / (10 years) * 0,001kha / ha * 1 year
= 1,457 Gg C * 3,946 kha
= 5,749 Gg C => 5,7 Gg C = 20,9 Gg CO2

Resubmission 2006:
Submission 2006 * CorrectionByPatchSize_aff / CorrectionByOccurrence_aff
= 2,89 * 0,781 / 0,639
= 3,5322 Gg CO2

Submission 2008:
See Resubmission 2006

Category B2: Land converted to Cropland

Other Land Converted to Cropland
Soil carbon stock change:
Submission 2005:
derived from overlay land use change map and soil carbon map based on generic data (de Groot et al., 2005)
= 9,60 Gg C = Gg CO_2

Resubmission 2006 and Submission 2008:
In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007).
The value for Other Land converted Grassland is derived from an overlay of the land use change map and this improved soil carbon map (Van den Wyngaert et al., 2007).
= 9,70 Gg C = Gg CO2

Category C2: Land converted to Grassland

Forest Land Converted to Grassland
Area:
Submission 2005:
(FADToGrass + TOFToGrass + HeatherToGrass) / (2000 – 1990 + 1)
(10310 ha + 3131 ha + 828 ha) / (11 years) * 0,001 kha / ha * 1 year
= 1,30 ha
Note: in this submission, the area deforested is reported under each respective category, consistently following the same methodology as for grassland. The total sums to 2,95 kha. The distribution is:

From Forest Land to	Surface (kha)
Cropland	0,16
Grassland	1,30
Wetland	0,00
Settlement	1,23
Other Land	0,26

ReSubmission 2006:
(FADToHeather + FADToCrop + FADToGrass + FADToWet + FADToSett + FADToWater + FADToSand + TOFToHeather + TOFToCrop + TOFToGrass + TOFToWet + TOFToSett + TOFToWater + TOFToSand) / (2000 – 1990) * CorrectionByPatchSize_def
= (2898 + 1274 + 10310 + 0 + 9013 + 946 + 604 + 152 + 422 + 3131 + 0 + 4164 + 228 + 111) / (10 years) * 0,001 kha ha-1 * 0,614
= 2,0416 kha => 2,04 kha submitted

Submission 2008:
See Resubmission 2006

Decrease in living biomass:
Submission 2005:
EFdef = MeanVolumeHosp * WoodDensity * ExpansionFactor * [Carbon]
= 190 m3ha-1 * 0,45 ton m-3 * 1,66 * 0,5 ton C ton-1DM
= 70,965 ton C ha-1 => EFdef = 71 Gg C kha-1

EFdef * (FADToHeather + FADToCrop + FADToGrass + FADToWet + FADToSett + FADToWater + FADToSand + TOFToHeather + TOFToCrop + TOFToGrass + TOFToWet + TOFToSett + TOFToWater + TOFToSand) / (2000 – 1990)
= 71 Gg C kha-1* (2898 + 1274 + 10310 + 0 + 9013 + 946 + 604 + 152 + 422 + 3131 + 0 + 4164 + 228 + 111) / (10 years) * 0,001kha / ha * 1 year
= 71 Gg C kha-1* 3,3251 kha
= 236,0821 Gg C => 236,1Gg C = 865,7 Gg CO2

ReSubmission 2006:
EFdef = MeanVolumeHosp * WoodDensity * ExpansionFactor * [Carbon]
= 190 m3ha-1 * 0,45 ton m-3 * 1,66 * 0,5 ton C ton-1DM
= 70,965 ton C ha-1 => EFdef = 71 Gg C kha-1

EFdef * (FADToHeather + FADToCrop + FADToGrass + FADToWet + FADToSett + FADToWater + FADToSand + TOFToHeather + TOFToCrop + TOFToGrass + TOFToWet + TOFToSett + TOFToWater + TOFToSand) / (2000 – 1990) * CorrectionByPatchSize_def
= 71 Gg C kha-1* (2898 + 1274 + 10310 + 0 + 9013 + 946 + 604 + 152 + 422 + 3131 + 0 + 4164 + 228 + 111) / (10 years) * 0,001kha / ha * 1 year * 0,614
= 71 Gg C kha-1* 3,3251 kha * 0,614
= 144,954 Gg C => 513,5 Gg CO2
Submitted is 513,5053 Gg CO2 (144,956 Gg C)

Submission 2008:
See Resubmission 2006

Other Land Converted to Grassland
Soil carbon stock change:
Submission 2005:
derived from overlay land use change map and soil carbon map based on generic data (de Groot et al., 2005)
= 89,87 Gg C = 329,5 Gg CO_2

Resubmission 2006 and Submission 2008:
In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007).
The value for Other Land converted Grassland is derived from an overlay of the land use change map and this improved soil carbon map (Van den Wyngaert et al., 2007).
= 92,05 Gg C = 337,5 Gg CO2

Category E2: Land converted to Settlement

Other Land Converted to Settlement
Soil carbon stock change:
Submission 2005:
derived from overlay land use change map and soil carbon map based on generic data (de Groot et al., 2005)
= 41,30 Gg C = 151,43Gg CO_2

Resubmission 2006 and Submission 2008:
In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007).
The value for Other Land converted Grassland is derived from an overlay of the land use change map and this improved soil carbon map based (Van den Wyngaert et al., 2007).
= 41,33 Gg C = 151,54 Gg CO2

Category F2: Land converted to Other Land

Forest Land Converted to Other Land
Soil carbon stock change:
Submission 2005:
derived from overlay land use change map and soil carbon map based on generic data (de Groot et al., 2005)
= -22,51 Gg C = -82,54 Gg CO_2

Resubmission 2006
For the resubmission, the area of Forest Land converted to other land use categories was changed, as the correction by patch occurrence was replaced by a correction based on patch size.
= SoilCChange_FLtoOL * CorrectionByPatchSize_def / CorrectionByOccurrence_def
= -22,72 Gg C * 0,614 / 0,441 = -31,63 Gg C = - 115,99 Gg CO2

Submission 2008:
See Resubmission 2006

Cropland, Grassland, Wetland & Settlement Converted to Other Land
Soil carbon stock change:
Submission 2005:
derived from overlay land use change map and soil carbon map based on generic data (de Groot et al., 2005)
Cropland Converted to Other Land = -34,10 Gg C = -125,03 Gg CO2 based on 0,33 kha
Grassland Converted to Other Land = -101,66 Gg C = -372,75 Gg CO2 based on 0,85 kha
Wetland Converted to Other Land = -6,08 Gg C = -22,29 Gg CO2 based on 0,05 kha
Settlement Converted to Other Land = -29,34 Gg C = -107,58 Gg CO2 based on 0,26 kha

Resubmission 2006 and Submission 2008:
In 2006, the calculation of the soil carbon stock was improved, using stratified soil data instead of more generic, and a few other corrections (Van den Wyngaert et al. 2007).
The value for land converted to Other Land for submissions from 2006 on is derived from an overlay of the land use change map and this improved soil carbon map (Van den Wyngaert et al., 2007).
Cropland Converted to Other Land = -33,91 Gg C = 124,34 Gg CO2
Grassland Converted to Other Land = -103,32 Gg C = 378,84 Gg CO2
Wetland Converted to Other Land = -6,31 Gg C = 23,14 Gg CO2
Settlement Converted to Other Land = -29,28 Gg C = 107,36 Gg CO2

Annex F: QA/QC control mechanisms : example for 2008

Voorstel Planning 2008 + QA/QC

Voor elk jaar wordt een document als dit gecreëerd waarin verslag gedaan wordt van de planning, het proces en de beslismomenten relevant voor (1) de eerstvolgende submissie van cijfers naar UNFCCC en Kyoto en (2) de ontwikkelingen op langere termijn van het rapportagesysteem voor berekening en submissie naar UNFCCC en Kyoto. Dit document bevat in principe alle informatie die nodig is om een QA/QC analyse van het proces uit te voeren.

Planning + procesbeheersing

Er wordt aan het begin van het jaar / aan het eind van het vorige jaar een planning opgesteld met daarin:
- de berekening van de cijfers
- tussentijdse beslismomenten
- mijlpalen en tussentijdse resultaten
- eventuele rapporten en andere resultaten

Tabel 1: Voorbeeld van planning van acties voor submissie van sector LULUCF

Datum		Acties	Uitgevoerd
12 Feb	WEBsinks	- Beslissen planning 2008 - Selectie verbeteracties 2008 - Beslissen QA/QC acties	
Feb		- controle submissie 2008 t-2	
Feb-Mei	-	- Uitwerken voorstellen verbeteracties - Update rapport 1035.6 met voorstellen voor verbetering gereed	
1 Mei		- Opsturen voorstellen verbeteracties	
6 Mei	LULUCF-dag	- Beslissen over uiteindelijke versie berekeningen LULUCF	
1 Sept		- Cijfers 2009 gereed – inleveren bij werkveldtrekker - 1st draft achtergrondrapporten & hoofdstukken voor update methoderapport gereed	
Sept-Okt		- Integratie + consistentie controles	
4 Nov	WEBsinks	- vaststellen definitieve LULUCF cijfers	
15 Nov		- submissie LULUCF to ER-database & CRF	
15 Dec		- Update rapport 1035.7 met alle verbeteringen n.a.v. review doorgevoerd gereed (beschikbaar voor schrijven NIR)	

Selectie verbeteracties

Naar aanleiding van
- ontwikkelingen in rapportageverplichtingen
- updates van Good Practice Guidance en IPCC Guidelines
- reviews (ARR, IRR)
- beschikbaar komen van betere – nieuwe – completere datasets
- beschikbaar komen van betere – nieuwe – completere methoden
wordt elk jaar (doorlopend) geïnventariseerd waar mogelijkheden en waar verplichtingen voor verbeteringen liggen. Aan het begin van het jaar wordt hiervan een lijst opgesteld (1) welke voor

de submissie van het volgende jaar doorgevoerd moeten worden en (2) welke acties naar latere datum doorgeschoven worden. Voor de verbeteracties van lijst (1) moet een uitgewerkt plan van aanpak beschikbaar zijn voor de zomer.

Beslissing definitieve vorm Nationaal Systeem

Voor elk van de verbeteracties die voor de submissie van jaar + 1 uitgevoerd moeten zijn, wordt een voorstel met een of meerdere opties uitgewerkt. Deze uitwerking bevat
- *een gedetailleerde methodebeschrijving & motivatie*
- *een motivatie van conformiteit met IPCC Guidelines en GPG en de verwachtingen daarover in de toekomst*
- *een inschatting van de orde van grootte van de verandering in getallen voor de submissie*

Deze achtergronddocumenten en de uiteindelijke beslissingen worden hier vastgelegd. Op basis van deze informatie moet elk verschil tussen de cijfers van dit en vorig jaar te verklaren zijn.

Berekeningen

Hier wordt voor elk jaar voor vastgelegd:
- *wie verantwoordelijk is voor welke berekeningen en wie ze uitvoert*
- *wie de berekeningen uitvoert*
- *welke protocollen gevolgd zijn*
- *welke methode- en achtergronddocumenten geldig zijn voor deze berekeningen*

Op basis van deze gegevens moet de informatie voor de NIR gemakkelijk te vinden zijn.

De LULUCF data worden berekend door Alterra en MNP volgens onderstaande tabel (Tabel 2).

Tabel 2: Overzicht van berekeningen uitgevoerd ten behoeve van de submissie LULUCF

Categorie	Wat	Wie	Beschrijving
Activity data: area	Landgebruik matrix op basis van topografische kaarten	Henk Kramer	Van den Wyngaert et al., 2008
C-fluxen Bos blijft bos	Eenvoudig boekhoud model op basis van NFI data	Isabel van den Wyngaert	Nabuurs et al., 2005 Van den Wyngaert et al., 2007 (5A_CO2_forest_2006.pdf)
C-flux Conversie bos naar ander landgebruik	Gemiddelde voorraad C in hout op basis van NFI & default conversiefactoren	Gert-Jan Nabuurs	Nabuurs et al., 2005 (5A_CO2_forest_2006.pdf)
C-flux Conversie naar bos	Gemiddele groei op basis van C-fluxen "Bos blijft bos" & leeftijd	Gert-Jan Nabuurs	Nabuurs et al., 2005 (5A_CO2_forest_2006.pdf)
C flux Conversies van en naar Other land	Overlay landgebruikskaarten & bodem C kaart	Willy de Groot	de Groot et al., 2005 5_CO2_land_use_categories_2006.pdf
C flux agrarisch gebruik organische gronden		Peter Kuikman	1035.2 5_CO2_land_use_categories_2006.pdf
Activity data: gebruik kalkrijke mesttsoffen & C-emissies	Op basis van landelijke cijfers en emissiefactoren	Gert-Jan van den Born	NIR

Activity data: arealen landgebruik & verandering in landgebruik (areaal in kha)

De Nederlandse landgebruiksmatrix is afgeleid uit een vergelijking (overlay) van twee landgebruikskaarten (1990, 2000) die gemaakt zijn door Henk Kramer (Alterra). Hierna is voor de categorie "Bos volgens de definitie" en "Bomen buiten bos" nog een correctieslag gemaakt door Gert-Jan Nabuurs (Alterra) en Isabel van den Wyngaert (Alterra). De te rapporteren arealen per landgebruik worden afgeleid uit de categoriën onderscheiden op de topografische kaart zoals aangegeven in Tabel 3. Het vaststellen en aanleveren aan de werkveldtrekker Isabel van den Wyngaert (Alterra) van de arealen landgebruik en landgebruiksverandering in de door UNFCCC gestelde landgebruiksklassen gebeurt door respectievelijk Gert-Jan Nabuurs voor klasse A (Bos) en Willy de Groot voor klasse B-F (alle andere landgebruiksklassen).

Tabel 3: Landgebruiksklassen zoals gebruikt bij de kaartoverlay & zoals vastgesteld door UNFCCC

UNFCCC landgebruiksklassen	**Nederlandse landgebruiksklassen (TOP)**
Bos – Bos volgens de definitie	Bos volgens de definitie
Bos – Bomen buiten bos	Bomen buiten bos
Bos – Heide	Heide + veengronden
Agrarisch (akker) land	Agrarisch (akker) land
Grasland	Grasland
Wetland	Rietmoeras (1990)
Settlements	Settlements & wegen
Ander landgebruik	Water + Zand & duinen

Emissies bij landgebruiksveranderingen (totalen in Gg C)

Voor een deel van de landgebruiksveranderingen wordt een koolstofflux gerapporteerd. Het gaat hierbij om de volgende fluxen:

Tabel 4: Rapportage van koolstoffluxen binnen de LULUCF sector

Naar↓ Van→	Bos	Akkerland	Grasland	Wetland	Settlement	Ander land
Bos	Biomassa + Oogst + Necromassa	Biomassa + Bodem	Biomassa + Bodem	Biomassa + Bodem[1]	Biomassa + Bodem	Biomassa + Bodem
Akkerland	Biomassa		-	-	-	Bodem
Grasland	Biomassa	-	Bodem	-	-	Bodem
Wetland	Biomassa	-	-		-	-
Settlement	Biomassa	-	-	-		Bodem
Ander land	Biomassa + Bodem	Bodem	Bodem	Bodem	Bodem	

1 Er staat IE in de CRF maar niets in de invultabel voor bodem

2 Voor een aantal overgangen is de rapportage in de CRF in tegenspraak met de achtergrondrapporten wat betreft de annotation keys. Het betreft hier voornamelijk het gebruik van “IE” waar “NO” of “NE” verwacht wordt.

Rapportage van fluxen bij overgang van en naar bos (Gg C ha^{-1}) worden berekend door Gert-Jan Nabuurs (Alterra). Alle andere overgangen zijn berekend door Willy de Groot (Alterra) en worden voor volgende jaren geëxtrapoleerd. Fluxen per ha worden vermenigvuldigd met het areaal en aan Isabel van den Wyngaert (Alterra) aangeleverd.

Emissies bij constant landgebruik (totalen in Gg C)

Koolstoffluxen bij constant landgebruik worden gerapporteerd voor Bos (Bos volgens de definitie en Bomen buiten bos) en voor Grasland.
Voor de landgebruiksklasse Bos betreft het toename en afname in bovengrondse biomassa en netto verandering in dood organisch materiaal. Dit wordt berekend door Isabel Van den Wyngaert (Alterra) en aangeleverd door Gert-Jan Nabuurs (Alterra) zoals beschreven in Nabuurs et al. (2005) en Van den Wyngaert et al. (2007).
Voor de landgebruiksklasse Grasland betreft het verandering in koolstofopslag in de bodem van minerale & organische bodems (*gerapporteerd onder minerale bodems als fluxen niet met*

zekerheid te scheiden zijn). Dit wordt berekend en aangeleverd door Peter Kuikman (Alterra) zoals beschreven in (1035.2).
Alles wordt aangeleverd aan Isabel van den Wyngaert (Alterra).

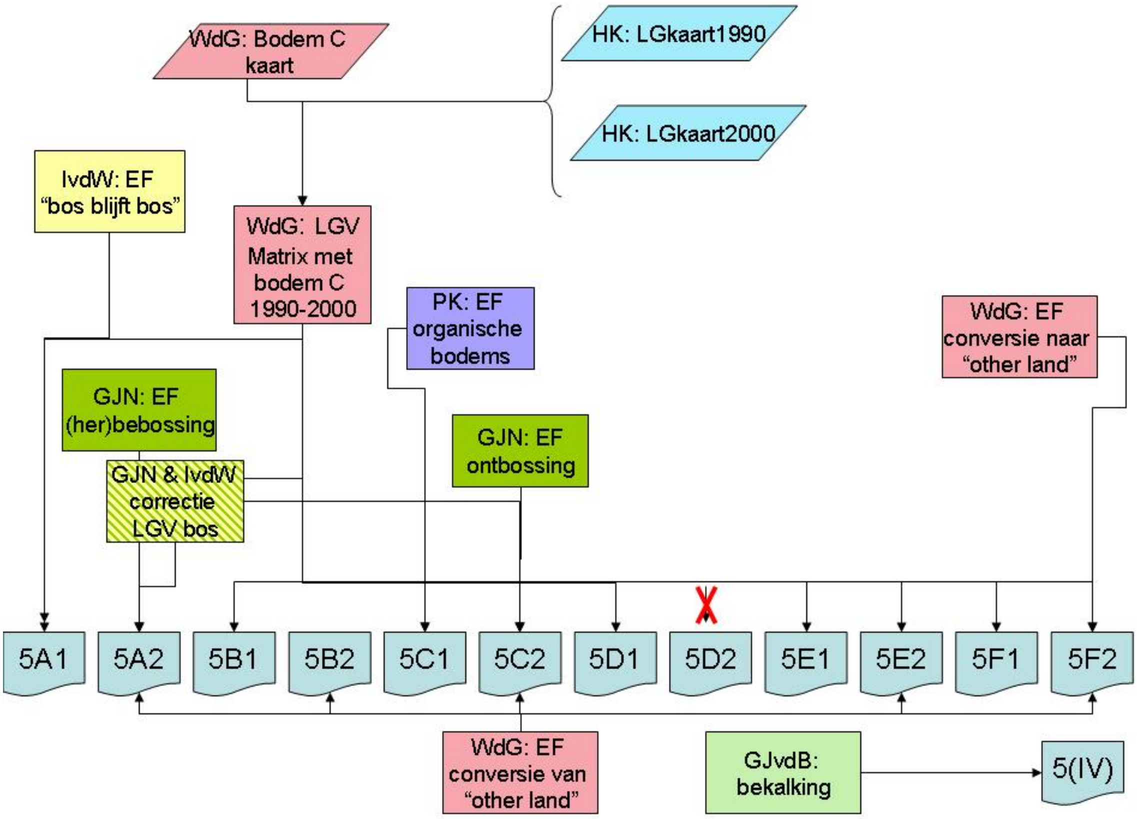
Emissies geassocieerd met het landbouwkundig gebruik van kalk

Koolstoffluxen geassocieerd met landbouwkundig gebruik van kalksteen ($CaCO_3$) of dolomiet ($CaMg(CO_3)_2$) op akkers of graslanden wordt berekend door Gert-Jan van den Born (MNP) en aangeleverd aan Isabel van den Wyngaert (Alterra).

Samenvatting

Figuur 1: Berekeningen voor sector LULUCF

(GJN = Gert-Jan Nabuurs (Alterra); GJvdB = Gert-Jan van den Born (MNP); HK = Henk Kramer (Alterra); IvdW = Isabel van den Wyngaert (Alterra); PK = Peter Kuikman (Alterra); WdG = Willy de Groot (Altera))



Integratie & Consistentie controles

Na het beschikbaar komen van de cijfers worden een aantal controles uitgevoerd op de dataset voor deze gebruikt wordt voor submissie. In deze paragraaf worden de uit te voeren controles beschreven en de resultaten van dat jaar samengevat in een tabel

Controles op data

Tabel 5: Lijst van kwaliteitscontroles na berekening van de emissies voor de sector LULUCF

Controle	Uitgevoerd	Resultaat	Acties

Voorgestelde controles: zie annex

Submissie

Hier wordt het traject beschreven, met controlemomenten en verantwoordelijken, dat de uiteindelijke cijfers volgen na berekening en controle tot de officiële submissie naar de UNFCCC (en Kyoto ?). De jaarspecifieke resultaten van de controlemomenten worden samengevat in een tabel aan het einde.

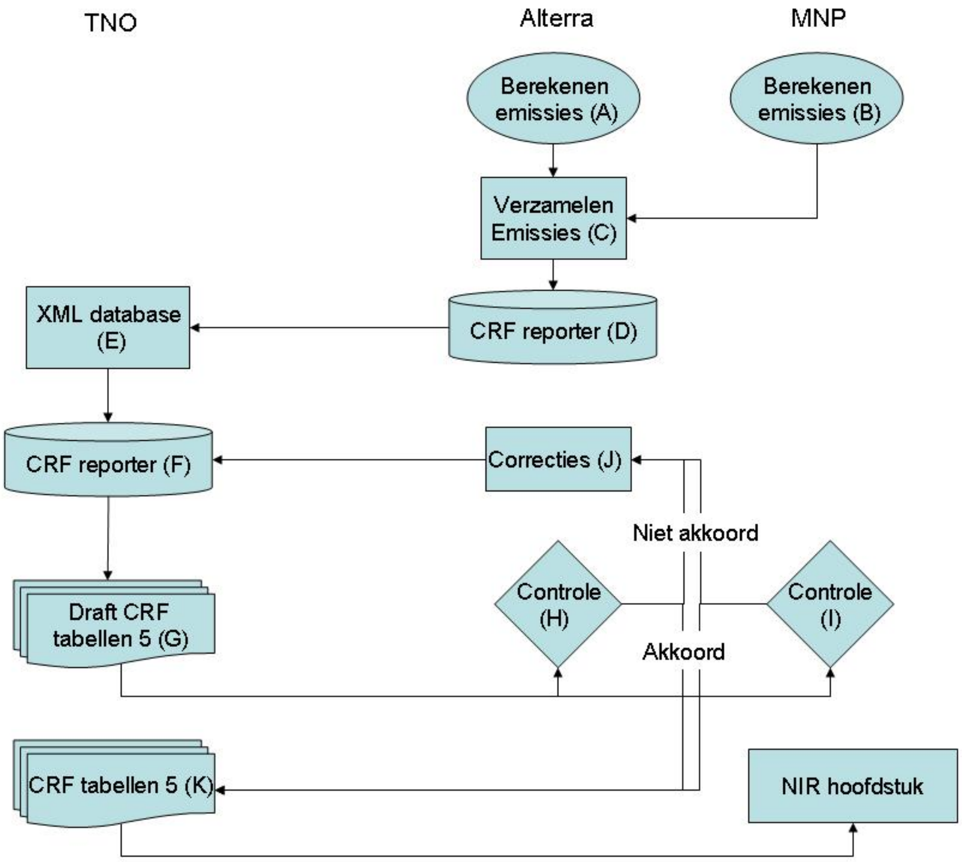
Traject Submissie 2008

De te rapporteren variabelen worden door Isabel van den Wyngaert (Alterra) ingevoerd in een kopie van de CRF reporter, de softwaretool die de officiële levering van de CRF aan de UNFCC voorbereidt (Figuur 2, A t/m D).. Als de LULUCF sector volledig ingevuld is, wordt een voorlopige CRF gegenereerd en gecontroleerd door Isabel van den Wyngaert (Alterra). Bij accoord wordt een XML-file met de LULUCF-gegevens gegenereerd en naar Peter Coenen (TNO) en Jack Pesik (TNO) gestuurd (Figuur 2, D t/m F).
Vervolgens worden de draft CRF tabellen voor LULUCF uit de CRF reporter gegenereerd door Jack Pesik (TNO) en door Peter Coenen (TNO) naar Isabel van den Wyngaert (Alterra) en Gert-Jan van den Born (MNP) gezonden ter controle (Figuur 2, G t/m I).
Isabel van den Wyngaert (Alterra) stuurt het spreadsheet vervolgens door naar de desbetreffende verantwoordelijken, Gert-Jan Nabuurs (Alterra) voor landgebruiksklasse A (Bos) en Peter Kuikman (Alterra) voor landgebruiksklassen B t/m F (Akkerland, Grasland, Wetland, Bebouwing & Ander land). Zij controleren of de getallen die zij aangeleverd hebben op een juiste manier in de CRF terecht gekomen zijn en rapporteren terug aan Isabel van den Wyngaert (Alterra) die vervolgens Peter Coenen (TNO) inlicht.
Gert-Jan van den Born controleert onafhankelijk van Alterra of de getallen goed terecht gekomen zijn in de CRF tabellen.
Hiermee wordt dus niet de correctheid van de berekeningen getoetst, maar wel de bewerkingen tussen aanleveren van de getallen en de officiële submissie.

Peter Coenen en Jack Pesik (TNO) genereren de herziene CRF tabellen (Schema 2, H t/m J). Deze controle-loop wordt doorlopen tot de juiste data in de CRF tabellen staan. Dit wordt verstuurd naar Wim van der Maas (MNP) die de definitieve submissie naar de UNFCCC doet (Figuur 2, K).

Op basis van die CRF en de methode- en achtergrondrapporten schrijft Gert-Jan van den Born (MNP) het hoofdstuk voor het National Inventory Report (NIR). Dit wordt voor publicatie nog gelezen door Isabel van den Wyngaert (Alterra).

Figuur 2: datastroom van berekende emissiegetallen naar officiële rapportage



Annex G: Description of inherited emissions in NIR UK and NIR Portugal

NIR United Kingdom 2007 (version 13 april 2007)

For forest biomass there is no mentioning of the inherited emissions in forest biomass since 1970. Only mentioning of activities from before 1970 is about taking into account present age class distributions that are determined by planting since 1920. But this concerns simply age effects of the present age class distribution, and determines present net flux. This is comparable to what is done in the Dutch national system [12].

There is only mentioning of inherited emissions with regard to soil C: Quote p 158:

Section 7.3.2. related to methodological issues related to soil C changes in cropland

The method for assessing changes in soil carbon stock due to land use change links a matrix of change from land surveys to a dynamic model of carbon stock change. Matrices from the Monitoring Landscape Change project for 1947 and 1980 and the ITE/CEH Countryside Surveys of 1984, 1990 and 1998 are used. Land use in the UK was placed into 4 broad groups – Forestland, Grassland, Cropland, and Settlements by combining the more detailed categories for the two surveys. Area change data exist for the period up to 1998 and those from 1990 to 1998 are used to extrapolate to the years 1999 to 2005. A fourth CEH Countryside Survey is due to take place during 2007, which should allow the matrices to be updated in 2008/2009.

'In Northern Ireland, less data are available to build matrices of land use change, but for 1990 to 1998 a matrix for the whole of Northern Ireland was available from the Northern Ireland Countryside Survey (Cooper & McCann 2002). The only data available pre-1990 for Northern Ireland is land use areas from The Agricultural Census and The Forest Service and processed by Cruickshank & Tomlinson (2000). Matrices of land use change had then to be estimated for 1970-80 and 1980-90 using area data. The basis of the method devised was to assume that the relationship between the matrix of land use transitions for 1990 to 1998 and the area data for 1990 is the same as the relationship between the matrix and area data for each of two earlier periods – 1970-79 and 1980-89. The matrices developed by this approach were used to extrapolate areas of land use transition back to 1950 to match the start year in the rest of the UK.' This is then used in soil carbon changes due to LUC. From Annex 3.7:

Table A 10.13.1 Weighted average change in equilibrium soil carbon density (kg m^{-2}) to 1 m deep for changes between different land types in England

From **To**	**Forestland**	**Grassland**	**Cropland**	**Settlements**
Forestland	0	25	32	83
Grassland	-21	0	23	79
Cropland	-31	-23	0	52
Settlements	-87	-76	-54	0

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[12] Note that the British system uses only one very simple growth function for all its forests. This is a very rough simplification

End Quote.
Thus in the UK NIR a back calculation of land use was made in order to arrive at land use in 1950. These land use areas were used to derive the equilibrium soil C per land use in 1990.

NIR Portugal (version 13 april 2007)

Concerning the forest biomass carbon balance, there is no mentioning of the year 1970. Forest biomass balance for a specific year is calculated based on annual growth rates of certain forest types in that year minus losses from e.g fellings and forest fires. In case of land use changes only losses of litter layer are taken into account in case of deforestation. In case of afforestation no litter layer increase is assumed.

For the land use change the Corine map overlays were made covering reference years 1986 and 2000. For soil C changes resulting from land uses that stay the same, or resulting from land use changes, simple IPCC GPG defaults are used.

Annex H. Notification of adjustment and calculation of adjusted assigned amount

Party: the Netherlands

Sector, category, sub-category (with code)	Gas	KC (e.g. L,T)/ non-KC	Identified inventory problem in terms of:		
			Missing estimate	**Estimate provided but not in line with GPG**	**Estimate provided but lack of transparency**
5B.2.1 / 5C.2.1 / 5D.2.1 / 5E.2.1 / 5F.2.1	CO_2	Not estimated	X	X	

Description of problem identified:

The estimates of net carbon stock changes of the categories relating to forest land converted to different land uses (cropland, settlement, grassland, wetland, other land) are affected by two main problems related to the measurement and reporting of the activity data:

- Incoherence between some elements in the methodologies of map classification (e.g. definition of land categories) applied for the 1990 and the 2000 maps, which resulted in an inconsistency of the land-use change matrix data;
- The absence of a time series of deforested areas from 1971, which resulted in non-estimation of carbon stock changes in these areas for the base year.

The incoherence between methodologies caused high overestimation of changes in land uses throughout the classes and, consequently, of the area deforested. Also, the non-reporting of inherited areas (the areas deforested from 1971 to 1989) has an effect in overestimating net emissions since carbon stock changes due to the vegetation regrowth (or still in place after the use change) have not been considered.

Recommendation by ERT:

Considering the short time available to the Party to prepare a comprehensive revision of the whole estimate, the ERT suggests the following:

- Reconstructing the time series of deforested areas from 1971 by a linear extrapolation of the values from 1990 back to 1971;
- Discounting the area reported under the categories relating to forest land converted to different land uses (cropland, settlement, grassland, wetland, other land) on the basis of additional conservative assumptions;
- Using the National Forest Inventory (NFI) data for carbon stock changes in living biomass;
- Using the data on litter that has been collected in 1990, in order to report carbon stock changes in this pool as a consequence of tree coverage loss, if any.

Finally, the ERT is in agreement with the application, for this recalculation only, of the assumption made by the Party that *for soil carbon stock changes after land use change it is assumed that the average carbon stock in the soil under the new and old land use are the same (Groot et al, 2005)*, since it makes the deforestation estimates more conservative.

Response / Information by Party:

In response to this notification of a potential problem, the Netherlands provided, within the required six-week period, a revision of its estimate and additional information. The revised estimate for net CO_2 emissions from deforestation (used for the calculation of the assigned amount) was 487.562 Gg CO_2, whereas the original estimate, used by the Netherlands in the calculation of the assigned amount in the initial report, was 280.212 Gg CO_2. The additional information provided by the Netherlands together with the estimate consisted of two documents: “Final response to ERT 1_6_07.doc” and “Netherlands reaction to the ERT 01062007.doc”. In response to additional queries from the ERT, the Netherlands also submitted further clarification and information, such as “070612 additional information on calculating and reporting deforestation.doc” (email of 14 June 2007), “Additional information for the ERT related to LULUCF.doc” (email of 14 June 2007), “Response last email sandro version 290607.doc” (email of 29 June 2007), “Country report FRA 2005 (Version 26-01-2005)1.doc” (email of 3 July 2007), “Answer part reaction to sandro comment to response 030707.doc” (email of 3 July 2007) and “Additional information on specific LULUCF elements 3 july.doc” (email of 3 July 2007).

Adjustment applicable? Rationale:

Having reviewed the revised estimate and all the additional information provided, the ERT concluded that its recommendations to the Netherlands had not been followed sufficiently to bring the estimate into full compliance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. In particular, the following have not been done in the Netherlands’ revised estimate: (a) the time series of deforested areas from 1971 to 1990 has not been reconstructed and, consequently, inherited emissions/removals have not been accounted for; and (b) the very high uncertainty of deforested area estimate, due to the inconsistency of the land-use change matrix, has been not reduced by the inclusion of either additional assumptions or discount factors in the recalculation process. Moreover, the revised estimate shows an additional problem – the high EF for decrease in the living biomass pool. The ERT therefore decided to calculate and apply an adjustment.

A detailed description of the adjustment is provided in the attachment below. This description corresponds to the description provided in annex II of the initial review report (FCCC/IRR/2006/NLD).

Calculation of the adjustment

1. The ERT identified the need for one adjustment in the LULUCF sector for the base year, which is an adjustment for the estimate of net CO_2 emissions from deforestation. The following sections describe the adjustment in accordance with the requirements defined in the annex to decision 22/CMP.1.[13]

1. The original estimate

2. In its initial report, the Netherlands provided an estimate for net CO_2 emissions from deforestation of 280.212 Gg CO_2. On 1 June 2007, after the ERT's in-country visit, the Netherlands submitted a complete set of revised CRF tables and revised the value for net CO_2 emissions from deforestation from 280.212 Gg CO_2 to 487.562 Gg CO_2.

2. The underlying problem

3. In various documents provided with the inventory submission or during the review process, the Netherlands provided eight different values for net CO_2 emissions from deforestation in the base year:

Initial report under the Kyoto Protocol	280.212 Gg CO_2
CRF (table 5)	369.673 Gg CO_2
Revised CRF (sum of relevant values in tables 5.C and 5.F)	647.482 Gg CO_2
NIR (page 150)	125.000 Gg CO_2
Updated national system for LULUCF (table 2.2)	216.000 Gg CO_2
Updated national system for LULUCF (table 4.2)	–124.670 Gg CO_2
Final response to ERT, 1 June 2007 (page 16)	487.562 Gg CO_2
Final response to ERT, 1 June 2007, annex 1 (page 18)	400.330 Gg CO_2.

4. These estimates vary greatly even though the same methodology and data set were used for calculating all of them. Given this high variability of the values for what is essentially the same parameter, it was a challenge for the ERT to understand how the estimate was made and whether it was correct. Having analysed that methodology and the data set used, the ERT came to the conclusion that there are three problems in the Dutch calculation of net CO_2 emissions from deforestation*:* the inconsistency of the land-use change matrix data; a high EF for decrease in the living biomass pool; and the fact that the estimate is incomplete.

Inconsistency of the land-use change matrix data

5. The land-use change matrix has been built on the basis of two reconstructed maps which "still held methodological differences and differences based on colouring in the

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[13] See paragraph 83 in decision 22/CMP.1 (page 66 in FCCC/KP/CMP/2005/8/Add.3).

hard copy maps",[14] so that "some land use changes are more unlikely to take place, e.g., the 10,310 ha changing from forest to grassland, the 26,971 ha changing from settlement to grassland and the 4,125 ha changing from settlement to forest. These are conversions that are not likely to take place, and could be the result of small methodological differences in drawing the hard copy topographical maps or a shift of grid cells".[15] Thus, the ERT's view is that several problems affect the land-use change matrix calculation. The main problems, which all lead to land-use change being overestimated, are as follows.

(a) As reported by the Netherlands, "some methodological differences are carried through in the topographical maps between 1990 and 2000, e.g. yards and farmyards are delineated clearly and coloured differently from the neighbouring land use in the 2000 map. This was not the case in the 1990 map".[16] This means that differences in the definitions of the land-use categories and potential differences in land classification methodologies have been found between the 1990 and 2000 maps; in practice, the same land element has been classified under two different categories from the 1990 to the 2000 maps without any change in the land use (and land cover) having actually occurred;

(b) The hard copies of the 1990 maps were digitalized and, considering that the Dutch landscape is highly fragmented, it is very likely that problems due to registration[17] occurred when the land-use change matrix was calculated from an overlay of the digitalized topographical maps of 1990 and 2000, causing a high level of land-use change and a very fine pattern of land-use changes. The Netherlands' land-use change matrix does in fact show the symptoms of a registration problem because:

  (i) "642,000 ha have changed in land use between 1990 and 2000; which is the 15 per cent of the land!";[18]

  (ii) The value of deforestation (and each other land-use change subcategory) "seemed high, as other types of previous information indicated deforestation areas in the range of 500 ha/year (personal communication with Mr. Van Tol) … and … a very fine pattern of single grid cell deforestation seemed to occur (fig. 2.1)".[19]

(c) "The basis for the 1990 grid map was a 1 : 25,000 map, the basis for the 2000 grid map was a 1 : 10,000 map … When applying re-gridding on these polygon-based maps, small errors may occur";[20]

(d) Finally, further confusion rises from the fact that the Netherlands has included in the forest land category three different subcategories – one

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[14] Alterra Report 1035.1, page 17.

[15] Alterra Report 1035.1, page 42.

[16] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 13.

[17] Registration is the process of superposing two or more images or photographs so that equivalent geographic points coincide: see <http://rst.gsfc.nasa.gov/AppD/glossary.html>.

[18] Alterra Report no. 1035.1, page 32.

[19] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 12.

[20] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 13.

> corresponding to forest according to the country's definition of forest, and the other two "trees outside forest" and "heather/peat and other nature terrains" which had to be reported under other land-use categories and have been reported here because they contain some wooden vegetation.

6. In order to correct the land-use change estimates provided by the matrix, the Netherlands carried out two exercises. The first tried to validate the year 2000 maps by overlaying the grid cells with the ground sample points of the NFI. The results showed that "out of the 1723 visited forest inventory plots, the 2000 map was corrected in 84 per cent".[21] The second (in April 2005) tried to validate the land-use change matrix as follows: "two areas for field validation were selected … both measuring some 10x10 km … From the situation in the field it was decided whether a land use change had actually occurred, or whether a land use change did not seem plausible over the past 15 years (2005–1990)".[22] The analysis was done at plot level (each single plot where a changed was detected by the matrix was visited in the field) and the "correctness percentages between the cases varied only slightly (between 41 and 47 per cent, average 44 per cent). Correctness for either forest according to definition and trees outside the forest were also very comparable".[23] This exercise was not carried out on a statistically sound basis because a sampling design was not implemented and it did not produce representative data for the whole land area of the country.

7. Overall, as noted by the Netherlands, a "validation against other independent data sources (e.g. land use maps derived for the Netherlands from remote sensing) was not carried out. … The Netherlands have assumed that the topographical maps as such represent the truth … topographical maps may serve as a good source of data for land use type estimation however, the maps themselves are already a product of generalization of the original background data and may thus contain a mapping error. It would be interesting to assess this error and use it error calculus in the NIR. Digitalization, classification and aggregation will introduce their own method related errors. The errors may be used to determine the minimal area of land use change event, which may be estimated with the known significance level".[24] Finally, the ERT noted that the correctness of the 1990 digital map has been not validated. In practice, all the Netherlands' attempts at validation checked whether a pixel/plot was without forest in either 2000 or 2005 but did not check whether that pixel/plot was really forested in 1990. All this (i.e., problems outlined in paragraphs 5, 6 and 7) means that net CO_2 emissions from deforestation must have been overestimated.

A high EF for the decrease in the living biomass pool

8. In the resubmitted CRF tables the Netherlands applied an EF for decreases in the living biomass pool that was higher than that in the original 2006 submission. The new value is consistent with the value reported on page 144 of the NIR but is not consistent with the data reported by the Netherlands to the FAO for the Global FRA 2005.[25] On

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[21] Alterra Report no. 1035.1, page 43.

[22] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 12.

[23] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 13.

[24] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 13.

[25] *Global Forest Resource Assessment 2005, Netherlands*, Country Report 028, Rome, 2004; table T7, page 24.

page 21 of Alterra Report 1035.1 the Netherlands reported that “HOSP[26] plot level data (2007 plots ~ 400 plots per year) for growing stock volume, increment, age, tree species, height, tree number and dead wood were used for 1990 situation. Forward calculation with these data was applied to the year 1999”; moreover, the ERT found the HOSP data in the Bosdata report entitled *Aspecten van bos en bosbeheer in Nederland: Resultaten Houtoogststatistiek 1995–1999”*.[27] The ERT was therefore able to recalculate the EF in an appropriate way, taking into consideration additional information provided by the Netherlands on the nature of the forest areas (i.e., parks, shrubs, bushes, coppices, harvested areas and very young plantations)[28] that are excluded from the HOSP but included in the CRF. The conclusion was that net CO_2 emissions from deforestation have been overestimated.

Incompleteness of the estimate

9. The time series from 1971 for each land-use change has not been reconstructed, although the Party agreed a 20-year period for stabilization of carbon stocks after conversion of land use. In practice, the Party has reported for 1990 the net emissions produced in the area deforested in 1990 only, while the correct application of the 20-year period requires the calculation of the 1990 net emissions produced on the whole area deforested from 1971 to 1990. Net CO_2 emissions from deforestation have therefore been overestimated, since so-called inherited removals have not been accounted for.

10. To summarize, the estimate of net CO_2 emissions from deforestation made by the Netherlands deviates from the IPCC good practice guidance and the IPCC good practice guidance for LULUCF because of (a) the overestimation of activity data that have been derived from an inconsistent land-use change matrix; (b) the failure to account for inherited net emissions (i.e., net emissions occurring in the 1990 on the areas deforested in the previous 19 years, from 1971 to 1989); and (c) the inconsistent value of the EF for decreases of carbon stock in the living biomass pool. All these factors have led to CO_2 net emissions from deforestation being overestimated.

3. The rationale for the adjustment

11. At the end of the in-country visit, the ERT informed the Netherlands that there was a potential problem in the estimate of net CO_2 emissions from deforestation. The ERT formulated the problem as follows*:* “The estimates of net carbon stock changes of the categories relating to forest land converted to different land uses (cropland, settlement, grassland, wetland, other land) are affected by two main problems related to the measurement and reporting of the activity data: incoherence between some elements in the methodologies of map classification (e.g. definition of land categories) applied for the 1990 and the 2000 maps, which resulted in an inconsistency of the land-use change matrix data; absence of a time series of deforested areas from 1971, which resulted in non-estimation of carbon stock changes in these areas for the base year”.

12. Considering the shortness of the time available to prepare a comprehensive revision of the whole estimate, the ERT suggested that the Netherlands address the problem in the following manner:

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[26] HOSP = Timber Production Statistics and Forecast (in Dutch: “Hout Oogst Statistiek en Prognose oogstbaar hout”).

[27] HOSP, Bosdata nr 4, 2000.

[28] From “ response_last_email_sandro_version_290607.doc”

(a) Reconstructing the time series of deforested areas from 1971 by a linear extrapolation of the values from 1990 back to 1971;

(b) Discounting the area reported under the categories relating to forest land converted to different land uses (cropland, settlements, grassland, wetlands, other land) on the basis of additional, conservative assumptions;

(c) Using the NFI data for carbon stock changes in living biomass;

(d) Using the data on litter that have been collected in 1990 in order to report carbon stock changes in this pool as a consequence of deforestation.

13. In response to this notification of a potential problem, the Netherlands provided, within the required six-week period, a revision of its estimate and additional information. The revised estimate for net CO_2 emissions from deforestation (used for the calculation of the assigned amount) was 487.562 Gg CO_2, whereas the original estimate, used by the Netherlands in the calculation of the assigned amount in the initial report, was 280.212 Gg CO_2. The additional information provided by the Netherlands together with the estimate consisted of two documents: “Final response to ERT 1_6_07.doc” and “Netherlands reaction to the ERT 01062007.doc”. In response to additional queries from the ERT, the Netherlands also submitted further clarification and information, such as “070612 additional information on calculating and reporting deforestation.doc” (email of 14 June 2007), “Additional information for the ERT related to LULUCF.doc” (email of 14 June 2007), “Response last email sandro version 290607.doc” (email of 29 June 2007), “Country report FRA 2005 (Version 26-01-2005)1.doc” (email of 3 July 2007), “Answer part reaction to sandro comment to response 030707.doc” (email of 3 July 2007) and “Additional information on specific LULUCF elements 3 july.doc” (email of 3 July 2007).

14. Having reviewed the revised estimate and all the additional information provided, the ERT concluded that its recommendations to the Netherlands had not been followed sufficiently to bring the estimate into full compliance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. In particular, the following have not been done in the Netherlands’ revised estimate: (a) the time series of deforested areas from 1971 to 1990 has not been reconstructed and, consequently, inherited emissions/removals have not been accounted for; and (b) the very high uncertainty of deforested area estimate, due to the inconsistency of the land-use change matrix, has been not reduced by the inclusion of either additional assumptions or discount factors in the recalculation process. Moreover, the revised estimate shows an additional problem – the high EF for decrease in the living biomass pool. The ERT therefore decided to calculate and apply an adjustment.

4. The assumptions, data and methodology used to calculate the adjustment

15. Since the estimate of net CO_2 emissions from deforestation is a sum of many LULUCF subcategories, the ERT decided that the adjusted estimate for CO_2 net emissions should be provided at the level of the category forest land converted to other land-use categories, as reported in CRF table 5 (column B, row 30). Since data are available to make it possibly to apply the default IPCC tier 1 method, and this method is the first one in the hierarchical order reported in table 1 of the annex to decision 20/CMP.1, the ERT decided to apply the default IPCC tier 1 method.

16. The adjustment is complex because several parameters (sources and sinks under different categories), not just one, need to be changed. The changed parameters should then be aggregated in order to arrive at an adjusted estimate for total net CO_2 emissions from deforestation. The adjustment is presented below in three steps.

Step 1: recalculation of the activity data

17. Together with the revised estimates submitted on 1 June 2007 in response to ERT's questions, the Netherlands also submitted a whole set of revised CRF tables. In these tables net CO_2 emissions from deforestation had increased, compared with the original 2006 inventory submission, from 369.673 Gg CO_2 to 647.482 Gg CO_2, because the parameters applied changed from the 2006 submission to the revised estimates. The activity data – the total deforested area – changed from 1.400 kha to 2.042 kha. Since this represents such a large change, the ERT asked the Netherlands to provide technical documentation describing the correction procedure for the land-use change matrix in detail. The ERT received only a general document in which this procedure is briefly described, without the specific detailed information required. The ERT therefore still considers that the problem of inconsistency of the land-use change matrix has not been solved and that the revised estimate of deforested area is not acceptable since it is not in line with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

18. The only alternative source of data that the ERT found on gross deforestation in Netherlands is an expert judgement on total aggregated deforested area that is reported in the Dutch official document entitled *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*. The ERT considered this document to be a more reliable source of data and therefore used it extensively in the calculation of this adjustment. The assumptions and data used to calculate the adjustment are listed here, taking into consideration that all the assumptions are made on a conservative basis and that all the data applied have been provided by the Netherlands in *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector* and other appropriate official documents.

19. Because of the absence of alternative data sources, the ERT adopted the distribution of deforested areas among different final land uses which is reported in the Netherlands' land-use change matrix (see table II.1).[29]

Table II.1. Distribution of deforested areas by different final uses, 1990–2000

Final land use	Area, ha	Share, %
Grassland	10 309.94	36.60
Cropland	1 273.69	4.52
Heather and other nature terrains	2 897.50	10.28
Settlement and roads	9 012.63	31.99
Water	945.50	3.36
Sand/dunes	603.63	2.14
Trees outside forest	3 130.19	11.11
Total	**28 173.06**	**100.00**

20. The ERT noted that "water" and "sand/dunes" are reported in the Netherlands' GHG inventory under the category other land. The ERT further noted that "heather and other

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[29] *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*, page 13.

nature terrains" and "trees outside forest" are erroneously reported under the category forest land. They should not be, since the Netherlands declared that neither matches the country's definition of forest; therefore, to ensure conservativeness for the adjustment calculation, the ERT considered these two types of land to be part of a virtual additional land-use category – 5.A*bis* – which does not belong to the category forest land although the same rules are applied.

21. Using the distribution shown in table II.1, the ERT reconstructed the time series of deforested areas from 1971 to 1990 by a linear extrapolation of the values calculated for the period 1990–2000 back to 1971 (see table II.2). Since no data are available, no further use changes on deforested land were assumed to occur, even if this is not a conservative assumption.

22. Average annual area deforested is therefore 500 ha/year. This is the value reported on page 12 of the official document *Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*. This represents 0.14 per cent of the Netherlands forest area in 1990 and is comparable to the German gross deforestation rate, which is 0.13 per cent[30] (Germany is the only country in the region that reports a complete set of deforested areas in the year 1990). Moreover, the value selected is consistent with the value (494 ha/year) calculated by the ERT on the basis of data reported in Summary table I on page 18 of the Bosdata report entitled *Aspecten van bos en bosbeheer in Nederland: Resultaten Houtoogststatistiek 1995–1999*.[31]

23. After the in-country visit, the Netherlands revised the data related to only one of the two test areas, collected during the field exercise of April 2005. In its final response to the ERT's questions, the Netherlands stated that "the re-assessment was made at the pixel level (25 by 25 m) rather than at the plot or parcel level as was done in the previous validation. The re-assessment has shown that the deforestation of area forest under the Kyoto Protocol definition was 61.4 per cent of the observed changes … Thus the correctness percentages are about 20 per cent higher if corrected for surface".[32] As mentioned above, this exercise was not done on a statistically sound basis (i.e., the exercise did not produce representative data for the whole land area; and a sampling design has not been implemented). Moreover, during the in-country visit, the national experts explained how the April 2005 field exercise was conducted, and the ERT in its presentation raised two problems: (a) a non-systematic error that occurred in the localization of the pixel on the field (it is very difficult and time-consuming to localize in the field one by one the square pixels of a digitalized map); and (b) a systematic error due to the fact that the reclassification of the pixels on the field has been done on the basis of the presence of at least 50 per cent tree cover, while the Netherlands' definition sets the minimum coverage as 20 per cent. The ERT therefore could not agree to the view that the data reported by the Netherlands in the revised CRF tables are of better quality than those of the 2006 submission.

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[30] <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/x-zip-compressed/deu_2007_crf_2may.zip>.

[31] HOSP, Bosdata nr 4, 2000.

[32] "Final response to ERT 1_6_07".

Table II.2. Distribution of the area to be reported as deforested in 1990 among different final uses

Area to be reported as deforested in 1990, ha

	Final land use category							
	5.B	**5.C**	**5.E**	**5.F**		**(5.G) - 5.A*bis***		**Total**
Year of deforestation	Cropland	Grassland	Settlement	Water	Sand/ dunes	Trees outside forest	Heather	
	Ha							
1971	22.60	182.98	159.95	16.78	10.71	55.55	51.42	500.00
1972	22.60	182.98	159.95	16.78	10.71	55.55	51.42	500.00
…*	…	…	…	…	…	…	…	…
1989	22.60	182.98	159.95	16.78	10.71	55.55	51.42	500.00
1990	22.60	182.98	159.95	16.78	10.71	55.55	51.42	500.00
Total	**452.09**	**3 659.50**	**3 199.02**	**335.6**	**214.26**	**1 111.06**	**1 028.46**	**10 000.00**
Total area deforested in 1990								**10 000.00**

* The same values, as shown for 1971, 1972, 1989, 1990, are used for all years from 1971 to 1990.

Step 2: recalculation of the EF for decreases in living biomass

24. In its submission of revised estimates after the in-country visit the Netherlands changed the EF value from –55.79 Mg ha^{-1} in the original 2006 submission to –70.99 Mg ha^{-1} in the revised estimates. Since this is a very large change, the ERT asked the Netherlands to explain the reason for it and how the old and the new EFs were calculated. The Netherlands explained in two documents – entitled "Additional information on the calculation process of specific LULUCF elements" and "Additional information on specific LULUCF elements, 3 July 2007" – (a) that the lower EF was the result of a calculation error, while the higher is the appropriate one, and (b) that the inconsistency with the FAO data is due to the fact that the FRA 2005 data were taken from an old version of the Netherlands report, while the data reported in an updated version (which was submitted to the ERT), entitled *Global Forest Resources Assessment Update 2005: The Netherlands Country Report* (Wageningen, 26–01–2005), are close to the reported new EF. The ERT did not consider the updated version of the report to the FAO FRA 2005 to be an official document of the Netherlands; nor did it contain the official, updated estimates of the FAO FRA 2005. Moreover, although the ERT agreed that the old and lower value of the EF was the result of a calculation error, it did not consider the new one to be correctly calculated, because it contains the questionable assumption that marginal forest areas (which are excluded from the 1990 NFI – the HOSP - but included in the national inventory report to the UNFCCC) have the same average carbon stock in the living biomass pool as high forest stands. The ERT judged this assumption to be incorrect because the Netherlands declared that those marginal areas consist of parks, shrubs, bushes, coppices, harvested areas and very young plantations, which in practice have no or only limited living biomass stock.

25. To support the adjustment, the ERT recalculated the EF on the basis of data collected from the Bosdata report entitled *Aspecten van bos en bosbeheer in Nederland: Resultaten Houtoogststatistiek 1995–1999* and from the document sent to the ERT by the Netherlands, entitled "Additional information on the calculation process of specific LULUCF elements".[33] The assumptions and data used to calculate the adjustment are listed below. It should be noted that all the assumptions are made on a conservative basis

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[33] From Response_last_email_sandro_version_290607.doc.

and all the data applied have been provided by the Netherlands in its official documents, as follows.

(a) Average growing stock per hectare of forest included in the NFI (1988–1992): 172 m^3 – from summary table I on page 18 of *Aspecten van bos en bosbeheer in Nederland: Resultaten Houtoogststatistiek 1995–1999*;

(b) Basic wood density: 0.45 – from “Additional information on the calculation process of specific LULUCF elements”;

(c) Average carbon density: 0.5 – from “Additional information on the calculation process of specific LULUCF elements”;

(d) Biomass expansion factor (from stem to whole tree): 1.66 – from “Additional information on the calculation process of specific LULUCF elements”;

(e) To the marginal areas – that is, 79,794 ha of forest area, which is the difference between the HOSP data (281,106 ha) and the CRF data (360,900 ha) – half of the average carbon stock of the forest area sampled in the HOSP has been assigned since these areas include areas with stock similar to high stands (parks) and areas without any biomass stock (areas “harvested between plot assignment and the actual field measurements”).

26. On this basis, the ERT calculated that the EF for any kind of conversion from forest to other uses – with the exception of conversion from forest to “trees outside forest”, where the change in land use does not affect the carbon stocks (i.e., the trees are still there even if they are grouped in smaller patches) – is equal to 57.14 Mg C/ha, as illustrated in table II.3.

Table II.3. Calculation of the EF for decreases in carbon stock in the living biomass pool

Parameter	Value	Unit
Average growing stock in HOSP areas	172	$m^3\ ha^{-1}$
Biomass expansion factor (from stem to whole tree)	1.66	
Basic wood density	0.45	
Average carbon density	0.5	
Average living biomass carbon stock in the HOSP areas	64.24	$MgC\ ha^{-1}$
Average living biomass carbon stock in the non-HOSP areas	32.12	$MgC\ ha^{-1}$
Average living biomass carbon stock in the whole area	57.14	$MgC\ ha^{-1}$

27. The ERT noted that the value thus calculated is consistent with the data submitted in the document Global Forest Resources Assessment 2005*:* Netherlands Country Report, in *Global Forest Resources Assessment 2005, Country Report 028* (Rome, 2004), where the following data were reported for the year 1990: “carbon in living biomass” = 20 Mt C (table T7), and “total forest area” = 345 kha (table T1), for which the resulting calculation shows 20 Mt C/345 kha = 57.97 Mg C ha^{-1}. Applying the recalculated EF, the ERT then recalculated the emissions due to living biomass carbon stock decreases, as shown in table II.4.

Table II.4. Calculation of decreases in living biomass carbon stock subdivided among different final land uses

Living biomass decrease in areas reported as deforested in 1990								
	Final land use category, ha							
	5.B	5.C	5.E	5.F		(5.G) - 5.A*bis*		Total
Year of deforestation	Cropland	Grassland	Settlement	Water	Sand/ dunes	Trees outside forest	Heather	
1990	–1.29	–10.46	–9.14	–0.96	–0.61	0.00	–2.94	–25.40
Total	**–1.29**	**–10.46**	**–9.14**	**–0.96**	**–0.61**	**0.00**	**–2.94**	**–25.40**
Living biomass decrease in 1990								**–25.40**

28. After the ERT had notified the Netherlands about the inconsistency of the reported value of the EF (with the data reported to the FAO and the data of its (HOSP) National Forest Inventory for the year 1990), it received the following comment in a document entitled “Additional Information on Specific LULUCF Elements, 3 July 2007”: “The reaction from the ERT expert for LULUCF on the value of calculation of the value of –70.99 Mg ha^{-1} referring to HOSP is an example of the misunderstanding that can occur when one does not use the best available combination of source. We use a combination of HOSP and MFV data to calculate this value, so only using HOSP data has to show not the same value. Our calculation method is documented in detail in the report National System of Greenhouse Gas Reporting for Forest and Nature Areas under UNFCCC in the Netherlands, Alterra-report 1035.1, 2005, starting on page 23 with ‘Following calculations are carried out to derive the annual carbon balance from the HOSP and MFV data and to forward calculate the balance’”. However, the ERT noted on page 21 of Alterra Report 1035.1 that “HOSP plot level data (2007 plots ~ 400 plots per year) for growing stock volume, increment, age, tree species, height, tree number and dead wood were used for 1990 situation. Forward calculation with these data was applied to the year 1999”. The ERT therefore considers the EF calculation based on the HOSP data to be appropriate and consistent.

Step 3: recalculation of inherited net emissions

29. The Netherlands has not reported inherited net emissions in either the original or the revised estimates, justifying this in annex 2 to the file named “final response to ERT 1_6_07.doc”, entitled “Effect of ageing prior to 1990 on carbon dynamics in forests and reconstructing time series of deforestation back to 1970”. The ERT considered this comment as being out of the context, and asked for justification once again, to which the Netherlands experts responded by recalling paragraph 5(b) of the annex to decision 13/CMP.1 which, in their interpretation, excludes inherited net emissions from the accounting. The ERT does not agree to this interpretation of decision 13/CMP.1 because net CO_2 emissions from deforestation in the base year are to be estimated, as in any other year, following the rules set out in the IPCC good practice guidance for LULUCF, which clearly states the need for reporting of net emissions occurring on deforested areas (i.e., areas where a land-use change is occurred) for a default period of 20 years.

30. To complete the adjusted estimate, the ERT calculated the inherited net emissions using the biomass data reported by the Netherlands in CRF table 5.A and the soil data reported by the Netherlands in appendix 1 to the “Protocol 5_CO_2_land_use_categories_2006” (for soil, the ERT did not use the data reported in the

CRF because these data are not differentiated on the basis of the final land use and are not related to the reported activity data, that is, the IEF is not calculated).

31. For data on litter losses it should be noted that the Netherlands responded to that ERT's suggestion that they should be included as follows: "The Netherlands has reported stocks of carbon in litter but no stock changes in forest remaining forest. For deforestation the Netherlands account for the loss of carbon stocks in litter".[34] Nevertheless, litter losses are not reported either in the 2006 CRF tables or in the revised CRF tables. Since national data on litter were not available to the ERT, and the exclusion of this pool from the estimate of net emissions from deforestation makes it conservative, the ERT did not include litter losses in its calculation of the adjusted estimate of net emissions from deforestation.

32. All the assumptions and data used and resulting from steps 1 and 2 are used, and the additional assumptions and data are listed below. Again, all the assumptions made are made on a conservative basis and all the data applied have been provided by the Netherlands in its official documents.

(a) In accordance with the default IPCC tier 1 method, living biomass changes after conversion in deforested areas converted to categories 5.B, 5.C, 5.E and 5.F have been set equal to 0. On the other hand, to ensure conservativeness, living biomass changes after conversion in deforested areas converted to "trees outside forest" have been calculated since, as reported by the Netherlands, the living biomass stock increases in those areas;

(b) Living biomass carbon decreases for conversion from forest to "trees outside forest" has been set equal to 0 since, in this case, the change in land use does not affect the carbon stocks (i.e., the trees are still there even if they are grouped in smaller patches);

(c) Average increase in living biomass in "trees outside forest" areas[35] are 2.69 MgC ha^{-1} year^{-1} – from table 5.A (cell D12) of the Excel file named "NLD-2006-1990-v1.6";[36]

(d) Average soil carbon stock in forest is 79.95 MgC ha^{-1} – from appendix 1 to "Protocol 5_CO$_2$_land_use_categories_2006";

(e) Average soil carbon stock in cropland is 95.07 MgC ha^{-1} – from appendix 1 to "Protocol 5_CO$_2$_land_use_categories_2006";

(f) Average soil carbon stock in grassland is 111.82 MgC ha^{-1} – from appendix 1 to "Protocol 5_CO$_2$_land_use_categories_2006";

(g) Average soil carbon stock in settlements is 96.98 MgC ha^{-1} – from appendix 1 to "Protocol 5_CO$_2$_land_use_categories_2006";

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[34] From "Final response to ERT 1_6_07.doc", page 16.

[35] This annual increment shall be applied to areas that have been converted within the period 1971–1990 from forest (according to the Kyoto Protocol definition) to other land uses which still contain trees (i.e. trees outside forest).

[36] <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/x-zip-compressed/nld_2006_crf_18sep.zip>.

(h) Average soil carbon stock in either water or sand/dunes is 0 MgC ha^{-1} – from appendix 1 to “Protocol 5_CO_2_land_use_categories_2006”;

(i) Average soil carbon stock in trees outside forest is 101.65 MgC ha^{-1} – from appendix 1 to “Protocol 5_CO_2_land_use_categories_2006”;

(j) Average soil carbon stock in heather and nature terrain is 111.82 MgC ha^{-1} – from appendix 1 to “Protocol 5_CO_2_land_use_categories_2006”.

33. With these data the ERT calculated net emissions from soil, as shown in table II.5.

Table II.5. Net carbon stock changes in soil subdivided among different final land uses

Net carbon stock changes in soil in areas reported as deforested in 1990								
	Final land use category							
	5.B	**5.C**	**5.E**	**5.F**		**(5.G) –5.A*bis***		**Total**
Year of deforestation	Cropland	Grassland	Settlement	Water	Sand/ dunes	Trees outside forest	Heather	
	Gg C							
1971	0.02	0.29	0.14	–0.07	–0.04	0.06	0.00	0.40
1972	0.02	0.29	0.14	–0.07	–0.04	0.06	0.00	0.40
…*	…	…	…	…	…	…	…	…
1989	0.02	0.29	0.14	–0.07	–0.04	0.06	0.00	0.40
1990	0.02	0.29	0.14	–0.07	–0.04	0.06	0.00	0.40
Total	**0.34**	**5.83**	**2.72**	**–1.34**	**–0.86**	**1.21**	**0.05**	**7.95**
Net carbon stock changes in soil in 1990								**7.95**

* The same values, as shown for 1971, 1972, 1989, 1990, are used for all years from 1971 to 1990.

34. On the issue of net carbon stock changes in soil it should be noted that during the in-country visit the ERT disagreed with the Netherlands’ decision not to report changes in soil carbon stock related to changes in land use (see section II.B.8 on the LULUCF sector) since this is not in line with the IPCC good practice guidance for LULUCF. However, since the data on soil carbon stocks reported in the Excel file named “LUC Matrix Final and Defor and Afforest C Balance after Validation”[37] show very little differences between different land uses, and forest soils have the second-highest carbon content, the ERT agreed to apply, for this recalculation only, the assumption made by the Party that “for soil carbon stock changes after land use change it is assumed that the average carbon stock in the soil under the new and old land use are the same (Groot et al., 2005), since it makes the deforestation estimates more conservative”.[38]

35. Nevertheless, the Netherlands’ resubmitted estimate of net emissions from deforestation including carbon stock change in soil does not link soil carbon changes to a land area (see table 5.F); moreover, analysing data reported twice (in the table of appendix 1 to “Protocol 5_CO_2_land_use_categories_2006” and in table 9 of Alterra Report 1035-3) on carbon stocks in soils for the different land uses, the ERT found very different data from those reported in the Excel file named “LUC Matrix Final and Defor and Afforest C Balance after Validation”. Those data show that, on average, forest soils

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[37] The file was submitted to the ERT during the in-country visit.

[38] From the document “Overview of problems identified for the base year for the consideration of potential adjustments”.

contain less carbon stock that any other land-use category (with the exclusion of other land), which suggests that, on average, a forest conversion results in a net increase in carbon stocks. The ERT, therefore, following the default IPCC tier 1 method in the recalculation, to be conservative, estimated soil carbon stock changes due to forest conversion using data from the two above-mentioned tables; these data have been used not only on inherited areas (areas deforested from 1971 to 1989) but also for estimating soil carbon stock changes in area deforested in the 1990, since the data reported in CRF table 5.F were too aggregated to be useful for this recalculation. Accordingly, the ERT has calculated living biomass carbon stock increases as shown in table II.6.

Table II.6. Living biomass carbon stock increases subdivided among different final land uses

Living biomass increase in areas reported as deforested in 1990								
	Final land-use category							
	5.B	**5.C**	**5.E**	**5.F**		**(5.G) - 5.A*bis***		**Total**
Year of deforestation	Cropland	Grassland	Settlements	Water	Sand/dunes	Trees outside forest	Heather	
	Gg C							
1971	–	–	–	–	–	0.15	–	0.15
1972	–	–	–	–	–	0.15	–	0.15
…*	…	…	…	…	…	0.15	…	0.15
1989	–	–	–	–	–	0.15	–	0.15
1990	–	–	–	–	–	0.15	–	0.15
Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.99**	**0.00**	**2.99**
Living biomass increase in 1990								**2.99**

* The same values, as shown for 1971, 1972, 1989, 1990, are used for all years from 1971 to 1990.

5. The adjusted estimate

36. To summarize[39], the following parameters have been adjusted by the ERT in the course of the calculation of this adjustment:

deforested area: Party's estimate = 2,042 ha year^{-1}; adjusted estimate = 500 ha year^{-1}

emission factor for living biomass decrease: Party's estimate = -70.99 MgC ha^{-1}; adjusted estimate = -57.14 MgC ha^{-1}

37. These adjusted parameters have been combined to obtain the adjusted estimate as follows:

Total living biomass decrease in areas that have been deforested from 1971 to 1990 = [area deforested in 1990[40] (500 ha) – area changed from forest to trees outside forest in 1990 (55.55 ha)] * EF (-57.14 MgC ha^{-1}) = +93.118 Gg CO$_2$ (-25.40 Gg C)

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[39] The comparison is made among revised estimates submitted by the Netherlands after the in-country visit and estimates calculated by the ERT.

[40] Default IPCC tier 1 method does not account for changes in living biomass following the removal of tree coverage

Total net carbon stock change in soils in areas that have been deforested from 1971 to 1999 = $\sum_{fLUc}\left[\left(SOC_{iLU} - SOC_{fLU}\right)\bullet\sum_{1971}^{1990}A\right]/20$ where: ‘fLUc’ is the final land-use category, SOC_{iLU} is the soil organic carbon stock in the initial land use, SOC_{iLU} is the soil organic carbon stock in the final land use (both have been derived from appendix 1 to the “Protocol 5_CO_2_land_use_categories_2006”) and $\sum_{1971}^{1990}A$ is the sum of all the areas converted to a final land-use category (see table II.2); 20 is the number of years needed for soil to reach a new equilibrium when a land-use change occurs. The result of this calculation is = -29.168 Gg CO_2 (+7.95 Gg C)

Total living biomass increase in areas that have been converted from forest to ‘trees outside forest’ from 1971 to 1990 = sum of area deforested from 1971 to 1990 (1,111.06 ha) * EF (+2.69 MgC ha^{-1}) = -10.969 Gg CO_2 (+2.99 Gg C)

Adjusted net CO_2 emissions from deforestation = bullet (a) + bullet (b) + bullet (c) = +52.981 Gg CO_2; that multiplied per the conservativeness factor (0.73) results in +38.676 Gg CO_2

38. Table II.7 shows the main adjustment steps as well as the overall result of adjustment. The adjusted conservative estimate for net CO_2 emissions from deforestation amounts to 38.676 Gg CO_2, compared to 487.562 Gg CO_2 presented by the Netherlands as a revised estimate after the in-country visit (and to 280.212 Gg CO_2 used originally in the initial report for the calculation of the assigned amount).

Table II.7. Calculation of adjustment for net CO_2 emissions from deforestation

Parameter/estimate	Value	Unit	Source
Category: V. LULUCF			
Party estimate of CO_2 net emissions from deforestation	487.562	Gg CO_2	Party's submission of revised estimates after in-country visit
Party's activity data for deforestation	2,042	ha $year^{-1}$	Party's submission of revised estimates after in-country visit
Party's emission factor for losses in living biomass	–70.99	Mg C ha^{-1}	Party's submission of revised estimates after in-country visit
Applied activity data in adjustment	500	ha $year^{-1}$	*Updates of the Dutch National System for Greenhouse Gas Reporting of the LULUCF Sector*
Applied emission factor for losses in living biomass in adjustment	–57.14	Mg C ha^{-1}	Recalculated by the ERT on the basis of HOSP data (see table II.3)
Calculated estimate for CO_2 net emissions from deforestation	52.981	Gg CO_2	Recalculated by the ERT on the basis of Party's data and applying default IPCC Tier 1 method (see tables II.4, II.5 and II.6)
Conservativeness factor	0.73		Table 3.a of annex III of Technical Guidance for Adjustments attached to decision 20/CMP.1
Adjusted conservative estimate for CO_2 net emissions from deforestation	38.676	Gg CO_2	
Total aggregate GHG emissions in the base year (including deforestation) as reported by Party	213,483.384	Gg CO_2 eq.	Party's submission of revised estimates after in-country visit
Total aggregate GHG emissions in the base year (including deforestation) after application of adjustment	213,034.498	Gg CO_2 eq.	ERT's calculation
Difference between original and adjusted aggregate GHG total in the base year	448.886	Gg CO_2 eq.	ERT's calculation
	0.2	%	

6. Conservativeness of the ERT's calculation of the adjustment

39. As described above, some assumptions have been made in order to ensure that the recalculated estimate is conservative. The main assumptions relating to conservativeness are:

(a) The gross deforestation annual rate has been taken close (550 ha vs 494 ha) to the net deforestation annual rate as reported by the NFI;

(b) Removals from deforested area belonging to the "trees outside forest" subcategory have been accounted for;

(c) In reconstructing the time series the ERT assumed a constant rate of deforestation for the whole period 1971–1990, although the forest inventory data[41] show a higher rate of net deforestation for the period 1984–1990.

40. A conservativeness factor of 0.73 has been applied at the aggregate level for the determined total net CO_2 emissions from deforestation. The ERT therefore judges that the resulting adjusted value is very likely to be conservative. The conservativeness factor was selected from table 3.a of annex III of the technical guidance for adjustments attached to decision 20/CMP.1. Namely, the value of 0.73 is the value recommended by

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[41] *Aspecten van bos en bosbeheer in Nederland: Resultaten Houtoogststatistiek 1995–1999.* HOSP, Bosdata nr. 4, 2000.

the technical guidance for emission estimates by category “Land converted to grassland – carbon stock changes in living biomass”. This value has been selected because the loss of carbon due to conversion from forest to grassland is the most important source of emission from deforestation (see tables II.4, II.5 and II.6). Moreover, this value is the most conservative one.