

Deforestation under Kyoto Protocol

Documentation of implementation



October 2010

Imprint

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Version	Date	Author
1.0	01.10.2010	LM
2.0	08.10.2010	LM

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1 Preface

1.1 Purpose of document

Switzerland has to estimate the area of deforestation meeting the definition of the Kyoto Protocol Art. 3.3 (deforestation_{Kyoto}). Background information and methods have been compiled in FOEN (2010¹). This document describes the technical implementation of the method.

1.2 Glossary

AREA	Swiss Land Use Statistics of BFS (<i>dt.</i> Arealstatistik). Three inventories are available AREA1 (85), AREA2 (97), AREA3 (09)
AD	Activity data; calculated land cover and land use change based on AREA combination categories and reported yearly to UNFCCC
CC	Combination category (18 categories ²); land classification for use within LULUCF based on land cover and land use categories
GHG	Greenhouse gas
LC	Land cover categories (27 AREA categories)
LU	Land use categories (46 AREA categories)
LULUCF	Land Use, Land Use Change and Forestry
NIR	National inventory report
UNFCCC	United Nations Framework Convention on Climate Change

¹ FOEN (2010a). Deforestations in Switzerland as reported under the Kyoto Protocol Art. 3.3. Draft from September 6, 2010.

² FOEN (2007). Definition of combination categories (CC) for LULUCF reporting based on AREA land-use/land-cover categories. Internal document, version 2 as of 30.05.2007.

2 Methods

Implementing the estimation of deforestation relevant for Kyoto ($\text{deforestation}_{\text{Kyoto}}$) includes two methodological aspects: (1) implementing the Kyoto definition for deforestation and (2) reporting yearly estimates based on activity data (AD) from the GHG NIR.

2.1 Kyoto Deforestation

The definition of $\text{deforestation}_{\text{Kyoto}}$ has been documented in the Swiss context (FOEN 2010¹). The document shows that the estimates for deforestation derived from the activity data ($\text{deforestation}_{\text{AD}}$) is 2.1 times higher than the estimates reported by the Swiss Statistics of Deforestation (FOEN 2009³). Hence, estimated $\text{deforestation}_{\text{AD}}$ is larger than $\text{deforestation}_{\text{Kyoto}}$.

As a solution, a detailed exclusion process based on land cover (LC) and land use (LU) categories has been established to classify $\text{deforestation}_{\text{Kyoto}}$ out of all $\text{deforestations}_{\text{AD}}$ (FOEN 2010¹). This exclusion process is applicable for changes between two consecutive AREA inventories.

2.2 Yearly reporting

Reporting of estimates for $\text{deforestation}_{\text{Kyoto}}$ has to be performed on a yearly basis. Activity data including $\text{deforestation}_{\text{AD}}$ is available on a yearly basis (FOEN 2010⁴). But activity data is only based on combination categories (CC²), which are aggregated from the LC and LU categories relevant for the exclusion process of $\text{deforestation}_{\text{Kyoto}}$ (FOEN 2010¹). Hence, detailed information on LC and LU category necessary to classify $\text{deforestation}_{\text{Kyoto}}$ is not available on a yearly basis, but only for changes between consecutive AREA inventories.

As a solution, the fraction of $\text{deforestation}_{\text{Kyoto}}$ from $\text{deforestation}_{\text{AD}}$ is calculated for changes between the three consecutive AREA inventories, where all necessary information is available. In doing so, the fraction is estimated at the sample population level, and not at the single sample level. These estimates are then linearly interpolated to yearly fraction estimates. In this approach, a change is assigned to the year of the second inventory, when it is assumed that the change has been completed. In practice, changes are assigned to the year 1996 for changes between AREA1 and AREA2, and to 2008 for changes between AREA2 and AREA3. An interpolation of the fraction value $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ is thus only possible for the years between 1996 and 2008. The closest fraction is used for years before and after that time period.

³ FOEN (2009). Jahrbuch Wald und Holz 2009. Umwelt-Wissen Nr. 0925. [Annuaire La forêt et le bois 2009. Connaissance de l'environnement no 0925]. Federal Office for the Environment, Bern. [German and French]

⁴ FOEN (2010b). FOEN 2010: Switzerland's Greenhouse Gas Inventory 1990–2008: National Inventory. Submission of 15 April 2010 under the United Nations Framework Convention on Climate Change and under the Kyoto Protocol. Federal Office for the

3 Implementation

3.1 Kyoto Deforestation

Quantification of deforestation_{Kyoto} is performed in a stepwise manner as outlined in Abb. 1. The criteria to extract deforestation_{Kyoto} are documented in Tab. 1.

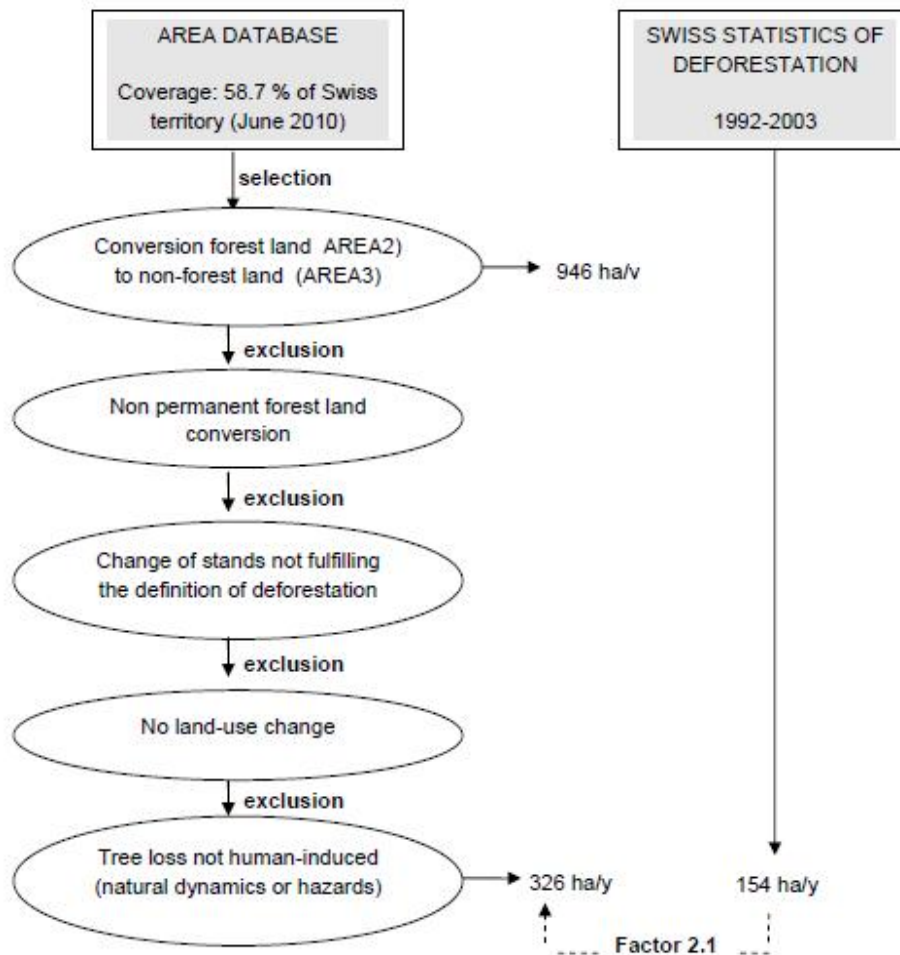


Abb. 1 Exclusion process to classify deforestation_{Kyoto} (from Fig. 1 in FOEN 2010¹)

Tab. 1 Criteria to classify deforestations_{Kyoto} (from table 2 in FOEN 2010¹)

Criteria	Criterion's number and explanation	Identification of affected areas	Area [ha/y]
Non-permanent conversions due to forest management practices or natural dynamics or hazards	1.1 Tree loss temporally limited: conversion into temporally non-forested area whose land-use can not be identified. As is common practice in Switzerland, natural regeneration is expected, but could not yet be recognized	AREA3: unused land (LU421)	209
	1.2 Tree loss spatially limited: conversion is caused by an alteration of the surrounding stand, but the change does not affect the tree cover at the sample point	AREA3: linear woods (LC46), cluster of trees (LC47)	111
Conversions of combination categories not meeting the definition of Deforestation	2.1 Converted areas which do not reach the minimum area of forest definition (<625 m ²)	AREA2: forest edges (LC42)	30
	2.2 Areas still fulfilling the Kyoto definition of Forest after the conversion, i.e. having the potential to reach 3 m at maturity in situ	AREA3: shrubs (LC31)	69
No change in land-use	3. Reduction of tree cover without land-use change; former land use was mainly alpine pasture	AREA2/3: same land-use category (LUxyz/xyz)	306
Tree loss not human-induced	4. Conversion due to natural hazards and dynamics	AREA3: unused or along streams located bare land LU-LC 421/402-51/52/53	80

The implementation of the exclusion criteria is described below with

- the *definition* according to Tab. 1,
- the *SQL-commands* for implementation in the database,
- the *number of samples* that meet the definition (estimated for entire Switzerland) and
- the *number of samples* that are consecutively excluded in the stepwise implementation.

Deforestation_{Kyoto} is therefore calculated by subtracting from deforestation_{AD} (Chapter 3.1.1) all cases that are not relevant for Kyoto (Chapters 3.1.2 - 3.1.7).

The criteria are applied on the raw data from the Swiss Land Use Statistics for submission 2011 (data supply June 24, 2010), which covers 58.7 % of the total Swiss territory. As an example changes between AREA2 and AREA3 are presented.

3.1.1 Deforestation

Definition	AREA2: forest (i.e. CC11, CC12, CC13) AREA3: Not forest (i.e. not CC11, CC12, CC13)
SQL	SELECT * INTO tbl_Deforestation97to09_Kyoto FROM Kyoto_24_6_10 WHERE kyoto97 IN (11,12,13) AND kyoto09 NOT IN (11,12,13);
Sample number	6'661, i.e. 946 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples selected	6'661

3.1.2 Criterion 1.1

Definition	AREA3: Not unused land (i.e. not LU421)
SQL	DELETE FROM tbl_Deforestation97to09_Kyoto WHERE lu09=421;
Sample number	1'469, i.e. 209 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples excluded	1'469

3.1.3 Criterion 1.2

Definition	AREA3: Not linear woods (i.e. not LC46), not cluster of trees (i.e. not LC47), not agriculture (i.e. not \geq LU201 AND not \leq LU243), not unproductive (i.e. not \geq LU401 AND not \leq LU424)
SQL	DELETE FROM tbl_Deforestation97to09_Kyoto WHERE lc09 In (46,47) AND (lu09 IN (201,202,203,221,222,223,241,242,243) OR lu09 IN (401,402,403,421,422,423,424));
Sample number	784, i.e. 111 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples excluded	518

3.1.4 Criterion 2.1

Definition	AREA2: not forest edges (i.e. not LC42)
SQL	DELETE FROM tbl_Deforestation97to09_Kyoto WHERE lc97 IN (42);
Sample number	208, i.e. 30 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples excluded	172

3.1.5 Criterion 2.2

Definition	AREA3: not shrubs (i.e. not LC31), not agriculture (i.e. not \geq LU201 AND not \leq LU243), not unproductive (i.e. not \geq LU401 AND not \leq LU424)
SQL	DELETE FROM tbl_Deforestation97to09_Kyoto WHERE lc09 IN (31) AND (lu09 IN (201,202,203,221,222,223,241,242,243) OR lu09 IN (401,402,403,421,422,423,424));
Sample number	487, i.e. 69 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples excluded	41

3.1.6 Criterion 3

Definition	AREA2/3: Not same land use category (i.e. not lu97 = lu09)
SQL	DELETE FROM tbl_Deforestation97to09_Kyoto WHERE lu09 \neq lu97;
Sample number	2'153, i.e. 306 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples excluded	1'960

3.1.7 Criterion 4

Definition	AREA3: Not bare land (i.e. not LC51, LC52, LC53), not along streams (i.e. not LU402), not unused (i.e. not LU421)
SQL	DELETE FROM tbl_Deforestation97to09_Kyoto WHERE lc09 IN (51,52,53) AND lu09 IN (402,421);
Sample number	560, i.e. 80 ha/y (extrapolated to total Swiss territory assuming a time period of 12 years and data coverage of 58.5%)
Samples excluded	177

The exclusion process applied to changes between AREA2 and AREA3 results in $6'661 - 1'469 - 518 - 172 - 41 - 1'960 - 177 = 2'324$ deforestation_{Kyoto} samples.

Extrapolating this estimate to the total Swiss territory over a time period of 12 years results in a deforestation_{Kyoto} of $2'324/12/0.587 = 330$ ha/y.

3.2 Yearly reporting

The fraction $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ was estimated for changes between AREA1 and AREA2, as well as AREA2 and AREA3. The AREA inventories cannot be assigned to a single year as each inventory is based on multiple acquisition years;

- AREA1 covers years 1979-1984,
- AREA2 covers years 1990-1996,
- AREA3 covers years 2004-2008.

Hence, $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ between AREA1 and AREA2 is assigned to the year 1996, $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ between AREA2 and AREA3 is assigned to the year 2008.

The fraction $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ for AREA2 is $345/794 = 0.43$ and assigned to the year 1996.

The fraction $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ for AREA3 is $330/946 = 0.35$ and assigned to the year 2008.

This means, that between AREA1 and AREA2 43 % of $\text{deforestation}_{\text{AD}}$ are $\text{deforestation}_{\text{Kyoto}}$ and between AREA2 and AREA3 35 % of $\text{deforestation}_{\text{AD}}$ are $\text{deforestation}_{\text{Kyoto}}$. The second fraction of $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ is thus 19 % lower than the first fraction.

The linear interpolation of estimates for fractions of $\text{deforestation}_{\text{Kyoto}}/\text{deforestation}_{\text{AD}}$ is outlined in the next table.

Tab. 2 Weighted calculation of yearly fractions

Year	AREA	Interval	Formula	Fraction
1979	1		$=12/12 * 0.43$	0.43
1980	1		$=12/12 * 0.43$	0.43
1981	1		$=12/12 * 0.43$	0.43
1982	1		$=12/12 * 0.43$	0.43
1983	1		$=12/12 * 0.43$	0.43
1984	1		$=12/12 * 0.43$	0.43
1985		1	$=12/12 * 0.43$	0.43
1986		1	$=12/12 * 0.43$	0.43
1987		1	$=12/12 * 0.43$	0.43
1988		1	$=12/12 * 0.43$	0.43
1989		1	$=12/12 * 0.43$	0.43
1990	2	1	$=12/12 * 0.43$	0.43
1991	2	1	$=12/12 * 0.43$	0.43
1992	2	1	$=12/12 * 0.43$	0.43
1993	2	1	$=12/12 * 0.43$	0.43
1994	2	1	$=12/12 * 0.43$	0.43
1995	2	1	$=12/12 * 0.43$	0.43
1996	2	1	$=12/12 * 0.43 + 0/12 * 0.35$	0.43
1997		2	$=11/12 * 0.43 + 1/12 * 0.35$	0.42
1998		2	$=10/12 * 0.43 + 2/12 * 0.35$	0.42
1999		2	$=9/12 * 0.43 + 3/12 * 0.35$	0.41
2000		2	$=8/12 * 0.43 + 4/12 * 0.35$	0.40
2001		2	$=7/12 * 0.43 + 5/12 * 0.35$	0.40
2002		2	$=6/12 * 0.43 + 6/12 * 0.35$	0.39
2003		2	$=5/12 * 0.43 + 7/12 * 0.35$	0.38
2004	3	2	$=4/12 * 0.43 + 8/12 * 0.35$	0.38
2005	3	2	$=3/12 * 0.43 + 9/12 * 0.35$	0.37
2006	3	2	$=2/12 * 0.43 + 10/12 * 0.35$	0.36
2007	3	2	$=1/12 * 0.43 + 11/12 * 0.35$	0.36
2008	3	2	$=0/12 * 0.43 + 12/12 * 0.35$	0.35
2009			$=0/12 * 0.43 + 12/12 * 0.35$	0.35
2010			$=0/12 * 0.43 + 12/12 * 0.35$	0.35

4 Application

Applying these fractions on the activity data for submission 2011 results in 7'972 ha Kyoto relevant deforestations and 12'102 ha not Kyoto relevant deforestations, of which 39 ha originate from CC11, 8'470 ha originate from CC12 and 3'592 ha originate from CC13. Total number of deforestation is 20'074 ha.