Biodiversity and Land Use

A Search for Suitable Indicators for Policy Use

Annexes

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Annex A MSA Methodology

Text is abstract from PBL website.
(See http://www.globio.info/what-is-globio/science-behind-globio)

A.1 General principles of the MSA methodology

The lack of a quantitative overview of global species trends makes it difficult to project development trends into the future. To by-pass species biodiversity data problems, an indicator – the Mean Species Abundance indicator (MSA indicator) - was developed at the European and global levels, using a number of proximate drivers (or pressures) as a crude measure for ecosystem quality. These relationships between pressures and species abundance (dose-response relationships) are based on extensive literature reviews.
The MSA can be calculated with the GLOBIO model.

The driving forces (pressures) incorporated in the model are:
- Land use - e.g. forest and built up area - and land use intensity (MSA_{LU}).
- Nitrogen deposition (MSA_N).
- Infrastructure development (MSA_I).
- Fragmentation (derived from infrastructure) (MSA_F).
- Climate change (MSA_{CC}).

Assuming no interaction among the drivers, for a specific location *i* the overall MSA is calculated by multiplying the MSA's related to the different drivers:

$$MSA_i = MSA_{LU(i)} \cdot MSA_{N(i)} MSA_{I(i)} \cdot MSA_{F(i)} \cdot MSA_{CC(i)}$$

The different land use types mentioned in the considered studies were categorized into six globally consistent groups:
- Primary vegetation
- Lightly used primary vegetation
- Secondary vegetation
- Pasture
- Plantation forestry
- Agricultural land, including cropland and agro-forestry systems

Different agricultural land use intensity classes are distinguished. A gradual increase in external inputs in agricultural systems forms the basis for different intensity classes:
- Agro-forestry
- Low-input (or traditional) farming
- Intensive (or conventional) farming
- Irrigated farming

Each intensity class carries a specific biodiversity value.

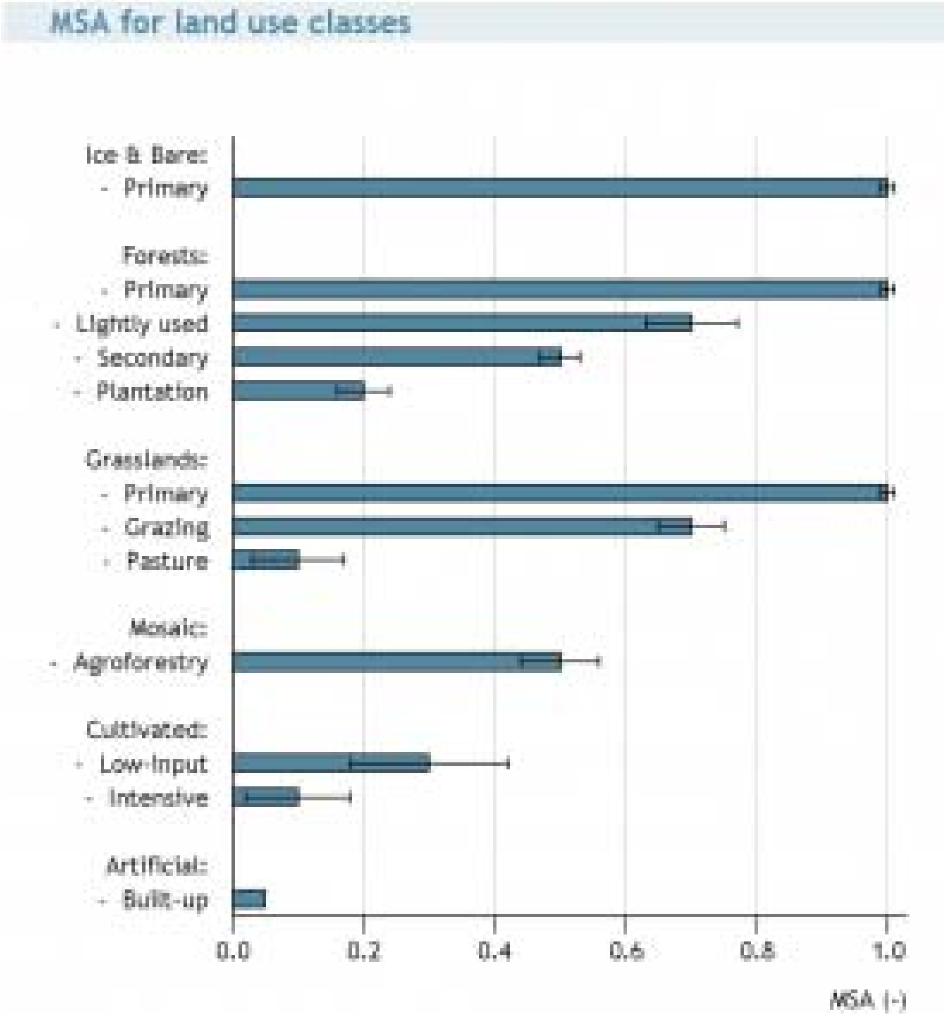
Most of the considered studies describe plant or animal species in the tropical forest biome, however; the sparse studies from other biomes confirm the general picture.

The values of the different MSAs for the different considered drivers are presented below.

A.2 Land use and land use intensity

MSA values are based on datasets comparing measured species abundance between at least one land use type and primary vegetation. A linear mixed effect model was fitted to the data.

Figure 1 MSA for land use classes

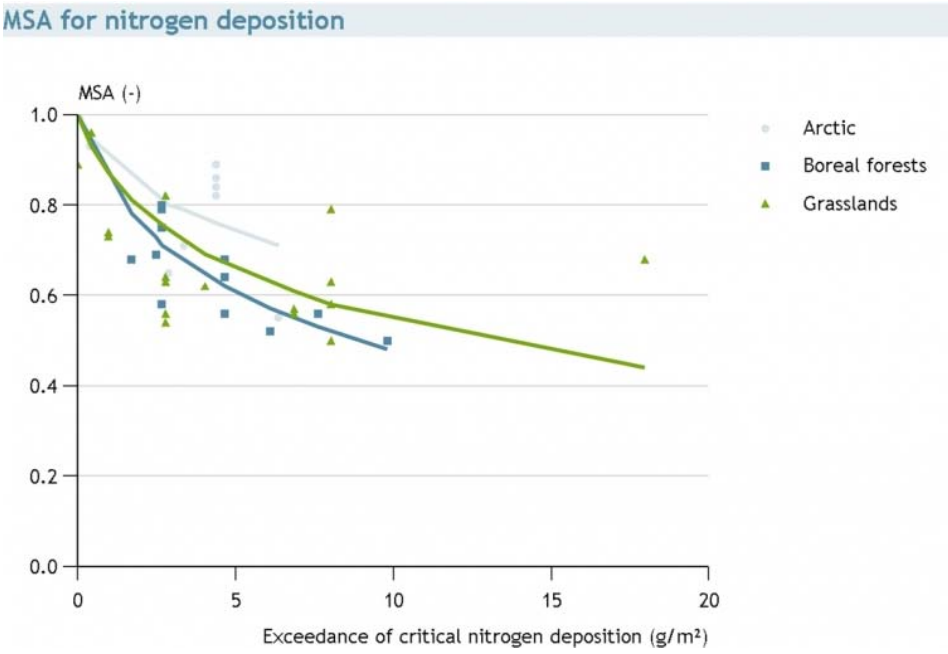


MSA values for land use.

A.3 Nitrogen deposition

In the MSA methodology for separate biomes, (log) linear regression models describe the relationship between N exceedance and MSA.
For croplands, atmospheric N deposition is considered not to affect MSA, because the atmospheric N deposition is relatively small compared to the addition of N by fertilizers. The latter is already accounted for in the estimation of agricultural impacts (land use).

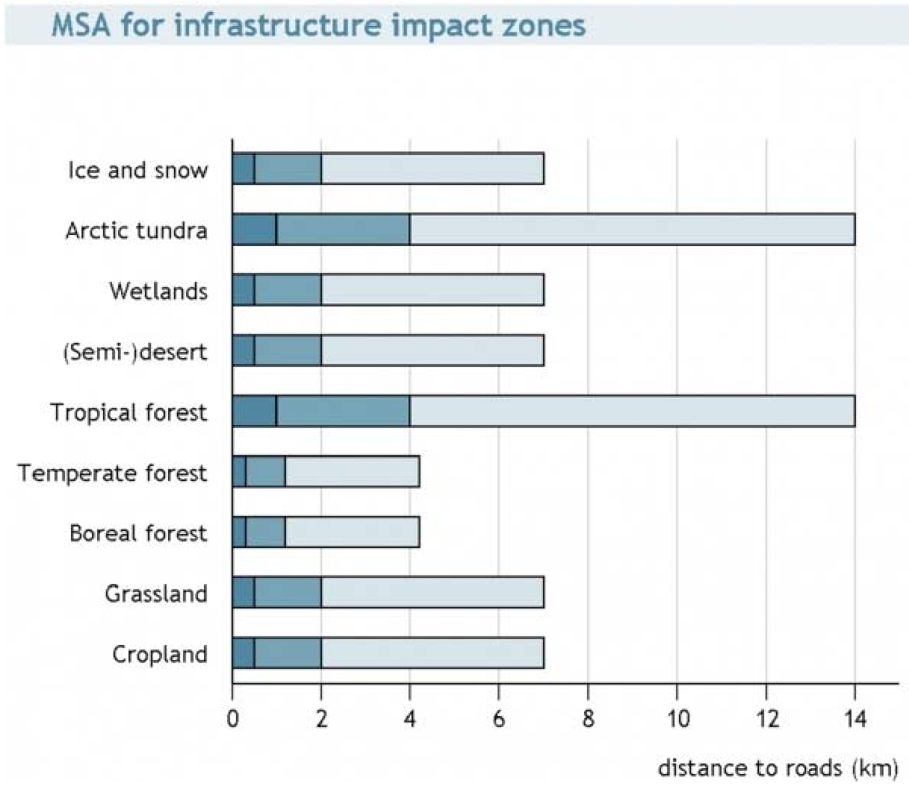
Figure 2 **MSA for nitrogen deposition**



A.4 Infrastructure

For impact of infrastructure on biodiversity, impact zones (high, medium, low) around roads have been defined, based on the distance to the road. The depth of the impact zones differ among ecosystems.

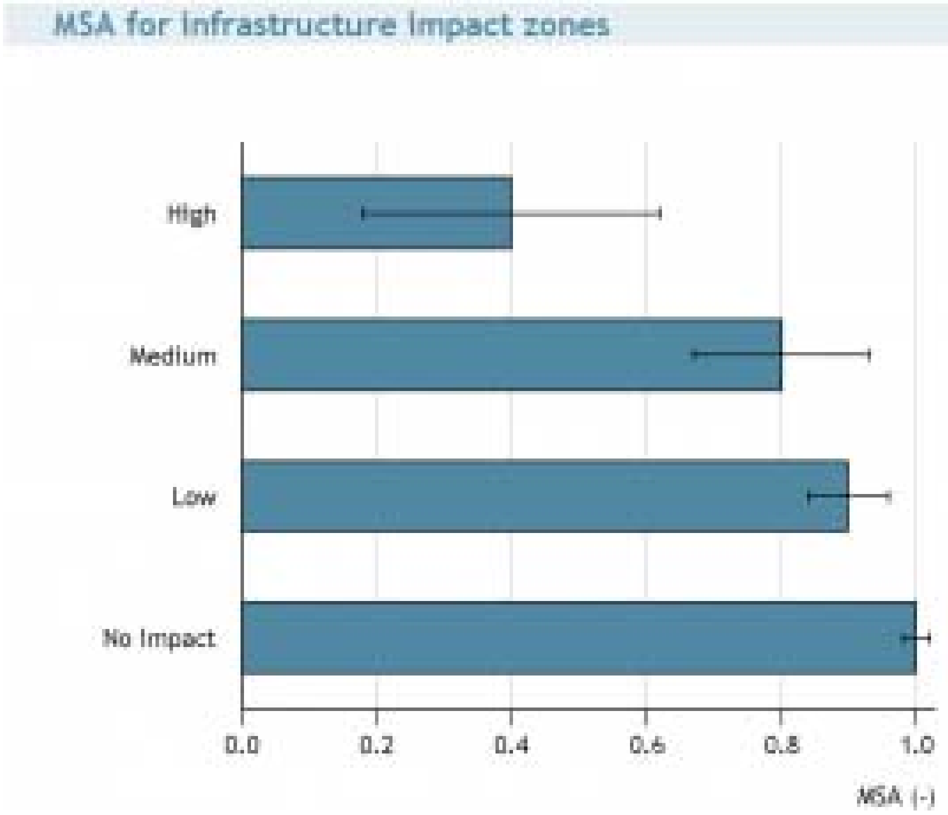
Figure 3 **MSA for infrastructure impact zones**



High = dark color; medium = intermediate intensity; low = light color.

The MSA values associated with the different impact zones are given below. The impacts include direct effects of disturbance on wildlife, and indirect effects such as increased hunting activities and tourism, and small-scale land use change along roads.
Infrastructure is set to affect only natural and semi-natural areas. In protected areas, infrastructure is set to have no impact. For each impact zone, MSA was estimated using generalized mixed models.

Figure 4 MSA for infrastructure impact zones

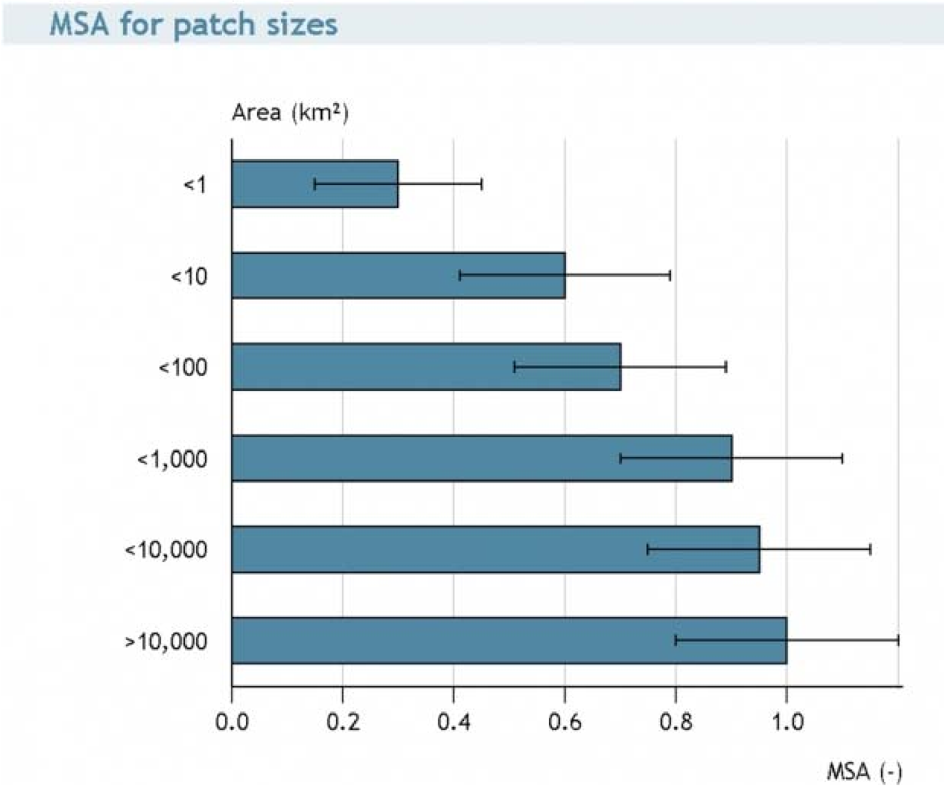


A.5 Fragmentation

GLOBIO includes the effects on fragmentation in terms of the effects of patch size on MSA. Distance between patches is not included.

The relationship between MSA and patch size is based on data on the minimum area required to support a viable population of a certain animal species (MVP). The proportion of species for which a certain area is sufficient for their MVP is calculated and considered a proxy for MSA.
The data show that patches of over 10,000 km^2 of suitable habitat provide sufficient space for viable populations of any species.

Figure 5 MSA for patch sizes



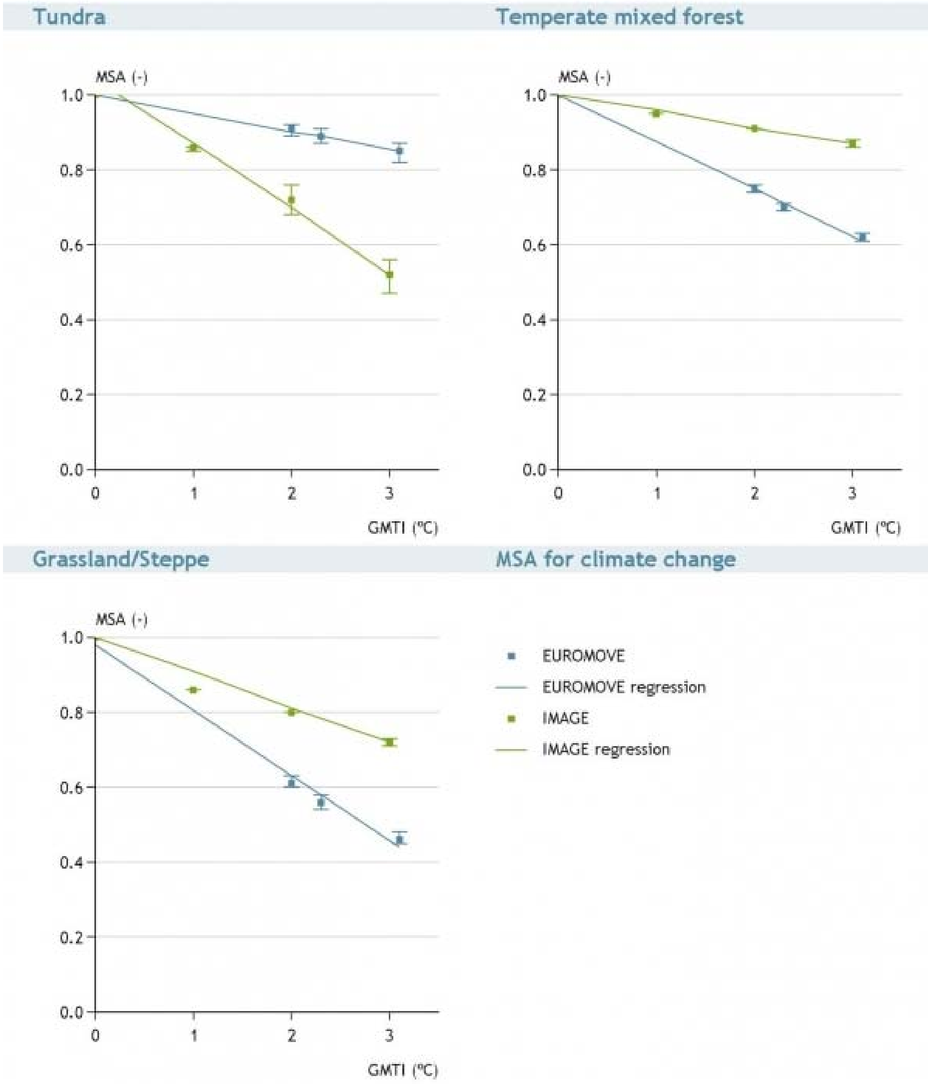
A.6 Climate change

For the impact of climate change, biome-specific regression equations relating changes in global mean temperature increase (GMTI) to MSA have been developed. As with infrastructure, climate change is set to only affect natural and semi-natural areas.

Three examples of regression lines relating estimated MSA values with global mean temperature increase (degrees Celsius) are given below for tundra, temperate mixed forests and grasslands. The error bars reflect only the standard error derived from the regression analysis.

The treatment of climate change is different from that of the other drivers, as the available empirical evidence is limited to areas that are already experiencing significant impacts (such as the Arctic and montane forests).
The cause–effect relationships for climate change are based on model studies. The models EUROMOVE and IMAGE were used to predict the proportion of remaining plant species and the proportion of stable area of biomes respectively, as a function of global mean temperature increase (GMTI). Stable groups of plant species occurring within a biome (EUROMOVE), or stable areas for each biome (IMAGE), are considered proxies for MSA.
For each biome a linear regression equation was estimated to relate cause and effect, i.e. GMTI and the MSA proxy. For each biome, the regression-equation was selected that predicts the smallest effects, either from EUROMOVE or from IMAGE, yielding conservative estimates.

Figure 6 **Impact of climate change and associated temperature increases on biodiversity, as expressed with MSA**



Annex B Eco-indicator 99 Methodology

B.1 General outline of methodology

The Eco-indicator 99 methodology concerns an endpoint impact methodology focussed on impacts on biodiversity. The methodology is based on the area-species relation of Arrhenius[1], expressed as:

$$S = a * A^b$$

In which:

- S = Species richness for the considered area A.
- a = Species richness factor, species richness for an area of the considered biome of infinite size.
- A = Area (m^2).
- b = Species accumulation factor – a measure for the tempo with which the number of species increases with area size.

In the Eco-indicator 99 methodology, the species richness of vascular plants is taken as indicator value for total biodiversity.

In the Eco-indicator 99 methodology, impacts of land occupation and land use change on 'ecosystem quality (EQ)' on both local and regional scale are taken into account, according to:

$$EQ_{total} = EQ_{local,occupation} + EQ_{local,conversion} + EQ_{regional,occupation} + EQ_{regional,conversion}$$

$$= 1.2 * A * (t_{restoration} * \Delta PDF_{1 \to 2} + t_{occupation} * \Delta PDF_{natural \to 2})$$

$$= 1.2 * A * (t_{restoration} * \frac{a_1 - a_2}{a_2} + t_{occupation} * \frac{a_{natural} - a_2}{a_{natural}})$$

In this relationship:

- *A* represents the considered area.
- $t_{restoration}$ represents the period of time required for a converted area to return from land use 2 back to situation 1.
- $t_{occupation}$ represents the period of time during which the area will be in situation 2.
- a_2 refers to the species richness of the considered actual land use
- a_1 and $a_{natural}$ refer to respectively the species richness of a previous land use and the species richness of the original natural system.
- PDF is the potentially disappeared fraction, a measure for the relative decline (or increase) in species richness.

The factor 1.2 indicates that regional effects result in a 20% increase in the local impacts of land occupation and conversion.

The local effect on biodiversity is naturally the result of the change in land use and associated change in land cover (see Figure 7).

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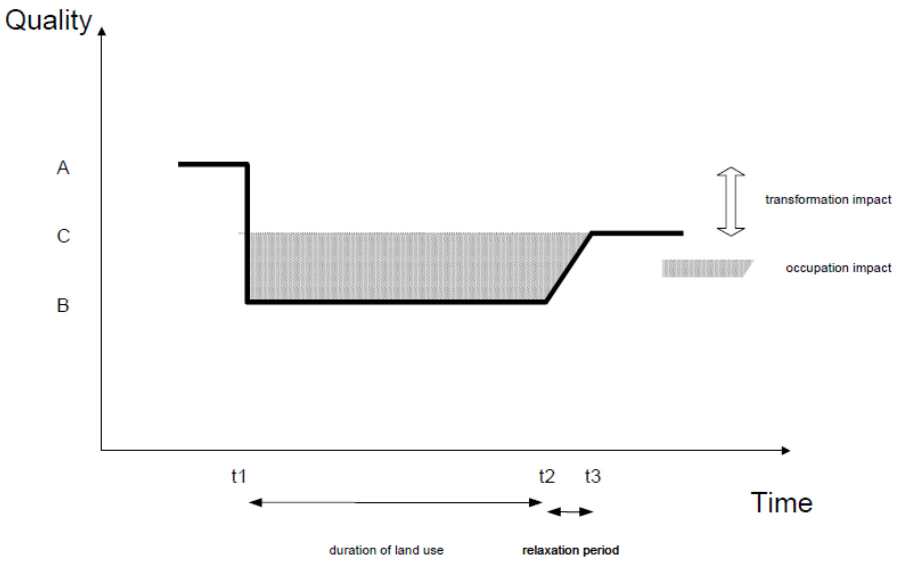
[1] See http://en.wikipedia.org/wiki/Species-area_curve.

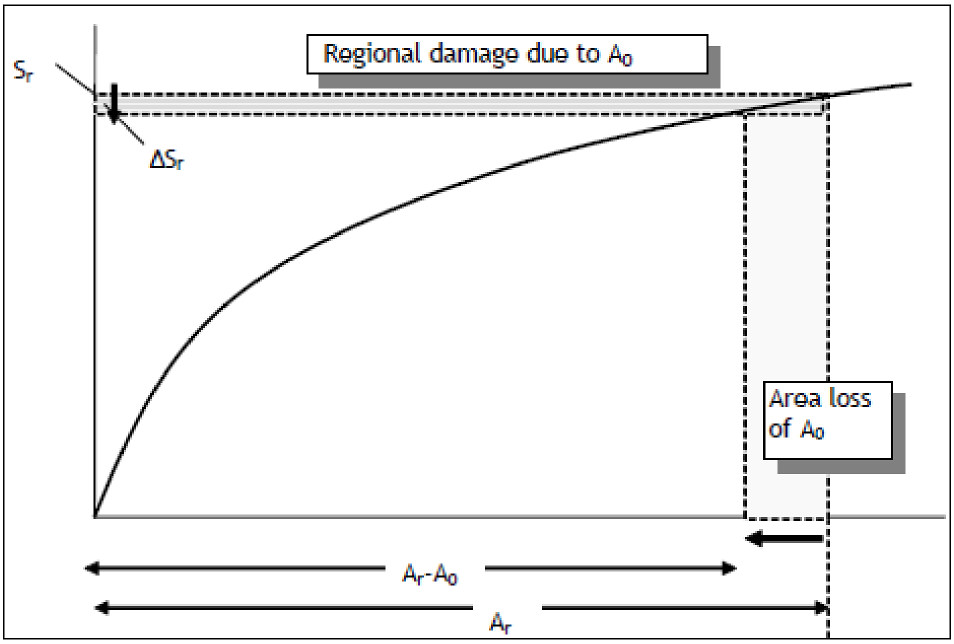
Figure 7 Visualisation of local impact of land occupation and transformation on biodiversity



Source: TNO, 2002, 'Quality'= biodiversity.

The regional effect refers to the change in area size of the original biome and the – according to Arrhenius relation – associated decrease in biodiversity (see Figure 8).

Figure 8 Visualisation of regional effect



Source: ReCiPe 2009.

A_o (= occupied area) represents the transformed and/or occupied area, evaluated in the LCA.

Ar represents the total original area of the biome from which part is occupied for a different use.

For $t_{restoration}$ two default values are to be applied:

- $t_{restoration}$ = 5 years for conversion between two unnatural types of land use (agricultural, built-up).
- $t_{restoration}$ = 30 years for conversion back to natural state of land used for unnatural uses.

As illustrated by the given relation, the methodology is based on ecosystem specific species richness (the number of species present in a specific ecosystem). The methodology also refers to the relative change in biodiversity, not to the absolute level of biodiversity.

Though the methodology is based on a mathematical relation with a power in it, by considering relative changes in biodiversity the resulting land use - the impact relationship is a simple first-order relationship in which the size of occupied or transformed area has been removed as factor of influence.

The methodology has been elaborated for Central European ecosystems, more specifically ecosystems in Switzerland and Germany. The assumed reference natural state has been defined as natural area in the Swiss lowlands.

B.2 Example

Two examples have been adapted from the Eco-indicator 99 manual. Used values can be found in paragraph B.4.

Example 1

An organic meadow is converted into continuous urban area.

The associated damage to the ecosystem is calculated as:

$$1.2 * A * t_{restoration} * PDF_{meadow \rightarrow continuous\ urban} = 1.2 * 5 * (0.96 - 0.70) = 1.56 / m^2$$

Example 2

The continuous urban area is or will subsequently be occupied for an assumed period of 50 years.

The associated ecosystem damage is calculated as:

$$1.2 * A * t_{restoration} * PDF_{natural \rightarrow continuous\ urban} = 1.2 * 50 * 0.96 = 57.6 / m^2$$

B.3 Purpose, strengths and weaknesses

Purpose

The Eco-indicator 99 methodology is an update of the Eco-indicator 95 methodology. The latter was developed as a tool for designers to be used within Integrated Product Policy (IPP) and the associated management system, the Product-Orientated Environmental system (POEM system). The aim of IPP and the associated POEM were/are the reduction of the total environmental impact of a product during its entire life cycle.
In view of this context, the Eco-indicator methodologies were/are aimed at supplying of ready for use information about the environmental impact related to raw materials, processing and waste removal processes. The methodologies should cover as many relevant types of environmental impact as possible and should allow for the weighing of contributions to the different considered environmental issues, giving 1 aggregated value for the total environmental impact over the entire life cycle.

Strength

Strength of the approach of land use (change) and associated impacts on biodiversity in the Eco-indicator 99 methodology is its simplicity.

Limitations

The mean limitations to the Eco-indicator 99 methodology are:

- Has been elaborated only for a specific European region.
- Based on a limited set of observations of species richness in different types of land use, especially for continuous urban land.
- Data for agricultural land use is based on observations of species in the field only and doesn’t take into account species richness in landscape components such as hedges and waterways.
- Uncertainties in available data have been corrected by application of ‘somewhat arbitrary’ correction factors, lying between 1 and 4.
- The examples above seem to indicate that land use change is less important than land occupation.
- The considered periods of time are highly arbitrary and theoretical or are very difficult to predict.
- The methodology assumes a uniform response of all vascular plants present to the pressure introduced y land transformation and/or occupation. In practice plants and other species can respond in very different ways and can be very sensitive or insensitive to such pressures.

B.4 Default values

Values for $PDF_{natural \rightarrow use}$ as mentioned in the Eco-indicator 99 methodology report are given in Table 1. The correction factors included in the table have been introduced for compensating for limited data availability and associated uncertainty in the value of PDF.

Table 1 Values for PDF for transition from natural area’s to indicated land uses

	CORINE classification	n	a	a_{low}	a_{high}	correction	$PDF_{natural \rightarrow use}$	σ^2_g
Continuous urban	1.1.1	9	11.0	0.7	164.0	1.0	**0.96**	2.4
Discontinuous urban	1.1.2	59	54.6	36.6	90.0	1.0	**0.80**	1.2
Industrial area	1.2.1	29	81.5	27.1	244.7	1.0	**0.70**	7.3
Rail area	1.2.2.2	41	81.5	73.7	90.0	1.0	**0.70**	1.05
Green urban	1.4.1	75	81.5	73.7	90.0	1.0	**0.70**	1.05
Conventional arable	2.2.1.1	16	12.2	11.0	13.5	2.0	**0.91**	1.2
Integrated arable	2.2.1.2	18	12.2	11.0	13.5	2.0	**0.91**	1.2
Organic arable	2.2.1.3	12	24.5	24.5	27.1	2.0	**0.82**	1.5
Intensive meadow	2.3.1.1	20	14.9	13.5	14.9	2.0	**0.89**	1.2
Less intensive meadow	2.3.1.2	17	40.4	36.6	40.4	2.0	**0.70**	2.1
Organic meadow	2.3.1.3	20	40.4	40.4	44.7	2.0	**0.70**	2.5
Broad-leafed forest	3.1.1	126	244.7	244.7	244.7	1.0	**0.10**	1.0
Swiss Lowlands (nature)		46	270.4	200.3	330.3	1.0	**0.00**	

Associated values for relative changes in species richness for local and local plus regional occupations are given in Table 2.

Table 2 PDF values for land use transitions

	PDF Occupation		Local and regional PDF of conversion from column to row												
	Only local	regional plus local	Continuous urban	Conventional arable	Integrated arable	Intensive meadow	Organic arable	Less intensive	Organic meadow	Discontinuous urban	Industrial area	Rail area	Green urban	Broad-leafed forest	Swiss Lowlands
Continuous urban	*0.96*	1.15		0	0	0.01	0.05	0.11	0.11	0.16	0.26	0.26	0.26	1.04	1.15
Conventional arable	*0.95*	1.15	0		0	0.01	0.05	0.10	0.10	0.16	0.26	0.26	0.26	1.03	1.15
Integrated arable	*0.95*	1.15	0	0		0.01	0.05	0.10	0.10	0.16	0.26	0.26	0.26	1.03	1.15
Intensive meadow	*0.94*	1.13	-0.01	-0.01	-0.01		0.04	0.09	0.09	0.15	0.25	0.25	0.25	1.02	1.13
Organic arable	*0.91*	1.09	-0.05	-0.05	-0.05	-0.04		0.06	0.06	0.11	0.21	0.21	0.21	0.98	1.09
Less intensive meadow	*0.85*	1.02	-0.11	-0.10	-0.10	-0.09	-0.06		0	0.05	0.15	0.15	0.15	0.91	1.02
Organic meadow	*0.85*	1.02	-0.11	-0.10	-0.10	-0.09	-0.06	0		0.05	0.15	0.15	0.15	0.91	1.02
Discontinuous urban	*0.80*	0.96	-0.16	-0.16	-0.16	-0.15	-0.11	-0.05	-0.05		0.10	0.10	0.10	0.84	0.96
Industrial area	*0.70*	0.84	-0.26	-0.26	-0.26	-0.25	-0.21	-0.15	-0.15	-0.10		0	0	0.72	0.84
Rail area	*0.70*	0.84	-0.26	-0.26	-0.26	-0.25	-0.21	-0.15	-0.15	-0.10	0		0	0.72	0.84
Green urban	*0.70*	0.84	-0.26	-0.26	-0.26	-0.25	-0.21	-0.15	-0.15	-0.10	0	0		0.72	0.84
Broad-leafed forest	*0.10*	0.11	-1.04	-1.03	-1.03	-1.02	-0.98	-0.91	-0.91	-0.84	-0.72	-0.72	-0.72		0.11
Swiss Lowlands	*0.00*	0.00	-1.15	-1.15	-1.15	-1.13	-1.09	-1.02	-1.02	-0.96	-0.84	-0.84	-0.84	-0.11	

Annex C ReCiPe Methodology

C.1 Overview of methodology

The ReCiPe methodology for characterising land use and associated impacts on biodiversity could be described as an adjusted version of the methodology for land use and biodiversity included in the Eco-indicator 99 methodology.

As in the latter methodology, the ReCiPe methodology is developed for a European context, uses the species richness in vascular plants as indicator value and is based on Arrhenius'[2] area-species relationship:

$$S = a * A^b$$

In which:

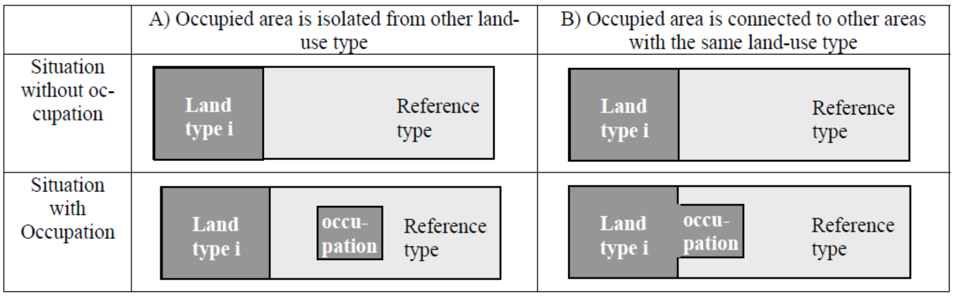
- S = Species richness for the considered area A.
- a = Species richness factor, species richness for an area of the considered biome of infinite size.
- A = Area (m^2)
- b = Species accumulation factor – a measure for the tempo with which the number of species increases with area size.

The reference situation for land use considered in the methodology is boreal and temperate deciduous forest or woodland - the biome that would cover 80-90% of Europe's surface without human impact.

In contrast to the Eco-indicator 99 methodology, the methodology in ReCiPe considers two different situations regarding a considered and used plot of land:

– Situation A: attached to land used for a similar use.
– Or situation B: an isolated plot, surrounded by land applied for some other use.

Figure 9 Different approaches considered in ReCiPe for regional impacts of land use



[2] See http://en.wikipedia.org/wiki/Species-area_curve.

For these situations following generalized relations have been derived for the environmental damage (ED) due to occupation and transformation.

$$ED_{occ.,sit.A} = (b_{ref} + \frac{a_{ref} - a_{occ} * A_{occ}^{z_{occ} - z_{ref}}}{a_{ref}}) * A_{occ} * t_{occ}$$

$$ED_{occ.,sit.B} = (b_{ref} - b_{occ} + \frac{a_{ref} - a_{occ} * A_{occ}^{z_{occ} - z_{ref}}}{a_{ref}}) * A_{occ} * t_{occ}$$

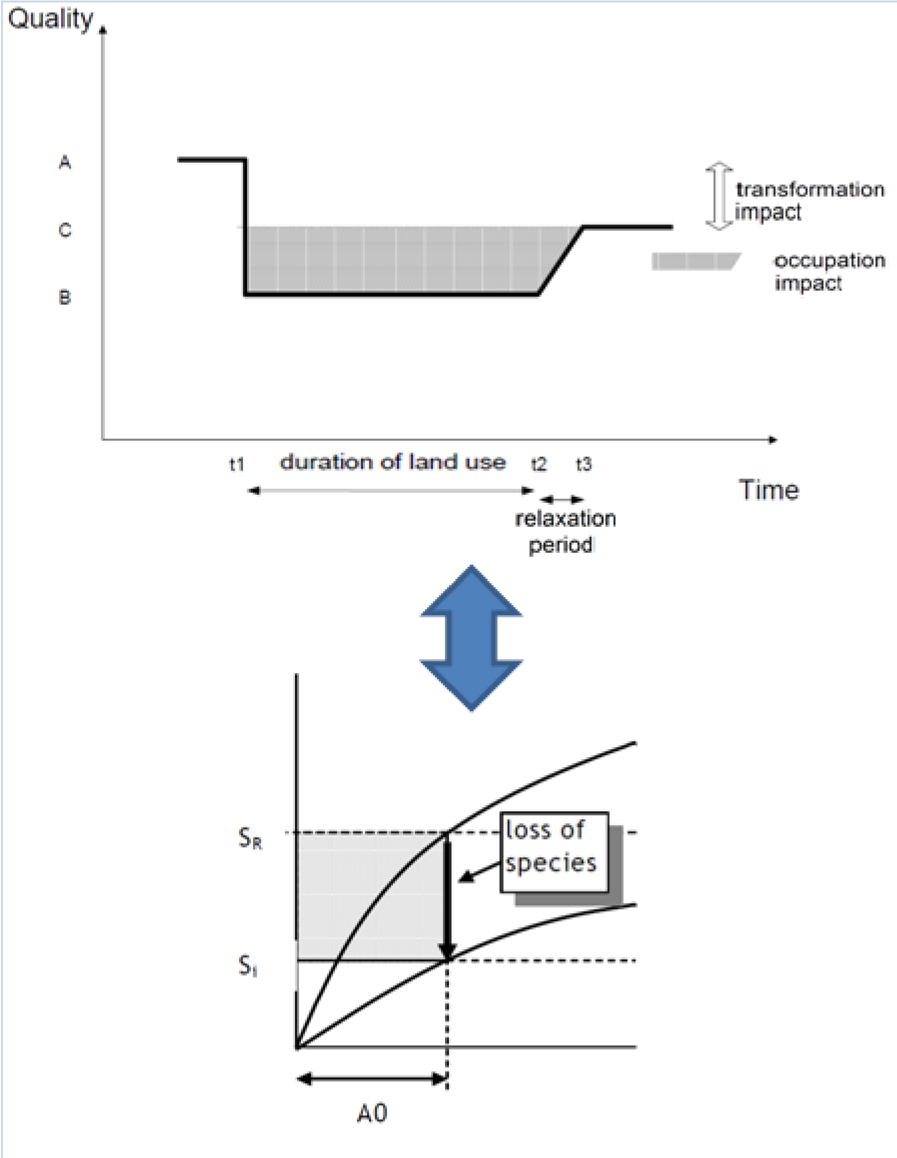
$$ED_{trans.,sit.A} = (b_{ref} + \frac{a_{ref} - a_{occ} * A_{occ}^{z_{occ} - z_{ref}}}{a_{ref}}) * A_{occ} * t_{restoration}$$

$$ED_{trans,sit.B} = (b_{ref} - b_{occ} + \frac{a_{ref} - a_{occ} * A_{occ}^{z_{occ} - z_{ref}}}{a_{ref}}) * A_{occ} * t_{restoration}$$

In these relations ED is equal with EQ in the Eco-indicator 99 methodology.

The essence of these relationships is more or less illustrated by both figures in previous Appendix (Figure 7, Figure 8).The approach of these effects in the ReCiPe methodology is a more mathematical one as perhaps illustrated by the illustration in Figure 10.

Figure 10 **Difference in mathematical approach between Eco-indicator 99 methodology and ReCiPe methodology for local impact**



Source: Combination by authors of Figure 7 and Figure 8.

The relationship for damage caused by transition and occupation is the same apart for the considered time required for restauration. This factor is free for the LCA practitioner to select for occupation, but is a predefined value for transition.

In the ReCiPe methodology three different perspectives are distinguished, representing different views on the damages caused by environmental impacts:

- Egalitarian Perspective E is the most precautionary perspective, taking into account the longest time-frame, impact types that are not yet fully established but for which some indication is available, etc.
- Individualist Perspective I, which is based on the short-term interest, impact types that are undisputed, technological optimism as regards human adaptation.
- Hierarchist Perspective H, which is based on the most common policy principles with regards to time-frame and other issues.

These different views are reflected in the restoration times assumed for land use transition and in the assumed geographic embedding of the occupied or transformed area (A - isolated or B - connected).

Table 3 **Selected restoration time and geographic embedment in different perceptions**

	Range	Egalitarian	Individualist	Hierarchism
Assumed geographic embedment		A - isolated	B - connected	A - isolated
Restoration time		Maximum restoration time	Mean restoration time with maximum of 100 years	Mean restoration time
Vegetation of arable land, pioneer vegetation	< 5	5	2.2	2.2
Species poor meadows and tall-herb communities, mature pioneer vegetation	5-25	25	11	11
Species poor immature hedgerows and shrubs, oligotroph vegetation of areas silting up, relatively species rich marshland with sedges, meadows, dry meadows and heath land	25-50	50	35	35
Forests quite rich in species, shrubs and hedgerows	50-200	200	100	100
Low and medium (immature) peat bogs, old dry meadows and heath land	200-1,000	1,000	100	500
High (mature) peat bogs, old grow forests	1,000-10,000	10,000	100	3,300

C.2 Strengths and weaknesses

Purpose
The ReCiPe methodology was developed with the aim of harmonizing LCA methodologies at the level of detail and modeling principles, while allowing a certain degree in freedom in terms of the main principles; their orientation towards midpoint or endpoint indicators.

Strengths
Strength of the methodology is the possibility for including different risk and damage perceptions.

Limitations
Apart from the limitations mentioned for Eco-indicator 99 methodology, it is a very mathematical approach.

C.3 Default values

Default characterisation factors are included in Table 4 to Table 8.
All default values refer to a reference area of 10,000 ha. The variables Z and c in these tables refer to the variables b and a in the relations in previous paragraphs.

The damage caused by occupation of a certain area of land can be found by multiplying the proper CF value with:

- For occupation: the area and time of occupation.
- For transformation: the area.

For transformation, only transformation of natural into non-natural area has been considered as – according to the developers of the ReCiPe methodology - for LCA it is especially relevant to be able to express environmental damages due to the transformation of natural areas into an artificial area.
For the agricultural land use types the authors only calculated the impact for the intensive land use, not for the monocultures or the extensive land use types.

Table 4 Characterisation factors for land occupation, for the egalitarian and hierarchistic perspectives

Land use type	Z	c	Local effect PDF.m²·yr	Regional effect PDF.m²·yr	Total effect PDF.m²·yr	CF_{occ} 10^{-9} *
Monoculture Crops/Weeds[1]	0.210[3]	2.0[1]	0.95	0.44	1.39	19.2
Intensive Crops/Weeds[1]	0.210[3]	4.6[1]	0.89	0.44	1.33	18.4
Extensive Crops/Weeds[1]	0.210[3]	6.2[1]	0.85	0.44	1.29	17.8
Monoculture Fertile Grassland[1]	0.349	3.7[1]	0.69	0.44	1.13	15.6
Intensive Fertile Grassland[1]	0.349	6.2[1]	0.48	0.44	0.92	12.7
Extensive Fertile Grassland[1]	0.349	7.9[1]	0.25	0.44	0.69	9.5
Monoculture Infertile Grassland[1]	0.349	7.1[1]	0.41	0.44	0.85	11.7
Extensive Infertile Grassland[1]	0.349	10.5[1]	0.00	0.44	0.44	6.1
Monoculture Tall Grassland/Herb[1]	0.349	0.9[1]	0.92	0.44	1.36	18.8
Intensive Tall Grassland/Herb[1]	0.349	4.7[1]	0.61	0.44	1.05	14.5
Extensive Tall Grassland/Herb[1]	0.349	7.2[1]	0.31	0.44	0.75	10.4
Monoculture Broadleaf, mixed forest and woodland[1]	0.439	3.1[1]	0.19	0.44	0.63	8.7
Extensive Broadleaf, mixed and yew LOW woodland[1,*]	0.439	5.2[1]	0.00	0.00	0.00	-
Broad-leafed plantation[2]	0.439	3.3[2]	0.37	0.44	0.81	11.2
Coniferous plantations[2]	0.439	2.8[2]	0.47	0.44	0.91	12.6
Mixed plantations[2]	0.439	1.8[2]	0.76	0.44	1.10	15.2
Continuous urban[2]	0.214	1.4[2]	0.96	0.44	1.4	19.3
Vineyards[2]	0.210[3]	2.8[2]	0.42	0.44	0.86	11.9

** Reference land use type; [1] data of CS2000; [2] data of Köllner; [3] z values taken from Köllner*

Table 5 Characterisation factors for land occupation, for the individualistic perspective

Land use type	z	c	Local effect PDF.m^2.yr	Regional effect PDF.m^2.yr	Total effect PDF.m^2.yr	CF_{occ} * 10^{-9}
Monoculture Crops/Weeds[1]	0.210[3]	2.0[1]	0.95	0.23	1.18	16.3
Intensive Crops/Weeds[1]	0.210[3]	4.6[1]	0.89	0.23	1.12	15.5
Extensive Crops/Weeds[1]	0.210[3]	6.2[1]	0.85	0.23	1.08	14.9
Monoculture Fertile Grassland[1]	0.349	3.7[1]	0.70	0.09	0.79	10.9
Intensive Fertile Grassland[1]	0.349	6.2[1]	0.50	0.09	0.59	8.1
Extensive Fertile Grassland[1]	0.349	7.9[1]	0.27	0.09	0.36	5.0
Monoculture Infertile Grassland[1]	0.349	7.1[1]	0.43	0.09	0.52	7.2
Extensive Infertile Grassland[1]	0.349	10.5[1]	0.03	0.09	0.12	1.7
Monoculture Tall Grassland/Herb[1]	0.349	0.9[1]	0.93	0.09	1.02	14.1
Intensive Tall Grassland/Herb[1]	0.349	4.7[1]	0.62	0.09	0.71	9.8
Extensive Tall Grassland/Herb[1]	0.349	7.2[1]	0.33	0.09	0.42	5.8
Monoculture Broadleaf, mixed and yew LOW woodland[1]	0.439	3.1[1]	0.40	0.00	0.19	2.6
Extensive Broadleaf, mixed and yew LOW woodland[1,*]	0.439	5.2[1]	0.00	0.00	0.00	-
Broad-leafed plantation[2]	0.439	3.3[2]	0.37	0.00	0.37	5.1
Coniferous plantations[2]	0.439	2.8[2]	0.47	0.00	0.47	6.5
Mixed plantations[2]	0.439	1.8[2]	0.66	0.00	0.66	9.1
Continuous urban[2]	0.214	1.4[2]	0.97	0.22	1.19	16.4
vineyards[2]	0.210[3]	2.8[2]	0.42	0.23	0.65	9.0

Reference land use type; [1] data of CS2000; [2] data of Köllner; [3] z values taken from Köllner

Table 6 Characterisation factors for land transformation, for the hierarchistic perspective

	Restoration time	Crops and weeds	Grassland	Broad-leaved plantation	Coniferous plantation	continous urban
PDF		1.3	0.8	0.9	1.1	1.4
Species poor immature hedgerows and shrubs + [a]	35	46	28	32	39	49
Forests, shrubs and hedgerows	100	130	80	90	110	140
Low and medium[b] peat bogs, old dry meadows and heath land	450	585	360	405	495	630
High (mature) peat bogs, old grow forests	3300	4290	2640	2970	3630	4620

[a] oligotroph vegetation of areas silting up, relatively species rich marshland with sedges, meadows, dry meadows and heath land.
[b] immature

Table 7 Characterisation factors for land transformation, for the hierarchistic perspective

	Restoration time	Crops and weeds	Grassland	Broad-leaved plantation	Coniferous plantation	Continous urban
PDF		1.3	0.8	0.9	1.1	1.4
Species poor immature hedgerows and shrubs + [a]	50	65	40	45	55	70
Forests quite rich in species, shrubs and hedgerows	200	260	160	180	220	280
Low and medium[b] peat bogs, old dry meadows and heath land	1000	1300	800	900	1100	1400
High (mature) peat bogs, old grow forests	10000	13000	8000	9000	11000	14000

[a] oligotroph vegetation of areas silting up, relatively species rich marshland with sedges, meadows, dry meadows and heath land.
[b] immature

Table 8 Characterisation factors for land transformation, for the individualistic perspective

	Restoration time	Crops and weeds	Grassland	Broad-leaved plantation	Coniferous plantation	Continous urban
PDF		1.12	0.65	0.37	0.47	1.2
Species poor immature hedge-rows and shrubs, + [a]	35	39	23	13	16	42
Forests quite rich in species, shrubs and hedgerows	100	112	65	37	47	120
Low and medium[b] peat bogs, old dry meadows and heath land	100	112	65	37	47	120
High (mature) peat bogs, old grow forests	100	112	65	37	47	120

[a] *oligotroph vegetation of areas silting up, relatively species rich marshland with sedges, meadows, dry meadows and heath land.*
[b] *immature*

Annex D Land Use Change in Ecoinvent

A more simplified version of the ReCiPe methodology, discussed in previous Appendix, has been integrated in the Ecoinvent LCA tool.
The difference between both methodologies concerns the methodology for land transformation. For land occupation, the Ecoinvent methodology is identical with the ReCiPe methodology.

For land transformation only transformation of natural areas is considered. For natural areas, only two reference types are distinguished: tropical rainforest and other natural areas.
For land with unknown initial use a 40:60 ratio of natural to non-natural area is assumed.

Difference in species richness (expressed in PDF) between natural areas and non-natural areas is assumed to be uniform for any kind of natural area and any kind of non-natural area. However, the restoration time is assumed to be 3,300–10,000 years for tropical rainforests and only 100–200 years for other natural areas. As a consequence, characterisation factors for tropical rainforest are very much higher than those for other natural areas (see Table 9).

Table 9 **Restoration time, PDF and characterisation factors for land transformation in the Ecoinvent methodology**

	Hierachist	Individualist	Egalitarian
Restoration time (years)			
Tropical rainforest	3,300	3,300	10,000
Other natural areas	100	100	200
Difference in species richness (PDF)			
Tropical rainforest	1.05	0.8	1.05
Other natural areas	1.05	0.8	1.05
Characterisation factor (PDF·m^2·year)			
Tropical rainforest	4,390	3,630	13,000
Other natural areas	130	110	260

This approach is inconsistent with the approach in ReCiPe, in which tropical rainforests are treated similarly to other types of fully developed, and biodiverse biomes, such as temperate rainforests and other types of primeval forests, such as Cerrado.
It is also inconsistent with the approach applied in determining environmental damage related to occupation, in which the reference is European forest or woodland.

Annex E TNO Methodology

E.1 Methodology outline

The methodology elaborated by TNO for Rijkswaterstaat has been based on previous work, LCACAP, by Weidema and Lindeijer for the EU Commission. The methodology takes into account occupation related and transformation related impacts.

For occupation the impact is determined using:

$$EO\text{ (Ecosystem Occupation)} = A * t * SR_i * ES_i * EV_i * SD$$

With:

– Local Species Density factor (SD) = $(1 - S_{act} / S_{ref})$ (SD ≤ 1).
– And ecosystem level factors:
  - SR_i (relative Species Richness of biome i) = S_i/S_{min} (SR ≥ 1).
  - ES_i (Ecosystem Scarcity of biome i) = $A_{pot,max}/A_{pot,i}$ (ES ≥ 1).
  - EV_i (Ecosystem Vulnerability of biome i) = $(A_{exi}/A_{pot,i})^{b-1}$ (EV ≥ 1).

Where:

– S_{act}= the actual species density, standardised to a certain area.
– S_{ref} = the species density in the reference state, standardised to a certain area.
– S_i = the species density in biome i.
– S_{min} = the species richness in the least species rich biome.
– $A_{pot,Ii}$ = the potential (natural) area of biome i.
– $A_{pot,max}$ = the largest value for Apot (to render scores ≥ 1).
– A_{exi} = the existing ecosystem/biome area left.

The relation implies combining a local, relative biodiversity score with global relative ecosystem scores (based on Weidema, 2001). In this manner, the global perspective and the local details are both assessed.

Species density scores have been standardised to the same standard area as Köllner has applied: 0.01 ha.

For land transformation, the same approach as for land occupation is chosen: using three ecosystem level factors and one species level factor:

$$ET\text{ (Ecosystem transformation): } A * SR_i * ES_i * EV_i * (S_{ini}-S_{fin}) / S_{ini}$$

With:

– S_{ini} = the initial species density before transformation, standardized to 0.01 ha.
– S_{fin} = the final species density after transformation, standardized to 0.01 ha.

Methodological choices have been summarized in Table 10.

Table 10 Overview of methodological choices made in TNO methodology

Subject	Choices made
Biodiversity levels included	Ecosystem and species level
Species included	Only vascular plant species included; equal weighting of all species
Relation of actual state to reference state for occupation	1 – {actual state/reference state}, or {reference state – actual state}/reference state
Species diversity reference state	Maximum or average score for regional biome
Species diversity standardisation	To 0.01 ha via Arrhenius formula using a = 4.1 and b = 0.2
Reference state data	Taken from [Barthlott, 1997]
Relation between initial and final state for transformation	1 – {final state/initial state}, or {initial state – final state}/initial state
Biome definition for ecosystem level	Taken from [Leemans et al., 1998]
Ecosystem quality aspects	Scarcity, vulnerability and value/quality
Ecosystem scarcity factor	Largest potential biome area/potential area of biome i
Ecosystem vulnerability factor	$\{\text{Existing area of biome i/potential area of biome i}\}^{b-1}$
Ecosystem value/quality	Species richness$_i$ / minimum biome species richness

E.2 Limitations mentioned for the proposed methodology

Purpose of the methodology

In order to integrate land use in LCA, the Road and Hydraulic Engineering Institute (DWW) has initiated the development of a new method.
The original reason to start the development of the land use methodology was that the theme 'degradation of ecosystems and landscapes' as mentioned in the CML guideline (1992) was not operational and that this theme is relevant for LCA's within the working field of several environmental policies, e.g. sustainable building and the Structure Plan on Surface Raw Materials. The focus was to develop a general method which can be used for all types of processes all over the world, just like other characterisation methods in the CML guideline.

Regional and local diversity in biodiversity

Land use impacts are very dependent on the place and time of the intervention. Not only are temporal aspects generally expelled from LCA studies, but for land use in general, the nature value will vary very much from one location to another as well as over time. All biodiversity and life support indicators for land use will suffer from this natural variation to a certain degree. When an indicator is applied in a very generic manner, this variation may be ignored or neglected, but the potential impacts will inevitably contain this variation.
It must be noted that natural variation in space and time is not restricted to land use impacts. In fact all LCA characterisation models are gross oversimplifications of the real impacts, which occur from a given intervention in the environment at a certain point in time and space.

Completeness of impacts considered

The cause-effect network between a type of land use and its potential impacts is complex. Many different impacts may result from a single land use, and many relationships may exist between those impacts. Therefore, there is an inherent limitation in the extent to which these impacts can be expressed in LCA. Either many indicators are applied to express initial stressor responses to land use, or a few indicators are chosen to indicate the impacts on high-level impacts on areas of protection such as biodiversity. In the first case the interpretation of different scores is hard, because the ultimate impacts can not be perceived. In the second case the interpretation may be easier, but maybe less valid due to various side-effects on excluded aspects of the area of protection. The balance between completeness of impact types and relevance to areas of protection determines the perceived adequacy of the impact indicators chosen.

Uncertain

Especially for re-naturation processes (often performed in mining practice nowadays) the uncertainty on the final state after re-naturation is large. Although this uncertainty can be estimated (as done in this project), it remains to be considered when performing such LCA studies.

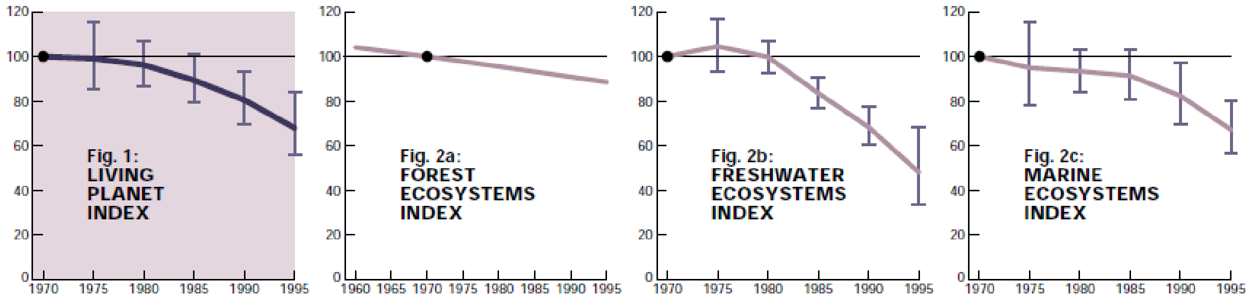
Table 11 Biome specifications considered in the TNO methodology

Biome	Potential biome area [km^2]	Actual area [km^2]	Ecosys Scarcity	Ecosys Vulner. $_{b = 0.2}$	Species Density [10'000 km^{-2}]	Ecosys Quality	$S_{ref. av.}$ [0.01ha]	$S_{ref. max}$ [0.01ha]
Ice	6.66^E+06	6.68^E+06	**3.80**	**1.00**	1	**0**	**0**	**0**
Tundra	9.03^E+06	9.54^E+06	**2.80**	**0.96**	100 - 200	**1**	**4**	**5**
Wooded tundra	3.08^E+06	3.77^E+06	**8.22**	**0.85**	200 - 500	**2 - 2.5**	**9**	**13**
Tundra total	1.21^E+07	1.33^E+06	**4.19**	**0.93**	100 - 500	**1 - 2.5**	**5**	**7**
Boreal forest	2.53^E+07	2.07^E+07	**1.00**	**1.17**	200 - 1000	**2 - 5**	**15**	**25**
Cool conifer forest	4.72^E+06	2.44^E+06	**5.36**	**1.70**	500 - 1000	**5**	**19**	**25**
Temp. deciduous forest	6.20^E+06	1.01^E+06	**4.08**	**4.26**	1000 - 1500	**7.5 – 10**	**31**	**38**
Temp. mixed forest	7.69^E+06	1.71^E+06	**3.29**	**3.32**	500 - 1500	**5 – 7.5**	**25**	**38**
Warm mixed forest	4.76^E+06	8.96^E+05	**5.32**	**3.81**	1500 - 3000	**15**	**57**	**75**
Mixed forest total	1.24^E+07	2.61^E+06	**4.07**	**3.49**	500 - 3000	**5 – 15**	**36**	**51**
Grassland/Steppe	1.72^E+07	9.02^E+06	**1.47**	**1.67**	200 - 1500	**2 – 7.5**	**21**	**38**
Savanna	1.15^E+07	5.39^E+06	**2.19**	**1.84**	200 - 3000	**2 – 15**	**40**	**75**
Grassland total	2.87^E+07	1.44^E+07	**1.77**	**1.74**	200 - 3000	**2 – 15**	**28**	**52**
Hot desert	1.42^E+07	1.16^E+07	**1.78**	**1.18**	100 - 200	**1**	**4**	**5**
Scrubland	8.12^E+06	2.24^E+06	**3.12**	**2.80**	500 - 4000	**5 – 20**	**57**	**100**
Tropical woodland	6.79^E+06	4.25^E+06	**3.73**	**1.45**	1000 - 3000	**10 – 15**	**50**	**75**
Tropical forest	5.74^E+06	3.78^E+06	**4.41**	**1.40**	1500 - 9000	**15 – 45**	**132**	**226**
Agricultural land		3.15^E+07						
Extensive grassland		1.23^E+07						
Regrowth forest		3.31^E+06						
Major cities		8.32^E+05						
Total area	131^E+06	131^E+06						

Annex F Living Planet Index[3]

The LPI[4] is generated by averaging three separate indices for the forest, freshwater, and marine biomes. Each index describes the average trends in populations of vertebrate species from around the world since 1970. Each index is set at 100 in 1970 and given an equal weighting.

Figure 11 Composition of the Living Planet Index



Source:
http://www.footprintnetwork.org/en/index.php/GFN/page/frequently_asked_technical_questions/#biodiv1

The index is currently based on nearly 3,000 population time series for over 1,100 species. All species in the index are vertebrates. The restriction of the index to vertebrate animals, and to years from 1970 onwards, is for reasons of data availability.

Published scientific literature and unpublished reports were searched for eligible time-series data on vertebrate populations, as were online databases such as the NERC Imperial College Global Population Dynamics Database (see: http://www.sw.ic.ac.uk/cpb/cpb/gpdd.html) and Ransom Myers' Stock Recruitment Database (see http://www.mscs.dal.ca/wmgers/welcome.html). Series were included if they met the following criteria:

– Estimates available for at least two years from 1970 onwards.
– Estimates of population size (global or regional), population density (e.g. numbers per unit area of survey plots, density from transects or point counts and numbers recorded per unit length of transects), biomass (e.g. spawning stock biomass from fisheries statistics) or numbers of nests (e.g. marine turtles). Numbers or densities of animals harvested by hunting or fisheries, though sometimes taken to be indicative of population size or density, were not used.
– Survey methods and area covered were comparable throughout each survey of the series, as far as could be ascertained. Estimates for the same species from different workers or research teams published in different papers were not considered to be comparable unless a special effort had been made to ensure this.
– Time series with little or no indication of how, where or when the data were collected were not used. Whether a species was native or non-native was not used as a criterion in the data collection.

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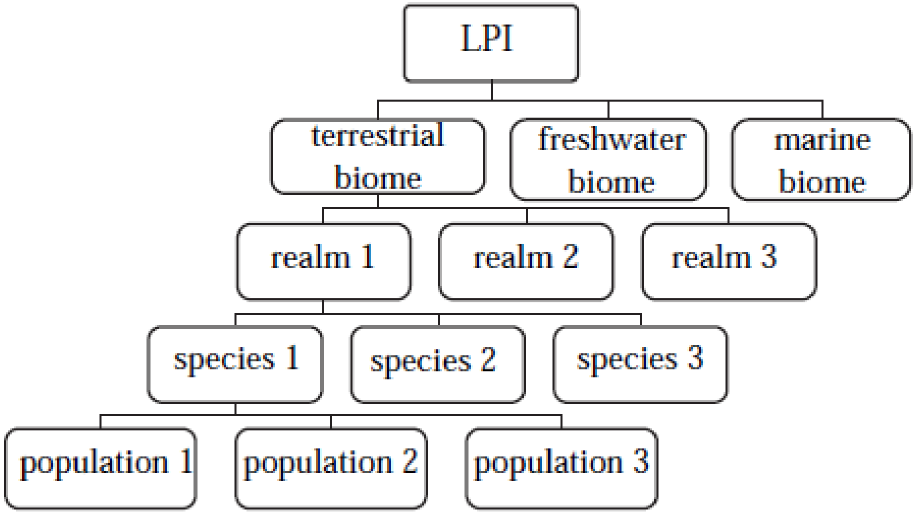
3 Abstracts of an article by Jonathan Loh et al, see: http://rstb.royalsocietypublishing.org/content/360/1454/289.full.pdf+html

4 See http://rstb.royalsocietypublishing.org/content/360/1454/289.full.pdf+html

The time series were developed for standard years at five year intervals, starting from 1970 (so 1975, 1980, etc.).
Annual data points were interpolated for time series with six or more data points using generalised additive modeling, or by assuming a constant annual rate of change for time series with less than six data points, and the average rate of change in each year across all species was calculated.
Next, the different time series into indices by applying the chain methodology:

The time series and associated indices were subdivided according to the hierarchy illustrated in Figure 12.

Figure 12 Construction of datasets for the Living Planet Index



Source: Loh, 2005.
Realm refers to biogeographical area's, e.g. the Afrotropical, Australasian, Indo-Malayan, Nearctic, Neotropical or Palaearctic terrestrial zones.

In the chain method for all time series the logarithm of the ratio of the population measure in one standard year to that of the standard year immediately preceding it is calculated:

$$d_t = \log(N_t/N_{t-5})$$

Where the N are the two population measures. Where there was more than one population series for a species for a given pair of standard years the mean value of dt across all series was calculated. Then, given species-specific values of dt for nt species, the average index value per realm was calculated:

$$\bar{d}_t = \frac{1}{n_t}\sum_{i=1}^{n_t} d_{it}.$$

The index for a terrestrial or freshwater realm or an ocean basin in standard year t was calculated as:

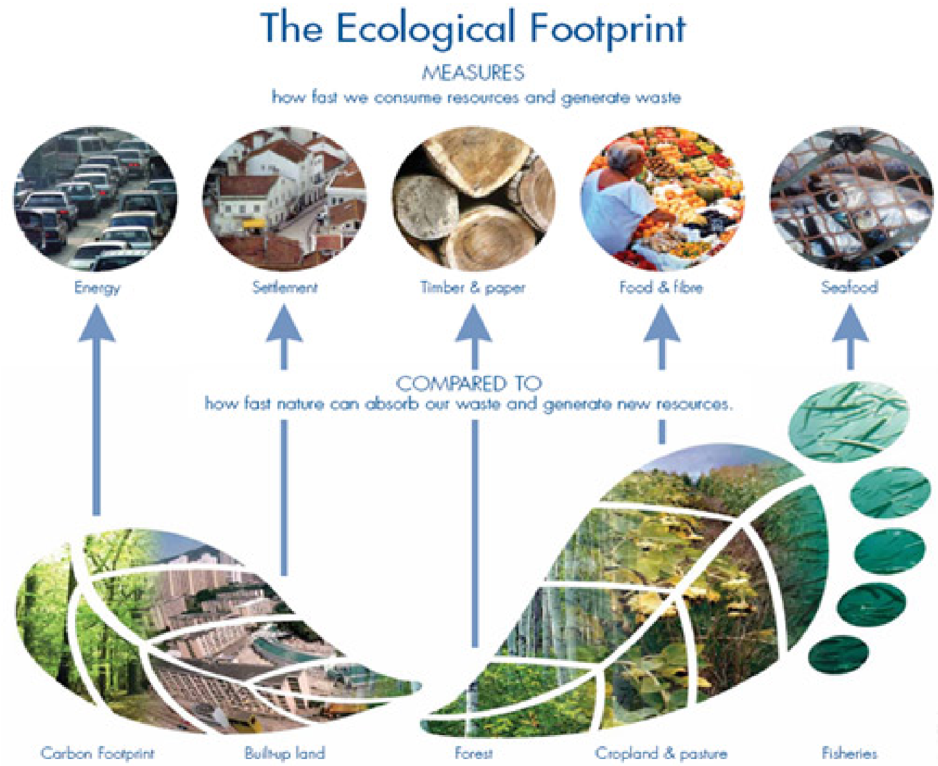
$$I_t = I_{t-5}10^{\bar{d}_t}$$

The World Wildlife Fund (WWF) indicates that there are limitations to the accuracy of these indices. First, forest area is not directly proportional to forest biodiversity, and there is an underlying decline in forest quality in many regions that is not reflected in the change in area of forest cover, which in many countries is increasing. Some indicators of forest quality have been proposed, but an agreement has yet to be reached on what the best measures should be. Second, it is difficult to ensure the representativeness of the freshwater and marine indices because the number of species in each sample compared with the total numbers of freshwater and marine species is relatively small. In both samples there is some bias towards birds and mammals, while fishes and reptiles are under-represented and amphibians altogether absent, reflecting the level of knowledge of these groups.

The number of threatened bird and mammal species refers to the number that are globally vulnerable, endangered or critically endangered (IUCN, 1996), and not necessarily the number of bird and mammal species that are threatened within each country: a species may be highly threatened in one country but in a lower risk category globally. Only birds and mammals were used as the assessment of the status of all bird and mammal species has been completed, whereas the assessment of other taxonomic groups is incomplete.

Annex G Ecological Footprint Methodology[5]

The ecological footprint is a measure of human demand on the Earth's ecosystems. It compares human demand with planet Earth's ecological capacity to regenerate. It represents the amount of biologically productive land and sea area needed to regenerate the resources a human population consumes and to absorb and render harmless the corresponding waste. Using this assessment, it is possible to estimate how much of the Earth (or how many planet Earths) it would take to support humanity if everybody lived a given lifestyle.



The Ecological Footprint uses yields of primary products (from cropland, forest, grazing land and fisheries) to calculate the area necessary to support a given activity. Biocapacity is measured by calculating the amount of biologically productive land and sea area available to provide the resources a population consumes and to absorb its wastes, given current technology and management practices. Countries differ in the productivity of their ecosystems, and this is reflected in the accounts.

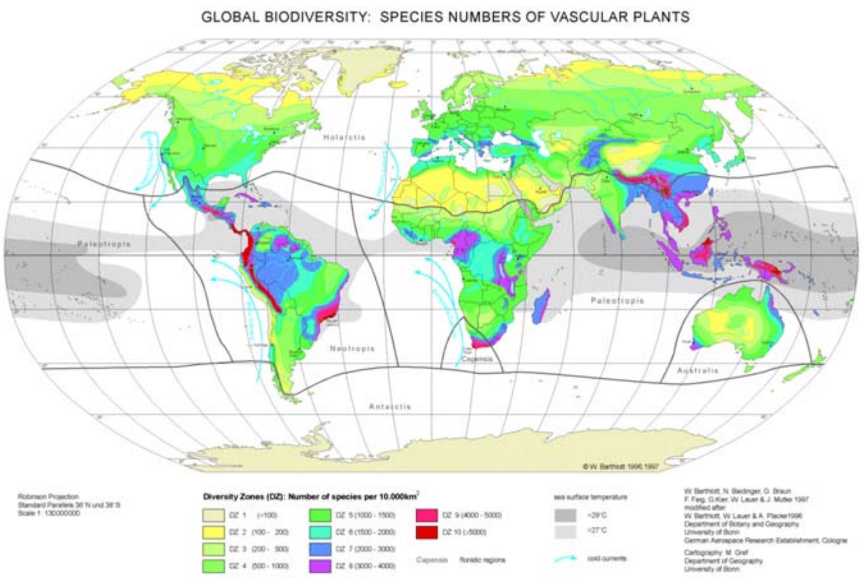
5 Based on: http://www.footprintnetwork.org/en/index.php/GFN/page/frequently_asked_technical_questions/#biodiv1

The Ecological Footprint is not an indicator of the state of biodiversity, and the impact of a particular activity or process on biodiversity does not directly affect the Ecological Footprint calculation for that activity. Given the same yields, for example, the Ecological Footprint of Forest Stewardship Council (FSC) timber and uncertified timber is identical. These two practices will have very different consequences for the available future capacity of the forest to produce timber, which would be reflected in future biocapacity assessments but not in current Ecological Footprint accounts.

Although not a direct measure of biodiversity, the Ecological Footprint supports biodiversity assessment and conservation in two important ways. First, the Ecological Footprint can be used as a large scale indicator of the underlying drivers or pressures that cause biodiversity loss. For this reason, the Convention on Biodiversity (CBD) and the Streamlining European Biodiversity Indicators (SEBI) processes have both adopted the Ecological Footprint as an indicator of pressure on biodiversity.

In addition, the Ecological Footprint can also be used to translate the consumption of a given quantity of material (such as one kilogram of paper) into the specific local land area from which it was harvested (such as one square meter of forest in Finland). After this initial translation, complementary indicators and assessment tools can be used to measure the impact on biodiversity associated with harvesting from that ecosystem. This approach has been used in Global Footprint Network’s work in contribution to the Sustainable Consumption and Production program of the United Kingdom’s Department for Environment, Food, and Rural Affairs (DEFRA).

Figure 13 Global species density map for vascular plants



Annex H Certification, Biodiversity and Land Use

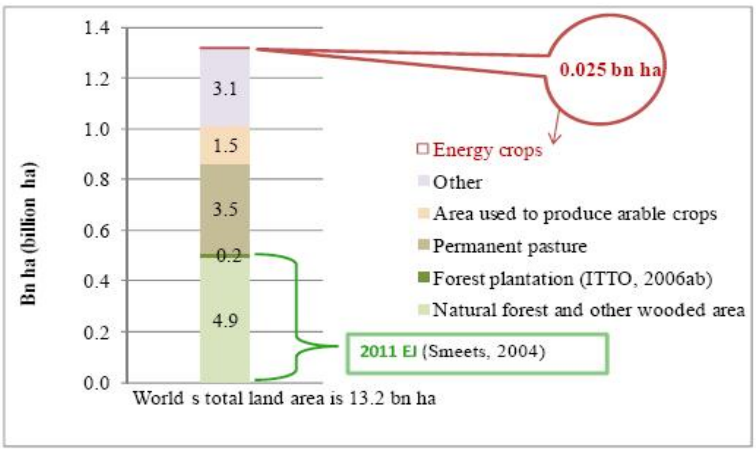
H.1 Introduction

Certification is a voluntary, market-driven approach, whereby producers agree to comply with a widely recognized standard drawn up by an independent body, and to be assessed against this standard by an accredited auditor (the Certification Body). Certified companies can label their products and make certain claims about their management and/or performance. This study tries to answer two questions with respect to certification schemes:

1. How have biodiversity and land use been taken into account?
2. Does certification help to protect biodiversity?

There is a close relationship between biodiversity and land use. Figure 14 shows the relative importance of the different categories of land use and its distribution is high on the international agenda. Although limited in scale, certification is one way of setting voluntary rules for management. According to FAO (2009), approximately 8% of global forest area has been certified under a variety of schemes and it is being estimated that one quarter of global industrial round wood now comes from certified forests (FAO, 2009). Most certification is found outside the tropics and less than 2% of forest area in African, Asian and tropical American forests are certified. Most certified forests (82%) are large and managed by the private sector (ITTO, 2008). The scope of forest certification is forest management within a production unit (Forest Management Unit). It plays virtually no role in the combat against the most important threat to biodiversity: the conversion of natural forests.

Figure 14 Distribution of land use type in world's total land area



Notes:
1) Other land: Land not included in the FAO land use categories.
2) Permanent pasture: Land used permanently for herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land).

Figure 8. Distribution of land use type in world's total land area (Sources: Faaij, 2008; ITTO 2006ab, Smeets et al., 2004).

Croplands and pastures have become part of the largest terrestrial biomes on the planet, rivalling forest cover in extent and occupying about 40% of the land surface. Bioenergy crops here are still small, but growing. For example, the European Commission had 15 studies done about biofuel production and on average its conclusion was that in the coming decennium the EU biofuel policy could have an indirect effect of 4.5 million ha land.

Scale and scope of certification of management units are not designed to contribute to overall land use planning. Land use is one of the main sustainability issues for the next coming decades but the link between certified land use and land use planning is still missing. This is also crucial for biodiversity protection. Considering the multiple spatial scales, certification schemes should be combined with additional measurements and tools on a regional, national and international level.

Two types of certification systems[6] can be distinguished, each with its own way of biodiversity/land use verification[1]:
- Source oriented: Systems that focus on the management of the area where a product or service is coming from (e.g. forest management certification systems). These systems focus on the management or exclusion of the entire production unit (cut-off date).
- User-oriented: Systems that focus mostly on the product/service itself (e.g. carbon storage, biomass for energy, vegetal oil, soy, timber plantations). These systems tend to exclude areas from production, e.g. as a result of their biodiversity values (spatial dimension). They usually do not address biodiversity very specifically within productive areas once the production site has been identified. There is a more strict separation between production and biodiversity conservation.

Two types of sustainability criteria/indicators can be distinguished;
- Performance-based: These criteria give specific minimum requirement for verification and monitoring. Criteria/indicators are measurable.
- System-based: Criteria/indicators are procedural and refer to procedures to be followed in order to increase sustainability.

H.2 Certification and sustainability: does it help?

There is a complicated relation between sustainability and certification. As mentioned before, certification of the production of biofeedstocks works at the level of management units and these are part of a broader landscape. In the context of the increasing demand for land is broader landscape planning essential for sustainability. However, within these limitations, certification seems an important tool. When looking at forests, where the majority of the world's terrestrial species is found, research shows "that Forest Management Units (FMU) being evaluated nowadays have fewer issues raised (corrective action requests or CARs) than FMUs evaluated in the past. This result suggests that FMU now have higher working standards than in the past. (…) results also indicate that certification is likely to have a large impact on the long-term sustainability of forest management mainly because FMU are requested to improve their monitoring system and to incorporate the results of the monitoring system into their management practices." (Peña-Claros, Blommerde and Bongers, 2009). See also Box 1.

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[6] See Erik Lamerts van Bueren, 2009.

Recent research suggests that forest management certification in the difficult tropics is beneficial for biodiversity: "Forest certification has certainly done more to improve tropical forestry than any other intervention with similar intentions (e.g., the Tropical Forestry Action Plan, the Montreal Process and the ITTO's many outstanding efforts). At the same time, we are unable to quantify the full extent of these benefits" (Roderick J. Zagt, Douglas Sheil and Francis E. (Jack) Putz, 2010).

For biofuels, the European Commission has run 15 studies on different crops, which on average conclude that over the next decade Europe's biofuel policies might have an indirect impact equal to 4.5 million hectares of land – an area the size of Denmark. Some European Union Member States have established internal certification schemes or other rules that will impact their production and use. These are for example the Cramer principles to biomass (Netherlands); Renewable Transport Fuel Obligation (RTFO) (UK); Biofuel Sustainability Ordinance (Germany) and International Sustainability and Carbon Certification (ISCC) (Germany).

For biofuel sustainability certification in the Netherlands, companies have to specify what scheme, accepted by the European Commission or NEA (Nederlandse Emissie Autoriteit), is used. Starting 1 July 2011, the government requires a formal verifier. Starting 1 July 2012, the verifier has to be authorised by the system or have at least begun formal procedure and has to declare that requirements have been fulfilled.

With land use being such an important issue, increasing productivity could be part of the solution. Intensification of production and plantations becomes ever more important and can have its implications for choice of crop. The oil palm is the most efficient oil-bearing crop in the world, but has often been planted in ecologically sensitive areas but it requires only 0.26 hectares of land to produce one tonne of oil while soybean, sunflower and rapeseed require 2.22, 2 and 1.52 hectares, respectively, to produce the same. The global production of palm oil increased more than nine-fold since 1980 to 45.1 million tonnes in 2009.

The large and expanding area planted with palm oil makes certification an ever more important tool for the sector. The share of RSPO certified sustainable palm oil (CSPO) in the global production increased to 6.4% in October 2010 compared to 3.2% a year ago. The demand for CSPO has showed a steady growth. Since August 2008, the annual production capacity of CSPO has increased to 3 million tonnes.

H.3 Certification schemes in this study

The increasing demand for agricultural products (food, feed and fibre) leads to a higher demand for land, even with the current rise in productivity. In addition, there is a growing competition for feedstock competition, of which the outcome has a clear environmental impacts. Certification gives clarity at the level of a production unit to companies (users and producers) and policy-makers on topics like sustainability and GHG emissions. This makes it an important tool. There is a need for a degree of international consensus, both because of concern over the varied activities and the lack of any common agreement. This results in different schemes, with limited acceptance and effectiveness. The question is how to encourage mutual recognition.

Here we analyse certification schemes that have been put in for four production categories and which we have screened for their management rules with respect to biodiversity and land use.

1. Forests and tree plantations.
2. Biofuels and biomass.
3. Vegetable oils and soy.
4. Organic agriculture.

Since the majority of the world's terrestrial species is found in forests (and most of that in the tropics), forestry operations have substantial impact on biodiversity. Therefore, its certification plays an important role as a mechanism to biodiversity protection but in a recent study (Effects of forest certification on biodiversity (Marijke van Kuijk, Francis E. Putz and Roderick Zagt, 2009, Tropenbos International, Wageningen) it was concluded that the issue is complex and that systematic collection of information is seldom done done. However, the authors evaluated 67 studies and with all its limitations it is concluded that "the forest management practices associated with forest certification appear to benefit biodiversity in managed forests".

In this analysis we included 4 forest certification schemes. There is an important distinction to make between natural forests and tree plantations. Forest certification schemes also make this distinction.

Vegetable oils and soy were grouped together since soy is can used as both oil and as whole beans. What they have in common is that both are crops that are expanding and that are important in the food, feed and fuel discussion.

Global vegetable oil production in 2009 was 132,8 million tones. In the next decade, the global consumption of vegetable oils is expected to increase by more than 25% to 184.3 million tonnes due to demographic developments and improving purchasing power. Competition between the different uses (food or fuel) and with other materials (wood) is strong and growing and this has become an important challenge for certification.

It is important to keep in mind that certification standards and initiatives are continuously updated and reviewed and this document aims to give a state of the art overview as of January 2011.

H.4 Methodology

This chapter highlights the way in which certification schemes handle biodiversity and land use. We analyse the way criteria and indicators (P, C and I) are verifiable and measurable. They are organised in a table, according to whether they focus on the management procedures (system-based) or the results in the field (performance-based). For the verification to be performance-based, specific measurable criteria/indicators are required.

Most certification schemes refer to additional documentation (standards, guidelines, definitions) for the interpretation of these principles and criteria. For full interpretation of the systems these documents should be considered. Here we focus on the definitions of the systems as given in their own documents.

Here we analyse international certification schemes. It is the quality of the international standard that is very important for recognition in the global markets since it guarantees minimum quality, independent from the movements in the chain and the country of origin. More freedom for national interpretation requires more knowledge of the specific national situation and makes trade less transparent.

First an overview is given, with its verification basis, of the biodiversity/land use criteria of all the certification systems and sustainability standards included in this analysis. Since measurability is the distinguishing criterion between verification methods of the schemes, in a second table we go into more detail of what makes a scheme performance-based and give the specific criteria/indicators. After this, lessons are drawn from those characteristics that make performance measurable in the schemes. For a better overall understanding, in a last table we give some basic facts of the dimensions of the different schemes, measured in hectares, volumes and geographic focus.

Unit of analysis for production:	Certification schemes or sustainability standard
Variables of analysis:	Biodiversity and land use
Level of analysis: schemes	Principles, criteria, indicators of international
Selection criterion:	Performance or system-based verification. A certification schemes is system-based and/or performance-based. They are characterised as system-based when they refer to procedures to be followed and as performance-based when they are oriented towards measurable results in the field
Note on the inclusion of land use rights of local people:	Rights are included because of significant impact on land use

Biodiversity & land use in certification scheme or sustainability standards					
Certification scheme or sustainability standard **Principles and/or criteria**	**Verification basis**				
	Biodiversity		**Land use**		**Note**
	System	**Performance**	**System**	**Performance**	
Forests and tree plantations					
Certfor (Plantaciones)					
Principle 1: Long-term Master plan Sustainable Forest Management			X	X	
Principio 2: … el valor ambiental de los ecosistemas nativos que contenga la Unidad de Manejo Forestal…	X	X	X	X	
Principio 9 Monitoreo y Control	X		X		
Certfor (bosques naturales)					
Principio 1 Planificación y Objetivos a Largo Plazo	X		X		
Principio 2 …diversidad biológica y las funciones de los ecosistemas presentes en la UMF se mantengan o mejoren…	X	X	X	X	
Principio 9 Monitoreo y Control	X	X	X	X	
FSC					
P&C 3 Indigenous peoples' rights			X		
P&C 6 (Environmental impact)	X	X			
P&C 8 (Monitoring and assessment)	X	X			
P&C 9 (Maintenance of HCVF)	X	X			
P&C 10 Plantations			X	X	
MTCC					No safeguards against conversion
Principle #1: Compliance with laws and FSC Principles	X		X		
Principle #6: Environmental Impact	X		X		

Biodiversity & land use in certification scheme or sustainability standards					
Certification scheme or sustainability standard **Principles and/or criteria**	**Verification basis**				
	Biodiversity		**Land use**		**Note**
	System	**Performance**	**System**	**Performance**	
Principle 9: Maintenance of High Conservation Value Forests	X	X	X	X	"Forest managers should conduct an assessment of HCVFs in accordance with relevant national and regional legal and regulatory frameworks"
PEFC					PEFC plays no role in the development of international forestry principles. Instead it relies on intergovernmental principles developed and adapted for different regions of the world. Examples are the Pan European Principles for European Forests or the ATO/ITTO principles
Criterion 5.4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems	X		X		
Biofuels and biomass					
Cramer criteria (NL)					A reporting obligation has been proposed where performance indicators are still missing for the following themes: 1. Land use change 2. Biodiversity 3. Protection of local 4. Ecosystems
3. Biodiversity	X		X	X	
Green Gold Label					Certificate system for sustainable biomass. It covers production, processing, transport and final energy transformation. Green Gold Label (GGL) offers standards for specific parts of the supply chain, as well as standards for track and trace
GGLS2: Agricultural Source Criteria: Principle 2. The agriculture management system is based on land-resource planning			X		
GGLS5 - Forest Management Criteria: Principle 2: Management plan	X		X		Several forest management certification systems are suggested. A general observation is that the weakest forest certification system determines the quality of the GGL standard
Principle 3: Environmental impact	X	X	X	X	
Principle 4: Monitoring and assessment	X	X			
GGLS7 – Conservation Stewardship Criteria	X		X		

Biodiversity & land use in certification scheme or sustainability standards					
Certification scheme or sustainability standard **Principles and/or criteria**	**Verification basis**				
	Biodiversity		**Land use**		**Note**
	System	**Performance**	**System**	**Performance**	
ISCC					
Biomass shall not be produced on land with high biodiversity value or high carbon stock and not from peat land. HCV areas shall be protected		**X**		**X**	
NTA 8080					
Biomass production shall not affect protected or vulnerable biodiversity and will, where possible, have to strengthen biodiversity		**X**		**X**	
RED		**X**		**X**	
Better Sugarcane Initiative					
PRINCIPLE 4. Actively manage biodiversity and ecosystem services	X		X		
Vegetal oil and soy					
RSPO					
Criterion 2.2 The right to use the land can be demonstrated, and is not legitimately contested by local communities with demonstrable rights				X	
Criterion 5.1 Aspects of plantation and mill management, including replanting, that have environmental impacts are identified, and plans to mitigate the negative impacts and promote the positive ones are made, implemented and monitored, to demonstrate continuous improvement			X		
Criterion 5.2 The status of rare, threatened or endangered species and high conservation value habitats, if any, that exist in the plantation or that could be affected by plantation or mill management, shall be identified and their conservation taken into account in management plans and operations	X		X		

Biodiversity & land use in certification scheme or sustainability standards					
Certification scheme or sustainability standard **Principles and/or criteria**	**Verification basis**				
	Biodiversity		**Land use**		**Note**
	System	**Performance**	**System**	**Performance**	
Criterion 7.3 New plantings since November 2005, have not replaced primary forest or any area required to maintain or enhance one or more High Conservation Values			X		
Criterion 7.5 No new plantings are established on local peoples' land without their free, prior and informed consent, dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions			X		
RTRS					
Principle 3: Responsible Community Relations			X		
Principle 4: Environmental Responsibility	X				
Basel Criteria (soy)					
3. Environmental Management	X	X	X	X	
Organical agriculture					
IFOAM (International Federation of Organic Agriculture Movements					
The Principle of Ecology: Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water	X		X		

H.5 Biodiversity and land use indicators in certification

When verifying management performance in the field, there are specific elements that are frequently used for verification of status and dynamics of biodiversity and land use.

Biodiversity

One of the most straightforward measures is to do a species inventory (see Notes). Since this is a costly and time-consuming exercise, one usually for the selection of indicator species, the status of which is assumed to reflect ecosystem health. The selection of the species and monitoring methodology is done by local specialists and is frequently the cause of heated debates.
Key questions to be answered are the criteria by which a species is being considered to be representative for the ecosystem, how easy it should be to spot them and what the relationship should be between the to be certified area and the range of the species. If the range is too wide, the species might not be found frequently in the specific area.

Biodiversity Monitoring and Indicator Species

Here we evaluate the usefulness of bio indicators as tools to assess biodiversity conservation in logged tropical forests. First, we surveyed the literature to assess animal responses to logging and, then, determined potential indicator tax, and gaps and advances in this field. Mammals are the main subject of studies addressing the effect of logging on fauna. However, intrinsic characteristics and methodological constraints make their use as bio indicators problematic. (…) Further difficulties were taxonomical complexity, the small number of trained people, the costs of monitoring population trends, the lack of information on the relations between changes in different groups, and the lack of congruence between traditional scales of research (plots) and appropriate scales of land management. The results suggest that until now animal indicators for monitoring logging operations and their impact on fauna may be ineffective to implement in forest management, and should be used only when direct measurement is impossible or highly costly. Useful indicators of environmental health would actually be playing their role of early warning and truly contributing to management plans when, rather than simply showing a change in the ecosystem, they facilitate the assessment of the acceptable degree of habitat modification.

Source: Animal Indicators, a Tool to Assess Biotic Integrity After Logging Tropical Forests? CLAUDIA AZEVEDO-RAMOS, OSWALDO DE CARVALHO JR, ROBERT NASI. IPAM 2005.

Another way to protect biodiversity is by the application of a geographic dimension. Specific areas inside the management area can be excluded of the production area. Criteria are needed to identify areas of high biodiversity and way to monitor them. Size and design are also key elements. Specific percentage of the area should be set aside. Once identified, this is relatively easy to monitor.

Monitoring approaches so far have not provided conclusive information about the effects of certification schemes. This can be because of scientific debate about the methodology of monitoring, time lines and scale. What are the external effects on the area and how to weigh them? Using scientifically approved methodologies provides credibility but can be very costly.

Land use

How much land can be converted into another use? Time as well as geography is an important criterion. In order to prevent conversion of any high conservation valued area (see below) and have it certified afterwards, often a cut-off date is being applied. For example, the Roundtable on Sustainable Palm Oil (RSPO) uses the following criterion: *Criterion 7.3 New plantings since November 2005, have not replaced primary forest or any area required to maintain or enhance one or more High Conservation Values*. FSC forest management certification scheme uses criterion 10.9: *Plantations established in areas converted from natural forests after November 1994 normally shall not qualify for certification.*
As mentioned earlier, geographical dimension rules are set for protected areas within the management unit.

In order to prevent production in specific areas, a framework for High Conservation Values has been developed. The framework is a flexible conservation tool with practical applications in natural resource management. There are HCVA's (High Conservation Valued Areas) and HCVF's (High Conservation Valued Forest). The HCV's include all critical biological, ecological, social and cultural values (see: Notes).

Land Use Rights

Frequently criteria are use, stating that no production can take place on peoples' land without their free, prior and informed consent, dealt with through a documented system. This is not only a social criterion but also ensures control by local peoples on other criteria. The right to use the land has to be demonstrated.

General

Sometimes principles are general but important functions are specified.
In combination with the monitoring principles it can be expected to be performance-based. Where this is the case the certification scheme is treated as such.
The meaning of the criterion "Compliance with applicable laws and regulations" depends on the quality of these in each specific situation. Benchmarks in an international certification scheme set the bottom line.

Performance principles, criteria and/or indicators
Forests and Tree plantations
Certfor (Natural Forest) Biodiversity
PRINCIPLE 2: …biodiversity and ecosystem functions are maintained or improved. 2.2.2 In the FMU it is forbidden to extract, cut or hunt species of fauna or flora that are in danger of extinction or under legal status of protection. 2.2.4 In the FMU there is a person responsible for the protection of environmental priority areas and areas for the protection of biodiversity. Verification. V1 Existence of a responsible person adequately qualified for this work. 2.4.5 In the environmental priority areas there is maintained at least 1 "eternal tree" per hectare. V2: The "eternal trees" reflect the existing variety of species in the succession dynamics of the type of forest in question. 2.5.1 Areas have been identified with fauna and/or flora species in danger of extinction in the red list or declared as such by the authorities. V1: Areas have been identified and localized where fauna/flora species classified as being in danger of extinction by the IUCN Red List or the red book of the CONAF. 2.5.2 Areas have been identified that represent natural habitats present in the FMU. V1: Existence of maps that show distribution of all types of natural habitats of the FMU 2.5.3 At least 10% of the surface of the FMU is maintained as area for biodiversity conservation. 2.6.1 In the areas for biodiversity conservation it is prohibited the extraction, cutting or hunting of any specie of fauna or flora that is threatened in its conservation status as indicated by the red books or competent authorities. 2.6.3 Existence of corridors that connect areas of biodiversity in the FMU. 2.6.4 Existence of buffer zones close to the areas for biodiversity conservation in the FMU.
PRINCIPLE 9: Monitoring and Control. 9.3.1 The FMU has a unique and unambiguous identification system of the identity and origin of the wood.
Certfor (Plantation) land use
PRINCIPLE 1: Long-term planning and objectives. 1.3.1 Master plan contains mapping with clear delimitations of the current distinct uses and potentials of the soil.
PRINCIPLE 2: Biodiversity and native ecosystems. 2.1.3. Plantations do not substitute native forest or any other environmentally high valued vegetation. 2.1.4. The establishment of plantations must not affect the areas that have been identified as biodiversity corridors. 2.1.5. Corridors of native vegetation are left in place where this is possible as a way of ensuring special continuity of these areas.
FSC Biodiversity
Principle #6: Environmental impact 6.3 Ecological functions and values shall be maintained intact, enhanced, or restored, including: a Forest regeneration and succession. b Genetic, species, and ecosystem diversity. c Natural cycles that affect the productivity of the forest ecosystem. NOTE: Although this principle still is general, important functions are specified and in combination with the monitoring principles (below)is expected to be performance-based.

Performance principles, criteria and/or indicators
Principle #8: Monitoring and assessment 8.2 Forest management should include the research and data collection needed to monitor, at a minimum, the following indicators: A Yield of all forest products harvested. B Growth rates, regeneration and condition of the forest. C Composition and observed changes in the flora and fauna. D Environmental and social impacts of harvesting and other operations. E Costs, productivity, and efficiency of forest management.
FSC Land use
Principle #10: Plantations 10.9 Plantations established in areas converted from natural forests after November 1994 normally shall not qualify for certification. Certification may be allowed in circumstances where sufficient evidence is submitted to the certification body that the manager/owner is not responsible directly or indirectly of such conversion.
MTCC
Principle 9: Maintenance of High Conservation Value Forests.
9.1 Assessment to determine the presence of the attributes consistent with High Conservation Value Forests will be completed, appropriate to scale and intensity of forest management. 9.1.1 Forest managers should conduct an assessment of HCVFs in accordance with relevant national and regional legal and regulatory frameworks, appropriate to scale and intensity of forest management operations in the PRFs for Peninsular Malaysia and forest management areas for Sabah and Sarawak, and in consultation with relevant stakeholders and experts.
9.3 The management plan shall include and implement specific measures that ensure the maintenance and/or enhancement of the applicable conservation attributes consistent with the precautionary approach. These measures shall be specifically included in the publicly available management plan summary.
Biofuels and Biomass
Cramer criteria
3. Biodiversity No deterioration of protected areas or valuable ecosystems. Comply with local requirements: – Plantations must not be located in or in the immediate vicinity of ‘gazetted protected areas’ (areas protected by the government) or areas of ‘High Conservation Value’. Reference year for ligneous feedstocks is 1994 (FSC 10.9), for palm oil 2005 (RSPO 7.3), and for other feedstocks 2006.

Performance principles, criteria and/or indicators
Green Gold Label (GGLS5: Forest Management Criteria)
Principle 3: Environmental impact Criteria: 3.1. The forest management is aimed at conservation of biological diversity and forest integrity, water resources, soils, unique ecosystems and landscapes 3.2 The following issues are included in the management plan 3.2a Environment in general: I. Description of current biodiversity (species, count, etc. from flora and fauna). II. Current or future protection measures for flora and fauna. III. Flora and fauna management, the object of which must be to create an ecological balance. IV. Protective forest varieties, plants and animals (overviews, areas). V. Climate, topography, soil types, rainfall catchment areas, etc. VI. Measures taken to prevent erosion, improve soil conditions, etc. VII. General maps indicating those areas that should be labelled as 'protected'. VIII. Disease and pest management. IX. Use of synthetic or chemical pesticides. X. Observational data of re-forestation.
Principle 4: Monitoring and assessment. Criteria: 4.1. Monitoring shall be conducted to assess the condition of the forest, yields of the forest products, and management activities. The results of monitoring shall be incorporated into the implementation and revision of the management plan. 4.2 The following indicators should be included in the monitoring system. 4.2a Yield of all forest products harvested. 4.2b Growth rates, regeneration and condition of the forest. 4.2c Composition and observed changes in the flora and fauna. 4.2d Environmental impacts of harvesting and other operations.

Performance principles, criteria and/or indicators
ISCC International Sustainability and Carbon Certification
Principle 1: Biomass shall not be produced on land with high biodiversity value or high carbon stock and not from peat land (according to Article 17, 3. of the Directive 2009/28/EC and § 4 to 6 of the German BioSt-NachV). HCV areas shall be protected. Biomass is not produced on land with high biodiversity value. This means land that had one of the following statuses in or after January 2008, no matter whether or not the land still has this status: – Forest land. Forest land comprises primary forests and other natural areas that are stocked with native tree species and do not show clearly visible indications of human activity and the ecological processes are not significantly disturbed. Tree species are defined as native, if they grow within their natural geographical range on sites and under climatic conditions to which they have adapted naturally and without human interference. The following tree species do not count as native: • Tree species that have been introduced by humans and that would not occur in that area otherwise. • Tree species and breeds that would not occur on these sites or under these climatic conditions, even if these sites or climatic conditions generally fall within the geographical range of the species. Clearly visible indications of human activity are: • Land management (e.g. wood harvest, forest clearance, land use change). • Heavy fragmentation through infrastructural constructions such as roads, power lines, etc. • Disturbances of the natural biodiversity (e.g. significant occurrence of non-native plant or animal species). Activities of indigenous people or other humans managing the land in a traditional way do not count as clearly visible indications of human activity, if they manage the forest on a subsistence level and their influence on the forested area is minimal (e.g. the collection of wood and non-timber products, the felling of a few trees as well as small-scale forest clearance according to traditional management systems). – Areas designated by law or by the relevant competent authority to serve the purpose of nature protection. Areas for nature protection purposes comprise areas that are designated by law or by the relevant competent authority to serve the purpose of nature protection as well as ISCC 202 Sustainability Requirements areas that have been acknowledged by the European Commission as areas for the protection of rare, threatened or vulnerable ecosystems or species. In Germany, all areas designated to serve the purpose of nature protection are protected parts of nature and landscape on the basis of the and the nature conservation acts of the states. They include the biotopes protected by federal or state law as well as Natura 2000 areas, nature conservation areas, national parks, national natural monuments, biosphere reserves, landscape protection areas, natural parks, natural monuments and protected landscape elements according to the Federal Act for the Protection of Nature of July 29th 2009 (BGBl. I, S. 2542) entering into force on March 1st 2010. Comparable legal regulations must be regarded in other countries. It is allowed to grow biomass on areas that serve the purpose of nature protection as long as the cultivation and the harvest of the biomass do not compromise the defined protection purpose. The protection purpose and the respective imperatives and interdictions must be followed according to the relevant protected area declaration. As long as a Natura 2000 area has not been placed under protection order, the relevant preservation objectives are authoritative. – Areas for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature. Biomass is not produced on grassland with high biodiversity.

Performance principles, criteria and/or indicators
Grassland of high biodiversity is defined as grassland which in the absence of human intervention would: 1. Remain grassland of intact natural species composition, ecological characteristics and processes (natural grassland); or 2. Not remain grassland and which is rich in species and not degraded (artificial grassland), unless there is evidence that the harvesting of the biomass is necessary to preserve its grassland status. Natural grassland develops under certain climatic and other factors (e.g. natural grazing, natural fires) preventing succession to dense forest. Its special characteristic is to remain grassland without any effort of humans. Natural grassland with high biological diversity is characterized by intact ecological traits and processes as well as a natural species composition. A significant occurrence of invasive species, for instance, could indicate that a natural grassland does not feature a natural species composition. A disturbance of ecological traits and processes can be caused by a significant change through man, for instance. As long as this influence does not cause a change in the natural species composition or a significant disturbance of the ecological traits and processes, an area is still to be regarded as natural grassland. In savannahs, for instance, extensive pasturing and anthropogenic fire do not pose a significant disturbance. Artificially created grassland is mainly agricultural land permanently cultivated for green fodder; it can be permanent grassland such as meadows, mowing pastures and grazing pastures. Biomass can not be harvested from areas that have been declared natural grassland of high biodiversity in January 2008 or thereafter. Whereas biomass is allowed to be harvested from artificially created grassland with high biodiversity, in case the preservation of the grassland status requires the harvest of the biomass. Local conditions of species richness must be regarded when evaluating whether a grassland features high biodiversity. Here, species richness must be assessed along the lines of the biogeographical conditions and site conditions (e.g. a species inventory for that region, if available). In case, of a land use change from a grassland without high biodiversity, the greenhouse gas emissions caused by that change must be incorporated into the green house gas balances. As long as no geographic areas featuring grassland with high biodiversity are determined, natural grassland is generally not allowed to be used for biomass production. Neither can artificially created grassland with high biodiversity be used. In case artificially created grassland areas are not permanently managed as grassland, but form part of a crop rotation system (fallow, rotations of pasture and cropping), they are to be treated as farmland on which biomass can be grown and used according to the sustainability ordinances. Set-aside farmland still counts as agriculturally managed land. The right to use this land after termination of the set-aside period in the same way and to the same extent endures. This holds also for areas that have changed in the course of the set-aside period. Thus, grassland areas that have evolved on former set-aside areas are generally suitable for the production of biomass.
NTA 8080
Principle 4: biodiversity *Biomass production shall not affect protected or vulnerable biodiversity and will, where possible, have to strengthen biodiversity* – National regulations and laws biomass production and production area The organisation shall: a Prove, as far as applicable, that the national laws and regulations are known in general and the laws and regulations with respect to land ownership and land use rights, forest and plantation management, forest and plantation exploitation, protected areas, wildlife management, hunting, spatial planning and the rules arising from signing of international conventions in particular. b Take measures which are needed to ensure that the requirements of the mentioned laws and regulations are complied with. c Take measures which are needed to ensure that the changes in applicable laws and regulations and the enforcement of these are established and applied properly. – Protected areas. The biomass production shall not be practised in a ‘gazetted protected area’ or in a zone which at any point is moved off a distance less than 5 km from a ‘gazetted protected area’. Biomass production in ‘gazetted protected areas’ or in a zone of 5 km around these areas is only then permitted when: a Biomass production is permitted according to applicable laws and regulations (under provisions) in the area.

Performance principles, criteria and/or indicators
b Biomass production is part of acknowledged management to protect the biodiversity values in areas that owe their great 'historical' biodiversity value to human intervention. c Biomass production at the production location is started before 1 January 2007, or a reference date from other certification systems (currently under development), and has taken place since in a continuous series of production cycles. The positions of protected areas indicated by governments shall be verified by means of the following sources: a "World heritage sites" of UNESCO (http://whc.unesco.org/en/list/). b IUCN List of protected areas of IUCN categories I, II, III and IV, according to the list available in the "world database on protected areas" (http://www.wdpa.org). c Ramsar areas, being wetlands falling under the "Convention on wetlands" (http://www.ramsar.org/), according to the available list (http://www.ramsar.org/index_list.htm) or more updated surveys or national data. d "integrated biodiversity assessment tool" (IBAT) (http://www.ibatforbusiness.org/ibat/). – Areas with high conservation value. The biomass production shall not be practiced in areas which are pointed out as areas with 'high conservation value' in dialogue with stakeholders or in a zone which at any point is moved off a distance less than 5 km from an area with 'high conservation value'. Biomass production in areas with 'high conservation value' or in a zone of 5 km around these areas is only permitted when: a It is demonstrated that by biomass production the 'high conservation values' of an area is not affected. b Biomass production is part of acknowledged management to protect the biodiversity values in areas that owe their great 'historical' biodiversity value to human intervention, such as reed-lands and heath lands. c Biomass production at the production location is started before 1 January 2007, or a reference date from other certification systems (currently under development), and has taken place since continuously. – Maintenance and recovery of biodiversity. The organisation shall: a At least 10% of the functional soil area of the production unit left covered with the original vegetation, representative for the area, for recovery of biodiversity. b Record in which land use zone the production unit is located. c Record whether the biomass production contributes to the recovery of degraded areas within the production unit. d Establish and record measures in management plans and monitor, measure and analyse these measures. e Document the results. The principle of precaution applies to 'high conservation values' within the production unit. In accordance with the scale of the production unit parts of the production are indicated for the purpose of this 'high conservation values', where no exploitation occurs and on which disruption by other activities is minimized. The 'high conservation values' which appear in the production unit are described in the management plan and, as far as possible, indicated on the map. – Strengthening of biodiversity The organisation shall: a Take measures, which are needed, where possible, to improve the biodiversity within the production unit and to limit fragmentation and disintegration of natural land on and through the production unit. b Take measures, which are needed to ensure that disruption of the environment by entering, use of agrochemicals, noise and invasion of exotic species from the production unit. c Establish and record measures in management plans and monitor, measure and analyse these measures. d Document the results.

Performance principles, criteria and/or indicators
RED
Article 7, paragraph 3 Biofuels and bio liquids taken into account for the purposes referred to in points (a), (b) and (c) of paragraph 1 shall not be made from raw material obtained from land with high biodiversity value, namely land that had one of the following statuses in or after January 2008, whether or not the land continues to have that status: – Primary forest and other wooded land, namely forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed. – Areas designated: (i) By law or by the relevant competent authority for nature protection purposes; or (ii) For the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature, subject to their recognition in accordance with the second subparagraph of Article 18(4); unless evidence is provided that the production of that raw material did not interfere with those nature protection purposes. – Highly biodiverse grassland that is: (iii) Natural, namely grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes; or (iv) Non-natural, namely grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status. – The Commission shall establish the criteria and geographic ranges to determine which grassland shall be covered by point (c) of the first subparagraph. Those measures, designed to amend non-essential elements of this Directive, by supplementing it shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 25(4).
Vegetal oil and soy
Basel Criteria (soy)
3. Environmental Management
3.1 Conversion of natural ecosystems
3.1.1 Primary vegetation and High Conservation Value Areas2 should not be converted to Agricultural land. General Guidance: Local interpretation should refer to existing national definitions of HCVA or equivalent land use conservation plans or consider how growers and the audit team can identify High Conservation Value Areas.
3.1.2 The farm should not be planted on land that has been deforested after 1994 unless commensurate conservation offset measures have been undertaken by the grower.
3.3.1 An understanding of the plant and animal species and habitats that exist inside and around the farm should be established General guidance: Information for large farms should include: Presence of protected areas in the locality of the farm; Details of any legally protected, red-list, rare, endangered or endemic species in and around the farm including population and habitat requirements; Identification of the range of habitats and ecosystems within the farm.

Performance principles, criteria and/or indicators
RSPO Land use
Principle 2: Compliance with applicable laws and regulations Criterion 2.1 There is compliance with all applicable local, national and ratified international laws and regulations. Indicators: – Evidence of compliance with relevant legal requirements. – A documented system, which includes written information on legal requirements. – A mechanism for ensuring that they are implemented. – A system for tracking any changes in the law. The systems used should be appropriate to the scale of the organisation.
Criterion 2.2 The right to use the land can be demonstrated, and is not legitimately contested by local communities with demonstrable rights. Indicators: – Documents showing legal ownership or lease, history of land tenure and the actual legal use of the land. – Evidence that legal boundaries are clearly demarcated and visibly maintained. – Where there are, or have been, disputes, additional proof of legal acquisition of title and that fair compensation has been made to previous owners and occupants; and that these have been accepted with free prior and informed consent. – Absence of significant land conflict, unless requirements for acceptable conflict resolution processes (criteria 6.3 and 6.4) are implemented and accepted by the parties involved.
Criterion 2.3 Use of the land for oil palm does not diminish the legal rights, or customary rights, of other users, without their free, prior and informed consent. Indicators: – Maps of an appropriate scale showing extent of recognised customary rights (criteria 2.3, 7.5 and 7.6). – Copies of negotiated agreements detailing process of consent (criteria 2.3, 7.5 and 7.6).
Principle 7: Responsible development of new plantings. Criterion 7.3 New plantings since November 2005, have not replaced primary forest or any area required to maintain or enhance one or more High Conservation Values. Criterion 7.5 No new plantings are established on local peoples' land without their free, prior and informed consent, dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions.

H.6 Conclusions

- Certification does not provide conclusive information about the management unit as a result of methodological challenges with monitoring/verification. However, recent research about the impact of certification of forest management concluded that it is a useful conservation tool and ‘that Forest Management Units (FMU) being evaluated nowadays have fewer issues raised (corrective action requests or CARs) than FMUs evaluated in the past. This result suggests that FMU now have higher working standards than in the past. (…) results also indicate that certification is likely to have a large impact on the long-term sustainability of forest management mainly because FMU are requested to improve their monitoring system and to incorporate the results of the monitoring system into their management practices.’ (Peña-Claros, Blommerde and Bongers, 2009). Recent research also suggests that forest management certification in the difficult tropics is beneficial for biodiversity.
- For biofuels, the European Commission has conducted 15 studies on different crops, which on average conclude that over the next decade Europe's biofuels policies, might have an indirect impact equal to 4.5 million hectares of land – an area the size of Denmark. It is still too early to provide conclusive information about the effects of certification schemes.
- Certification is based on a production unit (forest or plantation). It provides criteria for land use within the unit but is not considered to be a land use planning tool. Land use planning is usually on a broader scale of which a forest or plantation can only an element.
- In most certification systems a general criterion is formulated in terms of maintaining biodiversity and/or ecological functions and values.
- Main elements of performance-based criteria for biodiversity/land use are;
  - Biodiversity:
    - Species inventories.
    - Monitoring.
    - Protected areas and HCV.
  - Land use:
    - Land conversion: By setting rules (cut-off dates) management unit can be prevented from still getting certified after clear-cutting HCVA.
    - Land use rights.
  - General
    - Some principles can be considered performance-based when supported by measurable monitoring system.
    - Compliance with applicable laws and regulations can be performance-based, depending on specific situation. But is can be said certification requires legal status of management.

H.7 Challenges

- Demonstrate the role of scale and landscape. For supportive policies and certification implementation to be effective, good understanding of the multi-scale implications is fundamental.
- Link micro (certification), meso and macro levels.
- Demonstrate evidence of the relationship between certified forest management and the protection of biodiversity.
- Define the biodiversity in need to be protected.
- Reach agreement on required level of verification and monitoring for specific uses.
- Because of competition of different uses, ensure a certification system for a specific feedstock is applicable for all of them (e.g. certification of palm oil for food and energy).
- Certification can take advantage of the opportunities offered by REDD (Reduced Emissions of Deforestation and forest Degradation) by showing its carbon storage effects. Biodiversity concerns and local community participation should be an integral part of those efforts.

H.8 Notes

High conservation value areas (HCVA)

The High Conservation Value (HCV) framework is a valuable and flexible conservation tool with practical applications in natural resource management, land use planning, the design of responsible purchasing and investment policies and conservation advocacy. The adoption and national interpretation of HCVs has been driven by timber and pulp companies (for privately managed forests worldwide), national governments (for public forests, particularly in Romania and Bulgaria), and international conservation NGOs. Increasing numbers of landscape-level HCVF maps are being produced to help forest managers make informed site-level decisions.

Development of the HCV framework: The HCV concept was introduced for forest management certification by the Forest Stewardship Council (FSC, 1999), to define forest areas of outstanding importance – High Conservation Value Forests (HCVF). The HCVs include all critical biological, ecological social and cultural values. The HCV framework requires that land use managers must *identify* any HCVs that occur within their forest management units, *manage* them in order to maintain or enhance the values identified, and *monitor* the success of this management. Within natural forests, appropriate HCV management may range from complete protection to careful extractive uses such as selective logging, depending on the specific context.

HCVs in forest certification: The number and quality of HCV assessments carried out for certification purposes has steadily increased. In addition to FSC, the Malaysian Timber Certification Council (MTCC) has also adopted HCVF in its standard.

HCVs in agriculture and carbon certification. The value of the HCV framework has been recognised by other certification schemes for agricultural commodities. Major palm oil producers, buyers and social and environmental NGOs convened at the Round Table on Sustainable Palm Oil (RSPO) to agree on a set of sustainability principles and criteria, including HCV protection (RSPO Standard 2007). RSPO certified oil became available in 2008. HCV areas are also singled out for protection in the Basel Criteria for Responsible Soy Production, the Round Table on Responsible Soy (RTRS), the Round Table on

Sustainable Biofuels (RSB), the UK Renewable Transport Fuel Obligation (RTFO), the Dutch Cramer Commission for Sustainable Production of Biomass, and the Climate, Community and Biodiversity Alliance (CCBA) Standard for carbon projects.

Species inventories

For biodiversity monitoring, species inventories are usually required. However, this can be a time-consuming and costly exercise and is full of scientific challenges. The main questions are what species to monitor and how to do it.

For good monitoring, the definition of indicator species or taxa that could be an indicator for ecosystem health is often attempted. Indicator taxa or bio indicators are species or higher taxonomic groups whose characteristics (e.g. presence/ absence; population density, dispersion, reproductive success) can be used as an index for attributes too difficult or expensive to measure for other species or environmental conditions of interest (Landres et al.1988; Hilty and Merenlender, 2000).

Birds have been suggested to be good biological indicators of landscape degradation because they respond to habitat changes at several scales, perform important ecological functions in forests (e.g. predators, pollinators and seed dispersers) and are easily detected. Also mammals have been proposed but indirect effects such as increased hunting after logging make their response hard to interpret. Examples of times are the jaguar in the Amazon and forest elephants in the Congo Basin.

Monitoring approaches thus far, have not provided conclusive information about the effects of certification schemes. Reasons given for this are the high costs of conventional monitoring (and consequently the relatively small sample sizes), which does not permit representative sampling.

H.9 Status of the schemes

Forests and tree plantations	
CERTFOR	CERTFOR (Sistema Chileno de Certificación de Manejo Forestal Sustentable) is a Chilean private company that was established in 2002 as an outcome of a project developed by Fundación Chile, INFOR y CORFO. Its objective is the administration and periodic updating of its forest management standards and procedures.
Status	1.9 million ha
Geographical coverage:	Chile
Scope:	Forests, tree plantations and Chain of Custody
Initiator system:	Fundación Chile, INFOR y CORFO
Website	http://www.certfor.org
FSC	FSC *certification* is a voluntary, market-based tool that supports responsible forest management worldwide. *FSC certified* forest products are verified from the forest of origin through the supply chain. The FSC label ensures that the forest products used are from responsibly harvested and verified sources.
Status	– Total certified area: 134,211,624 ha. – No. countries: 81. – Total no. certificates: 1005.
Geographical coverage:	Global.
Scope:	Forests, tree plantations and Chain of Custody.
Initiator system:	In the wake of the UN Conference on Sustainable Development in 1992 (Rio Summit), concerned business representatives, social groups and environmental organizations got together and established the Forest Stewardship Council. Its purpose is to improve forest management worldwide.
Website	http://www.fsc.org
MTCC	The Malaysian Timber Certification Council (MTCC, established in October 1998) is an independent organisation established to develop and operate the Malaysian Timber Certification Scheme (MTCS) in order to provide assessments of forest management practices in Malaysia.
Status	A total of nine *Certificates for Forest Management* have been issued to Forest Management Units (FMUs) covering 4.83 million hectares or 34% of total permanent reserved forests (PRFs) in Malaysia. Malaysia exports yearly fora bout € 150 million of tropical timber to the Netherlands. This make the Netherlands the biggest buyer of MTCS certified timber from Malaysia. The Dutch Timber Procurement Assessment Committee (TPAC) changed its initial recognition based on the objection lodged by several NGOs and is awaiting a final decision.
Geographical coverage:	Malaysia.
Scope:	Forests, tree plantations and Chain of custody.
Initiator system:	
Website	http://www.mtcc.com.my
PEFC	Worldwide framework for mutual recognition of forest certification schemes since 2002 (on European level since 1999).
Status	– 232 million hectares of forest area. – Two-thirds of all certified forests globally are certified to PEFC. – Represented by national members in 34 countries.
Geographical coverage:	Global.
Scope:	All forest types.
Initiator	Founded in 1999 by PEFC governing bodies.

Forests and tree plantations	
System:	
Website	www.pefc.org
Biofuel and Biomass	
Cramer criteria	
Status	Standard available.
Geographical coverage:	Globally applicable.
Scope:	All biomass.
Initiator system:	Dutch government.
Website	http://www.senternovem.nl/mmfiles/412293MEZ%20biomassa%20EN_tcm24-198026.pdf
Green Gold Label	The Green Gold Label programme is a certificate system for sustainable biomass. It covers production, processing, transport and final energy transformation. Green Gold Label (GGL) offers standards for specific parts of the supply chain, as well as standards for track and trace.
Status	Over 5 million tones of biomass certified. Green Gold Label is establishing partnerships with emerging standards like the Dutch NTA8080 based on the Cramer Criteria and the EU CEN. Currently over 25 suppliers of biomass are certified producers, verified by accredited certification body Control Union Certifications.
Geographical coverage:	Global.
Scope:	Biomass.
Initiator system:	Green Gold Label was established in 2002 by Dutch energy company Essent and Skall International (now Control Union Certifications).
Website	http://www.greengoldcertified.org/
ISCC	
Status	After successful pilot testing, ISCC prepares for recognition and regular operations.
Geographical Coverage	
Scope	Most relevant crops pilot projects: EU rape, EU corn/weat, Brazil sugar cane, Brazil soy, Argentina soy, Malaysia palm oil.
Initiator system	
Website	www.iscc-project.org
Vegetal oil and soy	
RSPO	RSPO is a not-for-profit to develop and implement global standards for sustainable palm oil.
Status	Production capacity for RSPO-certified sustainable palm oil has increased in 2010 strongly, from 1,4 million tonne in January to 3,4 million tonne in December. This concerns total capacity of certified companies, including oil palm plantations as well as small palm oil producers. Actual production of RSPO-certificated palm oil was 2,3 million tonne in 2010, against 1,3 million tonne in 2009.
Geographical coverage:	Indonesia and Malaysia account for 85 percent of the global production.
Scope:	Palm oil.
Initiator system:	Unites stakeholders from seven sectors of the palm oil industry - oil palm producers, palm oil processors or traders, consumer goods manufacturers, retailers, banks and investors, environmental or nature conservation NGOs and social or developmental NGOs.

Forests and tree plantations	
Website	http://www.rspo.org
RTRS	The Round Table on Responsible Soy (RTRS) is an international multi-stakeholder initiative founded in 2006 that promotes the use and growth of responsible production of soy, through the commitment of the main stakeholders of the soy value chain and through a global standard for responsible production.
Status	At the General Assembly in June of this year, the members of the RTRS approved version 1.0 of the RTRS Standard. At the beginning of 2011 RTRS soy will be available for the market place, RTRS certified.
Geographical coverage:	Global.
Scope:	Soy.
Initiator system:	Multi stakeholder meeting. Membership is open to actors of the soy value chain and civil society.
Website	http://www.responsiblesoy.org/
Organic agriculture	
IFOAM	IFOAM is a worldwide umbrella organization for the organic movement. IFOAM provides "The Organic Guarantee System (OGS)" that unites the organic world through a common system of standards, verification and market identity.
Status	More than 750 member organizations in 116 countries.
Geographical coverage:	Global.
Scope:	Organic Agriculture.
Initiator system:	In 1972, the President of the French farmers' organization, Nature et Progrès conceived of a worldwide appeal to come together to ensure a future for organic agriculture. From there, people working in alternative agriculture banded together.
Website	http://www.ifoam.org/index.html

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Annex I Biodiversity Important for both Industry and NGOs

I.1 Introduction

Biodiversity is important for both industry and NGOs. Biodiversity is a worldwide issue that is difficult to regulate without the support of multinational companies and NGOs. In this chapter, we analyse how business, sustainability organisations, individual companies and NGOs deal with biodiversity. We focused on multinational companies based in the Netherlands. This analyse shows that in particular, the biochemical company DSM and the food company Unilever have strong statements on the protection of biodiversity and they also have concrete projects on this issue. It is not surprising that NGOs recognise the importance of biodiversity.

I.2 Industry views on biodiversity

I.2.1 WBCSD on biodiversity

Since 1997, the World Business Council for Sustainable Development has been working together with IUCN on guidelines for protection of biodiversity by business.
http://www.wbcsd.org/web/publications/business_biodiversity1997.pdf

Also in 2010, the WBCSD worked together with IUCN on biodiversity and presented their vision at the Nagoya CBD summit.
http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=NzE&doOpen=1&ClickMenu=LeftMenu

Key messages:

- The WBCSD strongly supports the key principle of The Economics of Ecosystems and Biodiversity (TEEB) report for policy makers; namely, that biodiversity and ecosystem values should be integrated more consistently and effectively into policy and regulation.
- Businesses have a strong interest in ensuring ecosystems continue to function properly to deliver both business and societal value. To this end, businesses are already helping to deliver improved conservation outcomes through their own actions including through investment in conservation-related research and development, through the creation and strengthening of sustainable supply chains and through programmes which build capacity, transfer technology and enhance monitoring and reporting performance.
- Businesses are keen to work more closely with policy makers on the design and implementation of biodiversity and ecosystem related policy and this collaboration can significantly improve the chances of delivering policies that work.
- A framework for closer collaboration between business and policy makers on biodiversity conservation is needed. This framework should include a more defined role for business within the Convention on Biological Diversity as well as in other multilateral environmental agreements.
- Much biodiversity and ecosystem policy and regulation relies on the private sector in its implementation, and in any event, it is often the private sector which has the resources and flexibility to develop and implement solutions at scale. For these reasons, as part of increased involvement

from business it is essential that overarching objectives and targets are designed to be relevant for business.
- New biodiversity and ecosystem policy and regulation should draw from successful examples from other policy fields and should seek to build on and scale up successful private sector voluntary initiatives in the field of biodiversity and ecosystem conservation.
- New biodiversity and ecosystem policy and regulation should also be based on sound principles, and Section 1.4 in this paper provides a view from business to inform these. Principles should include providing clear signals for business, creating a level playing field, recognising the importance of property rights, being mindful of potential economic and social impacts and adaptable to cultural differences between nations.
- This paper primarily focuses on proposals for new biodiversity and ecosystem policy and regulation. However, it is important to note that in many cases it is not new policy and regulation that is required, but the capacity and resources for more effective implementation and enforcement of existing policy and regulation.
- Beyond policy and regulatory reform, governments can take a leading role in the implementation of measures to enhance biodiversity and ecosystems by using their direct influence over state owned enterprises to drive the implementation of such measures.

I.2.2 BBOP, Business Biodiversity Offsets

http://bbop.forest-trends.org/
"The Business and Biodiversity Offsets Program (BBOP) is a partnership between companies, governments and conservation experts to explore biodiversity offsets. We are:
- Demonstrating conservation and livelihood outcomes in a portfolio of biodiversity offset pilot projects.
- Developing, testing, and disseminating best practice on biodiversity offsets. And
- Contributing to policy and corporate developments on biodiversity offsets so they meet conservation and business objectives.

The BBOP partners wish to show, through a portfolio of pilot projects in a range of industry sectors, that biodiversity offsets can help achieve significantly more, better and more cost-effective conservation outcomes than normally occurs in infrastructure development. The BBOP partners also believe that demonstrating no net loss of biodiversity can help companies secure their license to operate and manage their costs and liabilities."

Developers should pursue biodiversity offsets only at the end of the mitigation hierarchy, after they have reduced and alleviated residual environmental harm as much as possible. Biodiversity offsets can be used to compensate for the residual impact to biodiversity that cannot be mitigated onsite and therefore balance the impact of the project.

Offset activities:

Each offset must demonstrate additional, measurable conservation outcomes. While appropriate offset activities will vary from site to site, a range of different land (and marine) management interventions could typically be involved in biodiversity offsets, including:
- Strengthening ineffective protected areas: Improving the conservation status of certain neglected zones in a forest reserve by replanting degraded areas with native species and/or removing invasive alien species.
- Safeguarding unprotected areas: For instance, by entering into agreements with local communities as custodians of biodiversity.

- Addressing underlying causes of biodiversity loss: Working with communities to address their livelihood needs to support alternative sustainable livelihoods, such that unsustainable activities (currently depleting biodiversity – e.g. charcoal burning or crop plantation in forests) are stopped.
- Establishing corridors: Identifying and securing the conservation management of land that provides biological corridors between protected areas.
- Establishing buffer zones: For instance, around a national park lacking a buffer zone.
- Zoning marine areas: For example, demarcating and protecting areas important for feeding and breeding. Working with companies and communities to avoid exploitation in these areas. Supporting sustainable aquaculture initiatives for communities to compensate for lost income.
- Securing migration paths: Establishing interventions to secure migration paths.
- Removing goats from a biologically sensitive site which is being overgrazed.

I.2.3 Natural value initiative

The Natural Value Initiative (NVI) has developed a toolkit to enable the finance sector to (http://www.naturalvalueinitiative.org/):

- Evaluate how well the food, beverage and tobacco (FBT) sectors are managing biodiversity and ecosystem services risks and opportunities.
- Engage with FBT companies to reduce their risk exposure through the responsible management and harvesting of natural resources.

We are currently revising this toolkit for application to other sectors including mining, oil and gas and biofuels.

The toolkit consists of the following:

- The Ecosystem Services Benchmark: The ESB has been developed to enable institutional investors to better understand the risks and opportunities associated with the impacts and dependencies of the companies in which they invest in relation to biodiversity and ecosystem services.
- The Ecosystem Services Benchmark Guidance Document: This document describes the Ecosystem Services Benchmark (ESB), its content, application, strengths and weaknesses.
- The Ecosystem Services Benchmark V1: A template of the benchmark in Microsoft Excel.
- Linking shareholder and natural value: A report from our pilot study of the tool.
- A briefing document for the food, beverage and tobacco sectors on biodiversity and ecosystem services: A document outlining the business case for managing dependence and impacts on ecosystem services focusing on the food, beverage and tobacco sectors.

I.2.4 GRI

Biodiversity in included in the reporting guidelines of the GRI
http://www.globalreporting.org/ReportingFramework/G3Guidelines/

Biodiversity: a GRI reporting resource (2007)

Biodiversity is among the core G3 indicators, but is a challenging area for reporting. The resource document assists reporting organizations to understand biodiversity issues; the relationship to their activities and operations; discusses how the GRI Guidelines can be used to report on

biodiversity; and provides further resources to help organizations with their biodiversity reporting.
In 2007, the GRI presented a biodiversity reporting resource report http://www.globalreporting.org/NR/rdonlyres/07301B96-DCF0-48D3-8F85-8B638C045D6B/0/BiodiversityResourceDocument.pdf.
It is a general introduction on biodiversity including management suggestions for biodiversity reporting.

I.3 Individual companies views on biodiversisty

We checked the biodiversity statements of several large Dutch companies in several areas:
- Shell (petrol)
- Unilever (food)
- Philips (electronics)
- DSM (biochemistry)
- FrieslandCampina (dairy)

The following larger Dutch companies have statements on biodiversity.

I.3.1 Shell

The global oil company is used to work in sensitive areas.
The company reports on biodiversity (http://www.shell.com/home/content/environment_society/environment/biodiversity/) in 3 manners:

1. Biodiversity important for all operations
(http://www.shell.com/home/content/environment_society/environment/biodiversity/shell_biodiversity/)

Shell presents the following vision on biodiversity:

"Why does Shell care about biodiversity?
The growing human population using more resources is leading to an unprecedented decline in animal and plant species – for example, more than 17,000 plants and species were officially listed as endangered in 2008 compared to around 11,000 in 2000. Twenty percent of tropical forests and 50% of global wetlands have been destroyed in the past 50 years. Governments urgently need to find the right balance between development and nature conservation, according to the 2005 Millennium Eco-system Assessment. The spread of housing and farming is the biggest problem, but producing energy plays a role – from searching for oil and gas in sensitive areas to the extra land needed for energy infrastructure and increasingly for energy crops for biofuels.

Helping to protect biodiversity makes business sense for Shell. We must meet legal and regulatory requirements. But it also reduces our operational and financial risk by ensuring we get our projects right. It helps to build trust with regulators and third parties so our projects can win approval and acceptance, it can make us the first choice for business partners, and can attract and motivate staff.

Addressing issues early on
Assessing biodiversity is part of the impact assessments we perform for any new major project or large expansions to existing operations. This can influence decisions and project design.

If an area is rich in biodiversity we engage with the local communities and experts and develop biodiversity action plans. These plans help us to set targets, define specific actions and monitor progress to ensure our biodiversity objectives are met."

2. Operating in areas with high biodiversity
http://www.shell.com/home/content/environment_society/environment/biodiversity/

3. Working with biodiversity experts
Shell signed partnerships with the International Union for Conservation of Nature (IUCN) in 2007, with Wetlands International in 2008 and with The Nature Conservancy in 2009.

I.3.2 Unilever

Unilever has a global food company a close relation to agriculture and biodiversity.
http://www.unilever.com/sustainability/environment/agriculture/biodiversity/index.aspx

Vision

Biodiversity – the richness and variety of nature – is essential to the preservation of a healthy environment. Its decline reduces the pool of biological resources available to future generations.

Unilever's impact

The UN Convention on Biological Diversity – which aims to preserve biodiversity – has been signed by more than 160 countries.
Human activity can reduce biodiversity through, for example, intensive agriculture, destructive fishing practices or over-exploitation of natural resources such as forests and water. This is an issue for Unilever. Around half the raw materials we buy come from agriculture and forestry, measured by volume. We are among the world's largest users of agricultural raw materials such as tea, vegetables and vegetable oils. Growing our business – while conserving biodiversity – is a substantial challenge. We seek to ensure that our agricultural activities have minimal adverse effects on the number and variety of species found in a particular area or region.

Sustainable agriculture

Protecting biodiversity is central to our Sustainable Agriculture Programme. Sustainable agriculture is ultimately about sustainable use of biological resources. One of four principles in Unilever's Sustainable Agriculture Programme is: "Ensuring any adverse effects on… biodiversity from agricultural activities are minimised and positive contributions are made where possible". Biodiversity is one of the 11 core indicators used to measure sustainable farming practices.

We have developed biodiversity action plans for Unilever tea estates in Tanzania and Kenya, our farm research site at Colworth in the UK, Unilever palm oil plantations in Ghana, and our suppliers' tomato farms.

Biodiversity impact studies have also been carried out in Ghana and Tanzania, where we are working with local smallholder farmers on the cultivation of allanblackia, a crop which provides a new type of oil that can be used to make margarines and spreads with lower saturated fat content. On the basis of this, and in collaboration with the International Union for Conservation of Nature

(IUCN), we have developed and are implementing landscape restoration programmes.

Unilever is content with the high score on the NVI indicator
In 2009 a new analysis was published, evaluating how well a company manages its dependence and impact on biodiversity and ecosystem services, and covering companies in the food, beverage and tobacco sectors. The analysis was based on the Natural Value Initiative's (NVI) Ecosystem Services Benchmark. The analysis aims to enable investors to assess the level of risk of investing in companies that rely heavily on certain ecosystem services to carry out their business.

The benchmark results were published in October 2009 and presented to the United Nations Environment Programme (UNEP) Finance Initiative Roundtable in South Africa. Unilever was placed at the top of the benchmark ahead of more than 30 companies. We scored 78% overall while the sector average was 48%. Unilever's agricultural sourcing was recognised as best practice within the foods, beverage and tobacco industries in the UK, Brazil, the US, Australia, Switzerland, Malaysia, the Netherlands and France.

The benchmark methodology considers five performance categories: competitive advantage, governance, policy and strategy, management and implementation, and reporting. Unilever was deemed to be strongest in the categories of competitive advantage and policy and strategy.

Ecosystem services are the benefits that people obtain from ecosystems, such as freshwater and timber. The NVI states that over 60% of these services worldwide are being degraded or used up faster than they can be replenished.

The NVI is funded by the Dutch government and made up of three organisations: the world's first international conservation body Fauna & Flora; http://www.unilever.com/sustainability/environment/agriculture/biodiversity/index.aspxUNEP and the global financial sector); and the Fundação Getulio Vargas, a business school in Brazil.

Example: Biodiversity action plan in Tanzania
http://www.unilever.com/sustainability/casestudies/Biodiversity/tanzaniabiodiversityactionplan.aspx Unilever Tea Tanzania (UTT), formerly Brooke Bond Tanzania, has developed a biodiversity action plan to help preserve ecosystems in the country's Eastern Arc region.

I.3.3 Philips

Philips has no biodiversity policy. As an electronic company Philips focuses on energy, climate change and toxic components in there environmental policies.

I.3.4 DSM

DSM is also active with biodiversity.

Fokko Wientjes, director sustainable development
"Biodiversity is the backbone of all life on earth"
http://www.dsm.com/en_US/downloads/sustainability/triple_p_2009_43.pdf

Fokko Wientjes, Director Sustainable Development at DSM, says:
"Biodiversity is defined as variability among living organisms and ecosystems. This variability is an important condition for life on earth and it is vital for human survival. A variety of plants and animals are needed to provide us with food, clean water and fresh air. Ecosystems regulate our climate, contribute

to our health and provide us with important recreational services. DSM benefits from biodiversity as a source of inspiration and innovation. We have started a discussing how to include biodiversity in our sustainability policies. According to the International Union for the Conservation of Nature (IUCN), the world is facing a serious crisis in biodiversity. The rate at which animal and plant species are becoming extinct and the pace at which natural environments are being destroyed are increasing every day. This escalating loss is a serious threat to humankind and our way of life, now and in the future. DSM started several actions in 2009:

- We started to shape a biodiversity policy and invited IUCN, one of the most knowledgeable NGOs in this field, to be our sounding board, adviser and challenger in defining actions for including biodiversity in our thinking (strategy), acting (operations) and reporting (communications).
- We pledged our support to the Prince of Wales' Rainforest Initiative and signed IUCN's letter on Reducing Emissions from Deforestation and Forest Degradation (REDD).
- We became a member of (Young) Leaders for Nature.
- Our Deputy Chairman Jan Zuidam (retired on 1 January 2010) became a member of the 'Dutch taskforce on biodiversity and other natural resources'. This taskforce is a Dutch government initiative and will advise on measures on this topic."

Oscar Goddijn, Vice President of the Business Incubator at the DSM Innovation Center and member of DSM's biodiversity team, adds:
"Biodiversity is a very complex subject that we are currently investigating and discussing within DSM and with IUCN. In assessing the extent to which our activities are affecting biodiversity, we need to look beyond the direct impact and dependency of our manufacturing operations. We are analyzing the impact of our products throughout their life cycle. In our approach we focus on parameters influencing biodiversity. These parameters could be water, energy, land use and raw materials. As an example, in a case where a customer uses our 'product X' in a water-intensive process, we attempt to find ways to make that process more water-efficient. Our wine stabilizer Claristar® is such a product. It reduces water usage in the wine industry by 25 to 50%. A complicating aspect is that all parameters, such as water, energy and raw materials, are interconnected. For example, reducing water consumption may involve an increase in energy usage or the use of different raw materials. But this complexity should not keep us from analyzing our direct and indirect impact on biodiversity. In our analyses we have focused mainly on impact mitigation through efficiency improvements and product stewardship. I believe that it is not enough to mitigate the negative impact on biodiversity; we should aim for a neutral or positive impact. Some of the potential impacts are already being addressed by legal or voluntary initiatives such as REACH, Global Product Strategy, Emissions Trading, Climate Policy, Water Policy, Sustainable Sourcing, etc. Our biodiversity policy has to be complementary and supportive to these programs. We are presently developing a policy that, in line with the DSM Values (to be replaced by the Code of Business Conduct in 2010) and our Corporate Requirements, will ensure that our activities are acceptable to our stakeholders and society at large from a biodiversity point of view."

I.3.5 FrieslandCampina

Dairy company, FrieslandCampina, is working on biodiversity by:

- FSC sourcing of the beverage carton packaging (http://www.friesland campina.com/english/news-and-press/news/press-releases/2010-12-02-frieslandcampina-stapt-over-op-duurzame-kartonnen-drank verpakkingen.aspx).
- Use of sustainable soy for feed.

I.4 Reports on companies and biodiversity

In a report on around 1,800 FTSE listed companies, EIRIS found that 58% of them operate in sectors whose business activities have a considerable biodiversity impact.

The report's key findings were as follows:
- Very few FTSE AWD listed companies are assessed by EIRIS as having 'Good' biodiversity policy assessments.
- The Chemicals & Pharmaceuticals and Property Development sectors are doing the least to tackle biodiversity.
- Forestry and Paper sector displays the most advanced approach to biodiversity protection.
- Sectors with high biodiversity impacts associated with their supply-chain are failing to tackle biodiversity.
- Few companies link biodiversity to other key issues such as Climate Change, Air and Water Emissions, Water Use, Waste.
- Voluntary commitments to the Convention on Biological Diversity (CBD) remains low.
- Regional disparities exist: European companies performed best, Asian companies performed worst.

(http://www.eiris.org/files/research%20publications/Biodiversity2010.pdf)

I.5 Conclusion companies and biodiversity

Both large individual companies as business sustainability organisation present biodiversity as a fundamental and important issue that has to be protected. Companies in food (e.g. Unilever) and biomass (e.g. DSM) have the strongest goals and aims. An oil company like Shell which is working in sensible area's has strong statements on good housekeeping in sensible areas. Companies in electronics (like Philips) focus on energy and climate change and not on biodiversity.

Companies do not claim a universal indicator for biodiversity.

I.6 NGO's on biodiversity

Introduction
Many NGO's are active with protecting biodiversity. IUCN is worldwide active, also with research projects and in cooperation with business. WWF is most known worldwide for nature protection campaigns. Furthermore we checked Greenpeace and Birdlife

I.6.1 IUCN
IUCN seems the most active NGO on the issue of biodiversity.

http://www.iucn.org/what/tpas/biodiversity/
"Loss of biodiversity - the variety of animals, plants, their habitats and their genes - on which so much of human life depends, is one of the world's most pressing crises. It is estimated that the current species extinction rate is between 1,000 and 10,000 times higher than it would naturally be. The main drivers of this loss are converting natural areas to farming and urban development, introducing invasive alien species, polluting or over-exploiting resources including water and soils and harvesting wild plants and animals at unsustainable levels."

IUCN Solutions

IUCN carries out comprehensive research on the status of biodiversity. It runs projects to protect specific species, manage and restore national parks and other protected areas; and promotes the sustainable use of natural resources. IUCN also provides the knowledge, standards and tools for biodiversity conservation for governments, community organizations, the United Nations and business."

I.6.2 WWF

WWF is also active on the biodiversity issue and is more communicating to the general public.

http://wwf.panda.org/about_our_earth/biodiversity/
Biodiversity: the HUGE variety of other animals and plants on our planet, together with the places where found.
Our planet is simply amazing. Viewed by someone not from our world, it could be seen as one big, finely tuned and ultimately incredible machine. Lots of cogs, pullies and wheels (animals, plants and environments) working together. Depending on each other in so many ways. Creating a green, blue healthy world that you, us, everyone depends on. For food, fuel, medicine and other essentials that we simply cannot live without. Sure this machine can take some knocks and bruises. It can bounce back. It is part of what makes it so marvellous. But we're beginning to pull and stretch it further than it has ever been stretched before. We're entering unknown territory where some of the extinctions we are causing may have deep and profound effects on how we live our lives. In the grand time scale of our planet, these effects may be currently seen as the equivalent of storm clouds gathering on the horizon. But rest assured, the storm is coming.
Unless we learn to start loving and caring for what our planet already gives us.
What exactly is Biodiversity?

What is WWF doing?

WWF is unique in that its operates:

- At the local level: in the fields, forests, streams, estuaries and seas with development and conservation workers, local community members, indigenous peoples, farmers, fishers, landowners and consumers.
- At the international level: working with and seeking support from governments, policy makers, business and industry leaders, bankers, donors and more.

Through our efforts with partners worldwide we're promoting, developing and implementing lasting solutions to the environmental challenges that both you and we face.

Through our conservation programmes, we are combining traditional conservation with work to address the main drivers of biodiversity loss, including, for example, business practices and consumer choices. In parallel, we're working to reduce our ecological footprint – the amount of land and natural resources needed to supply our food, water, fibre, and timber, and to absorb our CO_2 emissions.

WWF, with its key partners (and that includes you!), can conserve most of life on Earth by conserving the most exceptional ecosystems and habitats – places that are particularly rich in biodiversity, places with unique animals and plants, places like no other. "Where will WWF do this?"

WWF will focus its resources on the conservation of 35 priority places - some of the world's truly most outstanding natural wonders. The priorities include:

1. (Amazon, Congo Basin, New Guineau)
The most species rich rainforests on Earth
2. (Western arc of the Amazon, Choco-Darien)
The richest places on Earth for rare, endemic and unique plants
3. (New Caledonia-Fiji-Vanuatu, Fynbos, Southwest Australia; Madagascar)
The richest large river systems for freshwater fish
4. (Amazon/Orinoco, Congo, Mekong, Yangtze)
The highest levels of endemism in the world for crayfish, mussels, and temperate water fish and the oldest river in the world
5. Southeast Rivers and Streams in the US)
The richest dry formations in the world
6. (Namib-Karoo-Kaokoveld, Chihuahuan Desert and springs)
The most diverse flooded grasslands and savannas
7. (Zambesian)
The most diverse tropical savannas, grasslands, and woodlands
8. (Cerrado-Pantanal, Miombo)
The world's most diverse coral reefs
9. Coral Triangle; Great Barrier Reef-New Caledonia-Fiji, East Africa Marine)
The most productive seas and sites of enormous aggregations of marine life, including seabirds
10. (Arctic, Southern Oceans, West African marine)
The world's tallest grasslands filled with the highest densities of tigers and rhinos
11. (Terai-Duar savannas of Eastern Himalayas).
Conservation efforts are also needed for threatened species whose survival cannot be guaranteed by conserving their habitat alone. WWF is focusing efforts on species that are of special importance either for their ecosystem or for people.

I.6.3 Greenpeace

Greenpeace in very active in stopping activities which have a negative influence on biodiversity.

http://archive.greenpeace.org/comms/cbio/bdfact.html
"Greenpeace campaigns around the world against pollution, nuclear energy and weapons, and for a change in practices and activities which lead to alterations in the atmosphere. Within our International Biodiversity Campaign, our work is focussed on key areas involving habitat destruction, the direct exploitation of species and systems, and the genetic manipulation of natural biodiversity."

I.6.4 Birdlife

Birdlife is the NGO which seems most active in campaigning for more action by the CBD and governments.

http://www.birdlife.org/community/2010/09/time-to-hit-the-biodiversity-target-%E2%80%93-birdlife%E2%80%99s-september-2010-round-up/
"Eight years ago World leaders committed themselves to the Convention on Biological Diversity (CBD) target to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth by 2010.

Recent analyses have clearly shown that they have failed to deliver on these commitments – instead overseeing alarming and continued declines.
Next month they are meeting in Japan to discuss a new target. This is a vitally important milestone for the future of wildlife on our shared planet. We'll be covering the news from the event, however looking back at September's stories we already have some powerful messages for governments to consider:
Biodiversity conservation must be valued as a means of achieving sustainable development
From government policy to personal choices, we must recognise the value of biodiversity - BirdLife International experts are among a group of leading conservation scientists and practitioners calling for a fundamental shift in the way we view biodiversity.
Building a future on IBA conservation in the Dominican Republic – Grupo Jaragua (BirdLife in the Dominican Republic) are working alongside local people to protect and value their natural resources, by getting them involved in conservation planning, environmental awareness activities and the implementation of alternatives for sustainable development.
Fijian villages shown new ways for forest management- Nature Fiji and BirdLife International are working with landowners in Vanua Levu (Fiji) to work towards sustainable forest use.
Governments must honour their biodiversity commitments
Is Germany going to keep its word? A broad alliance of German churches, development and environmental NGOs, including NABU (BirdLife in Germany), asked the German Federal Parliament to honour Germany's commitments towards biodiversity funding.

Maltese hunters have spoonbills in their sights – Malta has been shamed yet again by its illegal bird hunters who have blasted a number of Spoonbills this month. "It is about time that the government accepts the situation for what it is – a serious international conservation problem", said BirdLife Malta (BirdLife Partner).

Conservation action makes a big difference.
Conservation breakthrough in Botswana – The Botswana Government has recently gazetted a Lesser Flamingo sanctuary to provide formal protection of the Makgadikgadi Pans. This has been applauded by BirdLife Botswana (BirdLife Partner) who are helping to draft regulations for the new sanctuary.
Cousin Island Special Reserve, Carbon Neutral – Cousin Island has become the World's 1st carbon neutral nature reserve. Nature Seychelles (BirdLife Partner) runs the Reserve and revealed the new status at the opening ceremony of the 2010 Tourism Expo."

I.7 Conclusions NGO's and biodiversity

Especially IUCN and WWF focus on biodiversity. Also other NGO's like Greenpeace see the issue as biodiversity as a goal for there actions on other themes like climate change and pollution.