THE STATE OF AGRO-BIODIVERSITY IN THE NETHERLANDS

Integrating habitat and species indicators

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Linking Wild Species With Their Use of Different Agricultural Habitats

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Content:

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The state of agro-biodiversity in The Netherlands

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Abstract

An assessment has been made of the state of agro-biodiversity of wild species in The Netherlands. A core set of species has been used to assess the current quality of the agro-ecosystems. The quality was calculated as the relative average species abundance. 1950 has been pragmatically used as baseline, a time since when biodiversity loss rapidly accelerated due to introduction of intensive management practices. Further extent of the agricultural area has been taken into account. Looking at the change in agro-ecosystem quantity and quality, agro-biodiversity decreases a factor 2.9 since 1950. In simple terms this means that the abundance of characteristic wild species is on average 34% of their abundance around 1950.

Keywords

indicators, agro-biodiversity, ecosystem quality, ecosystem quality, natural capital index.

1. INTRODUCTION

This assessment deals with **wild-living species in agricultural ecosystems** at the national level. It focuses on the loss of biodiversity since 1950 when most modern intensive agricultural management practices were introduced. It builds further on species and habitat indicators discussed in the CBD (1997) and OECD (2001).

This paper has been produced by the RIVM and is based on information of i) the Central Statistical Office (CBS) and Alterra; ii) various organisations monitoring plant, reptile, bird, mammal, fish, butterfly and aquatic macro fauna species; iii) research institutes and universities which carried out research on baseline values[2].

The assessment has been made to support national policy making in The Netherlands. The set of requirements on biodiversity indicators for this purpose is presented in Appendix 1. The results will be extensively reported in the Dutch Nature Outlook (RIVM, in press); the method in the report Technical design of the Natural Capital Index (Ten Brink et al., in press).

[2] Floron, 1997; Ravon, 1999; Kleunen, 2001; Kleunen en Sierdsema, 2001; IWACO, 2001; Vlinderstichting, 1999; Hollander, 2000;

2. BIODIVERSITY LOSS DEFINED

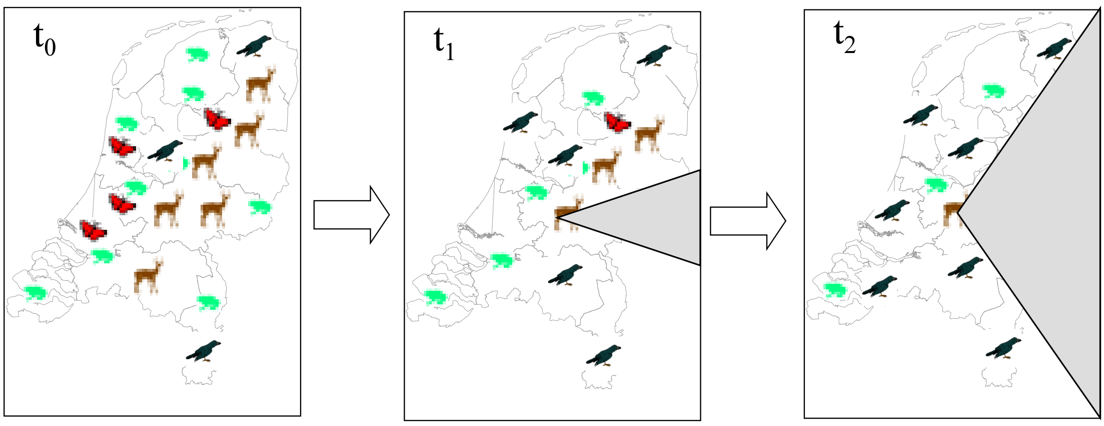
For the purpose of this assessment agro-biodiversity has been tangibly defined as:

> *the complete set of agro-dependent wild-living species*
> *with their corresponding abundance and distribution.*

The aim of the assessment is to measure the clear decrease in the abundance of many species and increase of a few other species in agro-ecosystems since the introduction of intensive management practices. As a result, the various agricultural ecosystems are getting more and more uniform. Common species are becoming more common, rare species more rare (Figure 1 and 2).

Figure 1: Schematic picture of the process of biodiversity loss of wild species, as a result of habitat loss (grey cut out) and ecosystem quality in the remaining habitat. As a result, the abundance of many species decline, while the abundance of some -mostly common species- increase. This process applies for natural as well as for agricultural ecosystems.

Note: the decrease of species abundance is a far more sensitive indicator than "species-richness".



Species extinction or extirpation is only the last step in a long process of ecosystem degradation (UNEP, 1997). This process is caused by two factors:

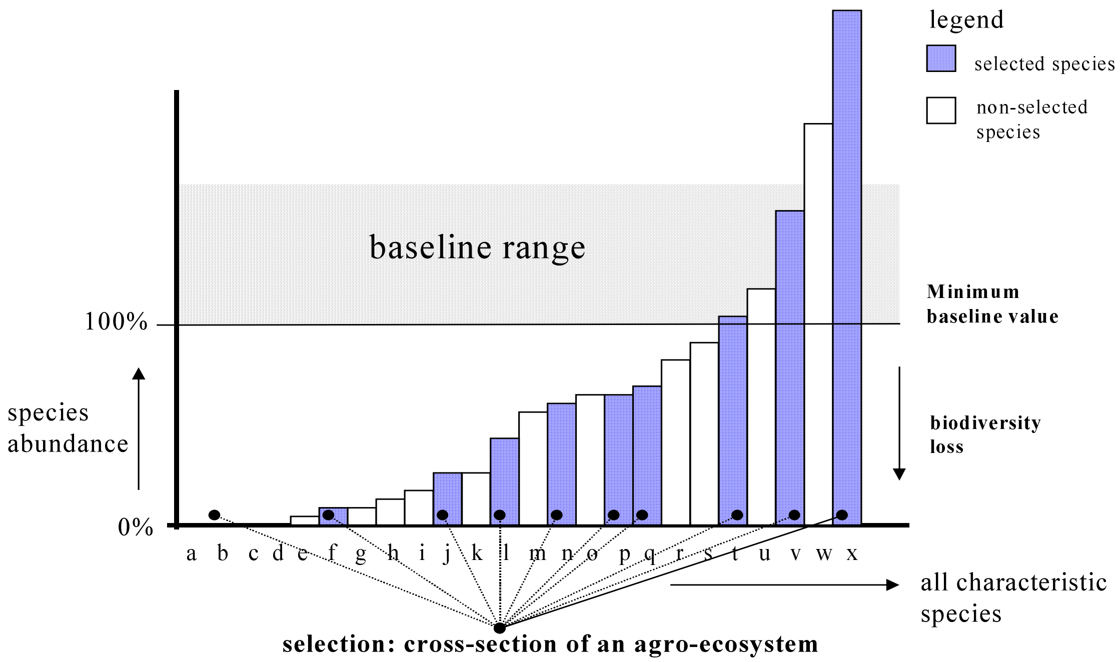
i) the loss of agricultural area on the one hand

ii) the decrease in ecosystem quality within agricultural area on the other hand, due to the use of fertiliser, pesticides, lowering groundwater tables, clearance of (semi)-natural habitats such as hedge rows, extensive used pasture, etc,.

3. METHOD

In order to measure the change in biodiversity, both factors, the loss (gains) of agricultural area and the loss of ecosystem quality have been determined since about 1950. The agricultural area (ecosystem quantity) has been defined as % of the total country[3]. Ecosystem quality has been calculated by the change in abundance of various species. It was not necessary or possible to measure all wild-living species dependent on agro-ecosystems. A core set of characteristic species has been selected from the different agro-regions and their main land-use types, including their (semi-) natural habitats (Figure 2 and Box 1).

Figure 2: Ecosystem quality can be calculated with a selection of species of the agro-ecosystem (grey bars)[4]. For each species quality is calculated as the ratio between the current state and (minimum) baseline state (% of the baseline). The ecosystem quality is the average quality of the selected set of species.



The species were selected with the help of 10 considerations (Appendix 2). The calculation procedure for ecosystem quality has been elaborated in Appendix 3.

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[3] The national area includes the entire terrestrial area, freshwater systems and marine watersystems within the 12 miles zone of the North Sea. This area is set at 100% in figures 3, 4 and 5.

[4] This approach is very similar to that of economic indicators. To determine the Price Index or inflation of a country it is not the prices of millions of products that are monitored in all shops. Instead, a so-called theoretical "shopping bag" is filled with a representative core set of products and subsequently monitored in a subset of shops. The changes in prices are averaged with different weightings because the price increase of bread cannot simply be averaged with the price increase for a car.

Box 1: Selected species for agricultural regions and land-use types

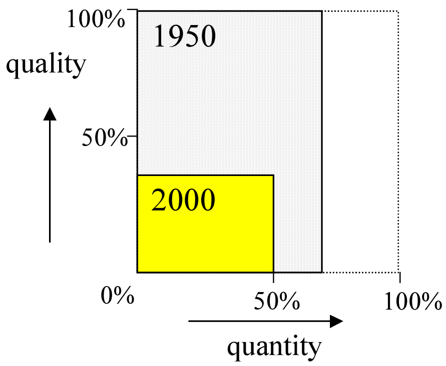
Selected species from six species groups:	
1) higher plants	(number of species 228)
2) butterflies	(number of species 27)
3) reptiles	(number of species 1)
4) birds	(number of species 31)
5) mammals	(number of species 1)
6) aquatic macro fauna	(number of species 42)

Species selected for 5 agricultural regions:	**Species selected for various land-use types:**
1. marine clay area 2. higher sandy soil area 3. peat area 4. riverine area 5. hilly area	1. arable land 2. permanent pasture 3. natural and semi-natural habitats within arable land and permanent pasture: ditches, forest patches (< 6,25 ha), hedges, etc.

The reference year 1950 as a baseline has been chosen on an arbitrary but practical point in time. On the one hand, biodiversity was still high and biodiversity loss was about to accelerate rapidly due to intensification, while on the other hand sufficient data was available to reconstruct the abundance of a core set of species. Current and baseline data were produced by various universities, institutes and volunteer groups organisations, commissioned and co-ordinated by RIVM. Appendix 4 elaborates on the functions of baselines.

Both agricultural area (habitat) and its quality can be expressed in one single figure (Figure 3). The lower the quantity and quality, the lower the remaining natural capital. In this fictitious figure agro-biodiversity has been decreased a factor 4 due to loss of habitat and quality. In simple terms this means that todate, the abundance of characteristic agro-dependent species is on average 25% of their abundance around 1950.

Figure 3: The state of agro-biodiversity in 1950 and 2000 in terms of habitat (quantity) and its quality (fictitious). Quantity is expressed as % of the national area**Error! Bookmark not defined.**



4. RESULTS

Figure 4 shows the state of the regional agro-biodiversity in terms of the remaining habitat and quality in the Netherlands around 1995.

Figure 4: The state of agro-biodiversity in the 5 Dutch regions in terms of the remaining habitat and quality around 1995 (RIVM, Ten Brink et al., in press).

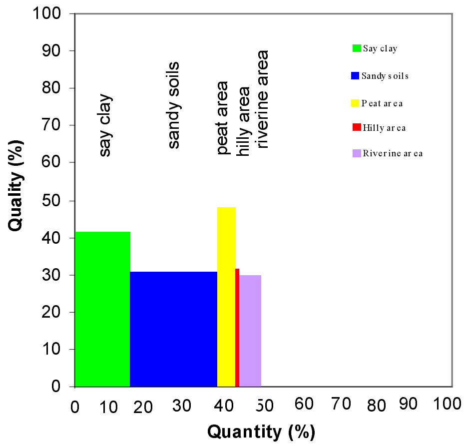
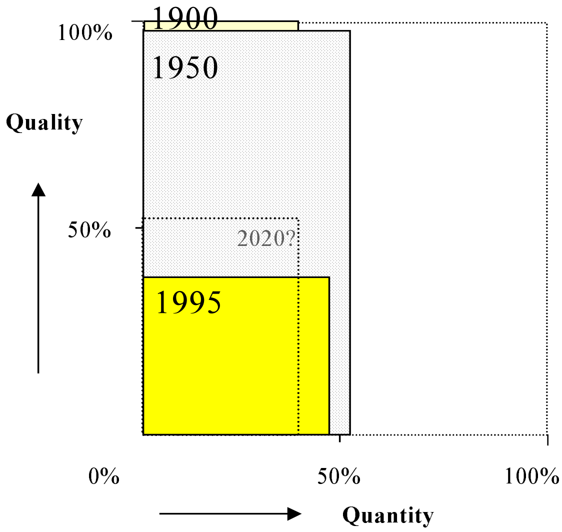


Figure 5 shows the change in national agro-biodiversity in terms of habitat and quality of the Netherlands from 1900 to 1950 and 1995.

Figure 5: The national agro-biodiversity in terms of habitat**Error! Bookmark not defined.** and quality of the Netherlands in 1900, 1950 and 1995. Due to loss of habitat and quality agro-biodiversity has been decreased a factor 2,9 in the last 45 years (RIVM, Ten Brink et al., in press).



The agricultural area expanded until 1950 by large-scale conversion of natural areas. Then its quality declined significantly, due to broad scale introduction of intensive agricultural practices. Moreover, the area declined because of conversion into build up area and reconversion into nature. Combining habitat and quality, 66% of the agro-biodiversity was lost in the last 45 years. *This means that the abundance of characteristic agro-dependent species is on average 34% of their abundance around 1950.* Studies on various policy scenarios are running todate, amongst which agriculture practices on a smaller area with higher and lower ecosystem quality and agricultural productivity (Figure 5).

5. DISCUSSION

1. The ecosystem quantity (habitat) and quality indicators match with the set of requirements on biodiversity indicators as listed in Appendix 1. They provide quantitative information on the past, current and future state of agro-ecosystems at the regional and national scale, on species and ecosystems. Further they are feasible and easy to communicate to policymakers and the public, are linkable with socio-economic scenarios to assess policy options and sensitive to track changes over time.
2. A dramatic loss of agro-biodiversity has taken place since 1950. This corresponds with the loss of important species-rich semi-natural elements and intensification of agricultural practices. Losses which have taken place before 1950, such as the loss of significant part of the poor extensively used grasslands, are not taken into account.
3. Although the average abundance of species is 34% of 1950, several species have a far lower abundance due to specific loss of suitable habitat.
4. According to OECD (2001) wildlife species diversity related to agriculture could be expressed with species and habitat indicators:
   A. the quantity of the agricultural area
   - *the extent and changes in agricultural area, land use and land type*
   - *proportion of semi-natural and uncultivated natural habitats on agricultural land*

   B. the quality of the agricultural area
   - *trends in population distributions and numbers of wild species related to agriculture*
   - *trends in population distributions and numbers of key "non-native" species threatening agriculture*

In this implementation the extent and changes in agricultural area and trends in abundance of species have been used.

5. Changes in agricultural land uses, and proportion of semi-natural and uncultivated natural habitats have not been applied here as indicators. By selecting species dependent on various land uses and (semi-) natural habitats, the effects of changes in their extent are included in the ecosystem quality indicator.
6. Actually, land uses and proportion of (semi-) natural habitats are alternative indicators for the ecosystem quality indicator. They do provide similar information. The formers are favourable in case data on species are lacking.
7. If the various land use types and (semi-) natural habitats are assessed on their biodiversity they can be expressed in terms of ecosystem quality. This opens up perspectives to a common approach for OECD-countries to assess their own specific agro-biodiversity in their own way, but resulting in similar terms of ecosystem quantity and quality.
8. In all cases, baselines are necessary in order to track, value and aggregate changes over time. In order to find a common denominator, as discussion on baselines is desirable.
9. It is of great importance the OECD framework on agro-biodiversity indicators fits well with the framework developed and discussed under the Convention on Biological Diversity (UNEP, 1997). The ecosystem quantity and quality approach is promising in this respect.

References:

Brink, B. ten, A. Hinsberg, M. de Heer, B. de Knegt, O. Knol, W. Ligtvoet, R. Rosenboom, R. Reijnen (2002 in press). *Technical design of the Natural Capital Index*. RIVM, Bilthoven.

FLORON (1997). *Een Ecologische Kapitaal Index voor de Flora, aanzet tot kwantificering van de floristische kwaliteit*. Landelijk Bureau FLORON, Leiden.

Hollander, H. (2000). *Ecologisch Kapitaal Index Zoogdieren; referentiewaarden voor de periode rond 1950.* Mededeling 48, Vereniging voor Zoogdierkunde en Zoogdierbescherming, Arnhem.

IWACO (2001). *Referentiewaarden voor macro-faunasoorten in laagveensloten*. IWACO.

Kleunen, A., H. Sierdsema (2000). *Natuurlijke referentiewaarden van enkele zeer zeldzame of in Nederland uitgestorven broedvogelsoorten.* SOVON-ondrzoeksrapport 2001/05.SOVON Vogelonderzoek Nederland, Beek-Ubbergen

OECD (1998a). Agriculture and Biodiversity, OECD workshop on agri-environmental indicators. Paris: OECD publications (nr. COM/AGR/CA/ENV/EPOC(98)79).

OECD (1998b). *Report on the OECD workshop on agri-environmental indicators*. York, September 1998, Paris: OECD publicatons (nr: COM/AGR/CA/ENV/EPOC(98)136).

OECD (2001). *Environmental Indicators for Agriculture, volume 3, methods and results*. Paris: OECD publications.

RAVON (1999). *EKI-Reptielenindexen op basis van het referentiejaar 1950.* Aut: A. Zuiderwijk, A Groenveld, G. Smit, RAVON Werkgroep Monitoring, Amsterdam.

RIVM (2002, in press). *National Natural Outlook 2*, RIVM/Alterra, Bilthoven.

SOVON (1997). *Ecologische Kapitaal Index voor Vogels*. Aut.: Hagemeijer, W., H. Sierdsema, SOVON, Beek-Ubbergen.

Kleunen A. (2001). *Reconstructie van broedvogelpopulaties van zeldzame broedvogels en kolonievogels in 1950 en 1998 ten behoeve van de Ecologische Kapitaal Index.* SOVON-onderzoeksrapport 2001/03. SOVON Vogelonderzoek Nederland, Beek-Ubbergen.

UNEP (1997a). *Recommendations for a core set of indicators of biological diversity*. CBD secretariat, Montreal (nr: UNEP/CBD/SBSTTA/3/9).

UNEP (1997b). *Recommendations for a core set of indicators of biological diversity*. CBD secretariat, Montreal (nr: UNEP/CBD/SBSTTA/3/13 inf.).

Vlinderstichting (1999). *Ecologisch Kapitaal Index – Dagvlinderindexen op basis van referentiejaar 1950.* Aut.: Swaay, C.A.M. van. De Vlinderstichting, Wageningen, rapportnr. VS 99.12.

Appendix 1: Requirements on biodiversity indicators for the National Nature Outlook

To fit into the National Nature Outlook biodiversity indicators should:

- provide information on the state of nature
  - at the regional and national scale
  - at species and ecosystem level
  - on their naturalness for self-regenerating ecosystems and species-richness for made-made ecosystems
- be quantitative, feasible and affordable
- be easy to understand and policy significant
- be sensitive and able to show trends
- be interlinkable with socio-economic scenarios for future projections
- allow aggregation at regional and national levels
- take into account regional-specific biodiversity
- be scientifically sound

Appendix 2: 10 considerations for choosing species (quality variables[5])

Each species should:

1. **have available quantitative data**
   - is *quantitative data about abundance, distribution and use for the past and present available or reconstructible? Is there data for pressure-effect relations?*

2. **be policy and ecosystem relevant**
   - *e.g. ecosystems/species of high economic, cultural or ecological interest (key species, see annex 1 UN-convention on biological diversity), red list species, extinct or threatened (endemic) species;*

3. **be susceptible to human influence**
   - *steerable and predictable, is linkage possible to the outputs of socio-economic and environmental models?;*

4. **be accessible to accurate and affordable measurement**
   - does a monitoring programme exist? Is it financially feasible?

5. **have indicative value**
   - does the *species provide more information about biological diversity than only its own value?*

6. **be stable**
   - can anthropogenically-caused fluctuations be reasonably distinguished from natural fluctuations?

7. **be useful for at least a 20-30 year period.**
   - does the species indicate a problem that will not definitely be solved within a few years (in that case it would *lose political significance)?*

The set of species should:

8. **provide a representative picture of the changes of biological diversity at the regional and global level;**
   - *the species must be a cross-section of the entire ecosystem to provide a representative picture relating to:*
     - *different sub-systems;*
     - *different taxonomic classes;*
     - *high and low parts of the food web;*
     - *terrestrial and aquatic ecosystems;*
     - *present day and former biological diversity;*
     - *sessile, migratory and non-migratory species;*
     - *key species, threatened species, endemic species, species of socio-economic importance;*

9. **reflect the effects of the main anthropogenic pressures and nature conservation programmes affecting biological diversity:**
   - the species must be a cross-section of main pressures in considered area such as: exploitation, pollution, fragmentation, habitat destruction, disturbance, exotic species, climate change;

10. **be as few in number as possible;**
    - *the less species the more communicable to policy makers and the public; therefore aggregation to only a few, preferably one, quality indicator must be possible.*

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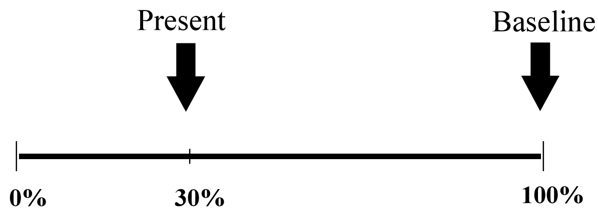
[5] In this case, mainly species have been choosen as quality variables to assess ecosystem quality. It is also possible to chose structure variables at the ecosystem level (i.e. ratio of dead and living wood) or ecosystem processes.

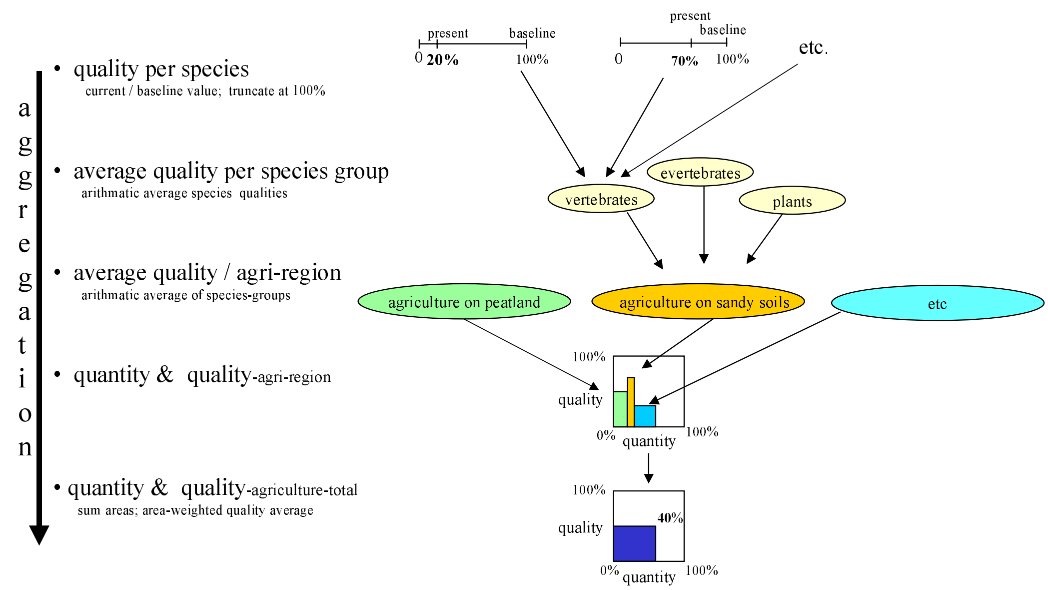
Appendix 3: The calculation procedure of agro-ecosystem quality

1. *Quality per species:*
   For each species the abundance in the baseline state and current state has been estimated. The current quality of each species is determined as the percentage of the baseline state.



2. *Quality per species group*
   the average quality of plants, vertebrates and evertebrates is determined as the average of the species within that group.
3. *Quality per agro-region*
   the quality of the agro-ecosystem per region is determined by averaging the quality of the three species groups.
4. *Quantity per agro-region*
   The agro-ecosystem area is calculated for each region in 1950 and 1990 as percentage of the countries total area.
5. *Quality national agro-ecosystem*
   The national agro-ecosystem quality is the area-weighted average of the regions-quality.
6. *Natural Capital Index*
   If politically desired, a natural capital index might be calculated for each region by the product of agro-ecosystem quantity and quality. If these regional natural capital indices are added a natural capital index is achieved at the national level.

Figure: Calculation procedure on agro-ecosystem quality and area.



Appendix 4: Baselines and their role in policy making

Baselines have various functions:

1. baselines transform data into policy significant information
2. baselines provide a common denominator to assess ecosystems (parts) in a consistent and comparable way
3. baselines enable aggregation of many variables to a few or one single indicator.

Baselines are common and indispensable instruments in many fields, such as medical surgery (blood pressure, O2 concentration, pulse etc.), climate change (pre-industrial CO2 concentration), water and soil quality (natural background values of nutrients and heavy metals), economy (price index with its shopping basket and consumption frequency), education (exams).

It has to be stressed that baselines serve in this assessment as a calibration point or benchmark to quantify the extent of change due to human activities in modern times. The baseline is *not* necessarily the targeted state. Policy makers choose their targets on ecosystem quantity and ecosystem quality somewhere on the axis between 0 and 100% (see Appendix 3) depending on their balance of social, economic and ecological interests. Below an example of the function of a baseline in nature conservation.

Box 2: Baselines in conservation policy

Example: "**currently are 1,000 dolphins** in the Sea". This data has no significance as such, it only have significance in relation to baseline values. Baselines make such statistics meaningful indicators. The type of baseline determines the policy message. Some examples:

Baseline type	*Baseline value*[6]	*Meaning of current value Vis a vis baseline*	*Policy signal*
1. Natural state	> 10,000	Currently 10% of original population is left. 90% was destroyed by anthropogenic factors, such as pollution, depletion of major fish stocks and drowning in fish nets.	The population is still heavily deteriorated. Let's work out further measures for decision making.
2. Specific year 1993: CBD was ratified	500	The current population has been doubled	Policy makers did a very good job. Fishermen speak about a plague. They propose to limit the population to 500. Limitation measures?
3. Genetically Min. pop. size	250	The current population is 4 times above the critical level	No need to worry about dolphins
4. Red list	750	The current population is 33% above red list criterion	Great job done in last years. Dolphins can be removed from the red list. "Let's go back to

[6] In numbers of dolphins

			business”
5.Species richness	200 species	Much of the population can still be lost without losing a species. Even if extirpated it would not affect the species-richness. An alien seal species compensates the loss.	1000 dolphins is fine but not interesting. The species richness is only affected when the population is zero. No measures are needed, even if the dolphins were to disappear.
6. None	---	1000 dolphins seems a lot, and the population appears to be growing.	Fishermen say dolphins are becoming a plague and must be limited. Conservationists state that 1000 is not much at all. To restore a healthy marine ecosystem it should increase to several 1000s. A political discussion is unavoidable