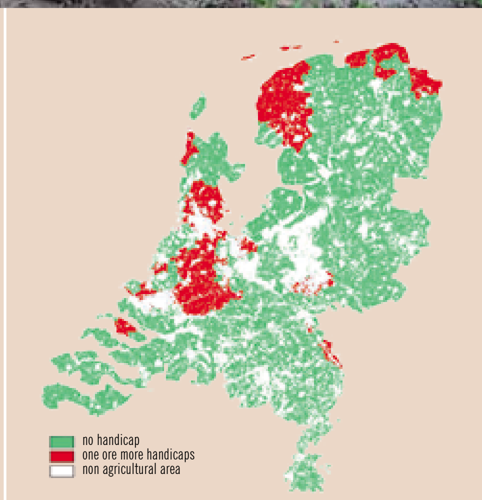
Natural handicaps in Dutch agricultural areas

Assessment of Less Favoured Areas based on biophysical criteria

Annemieke Smit
Fokke Brouwer



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In order to assess agricultural areas with natural handicaps, the European Commission proposed a set of biophysical criteria. In this report all criteria were applied to the Dutch agricultural areas. The application of the criteria showed that four criteria led to the delineation of areas with natural handicaps. The handicaps were soil drainage, texture, chemical properties and slope. The criteria for low temperature, heat stress, rooting depth and soil moisture balance were not applicable to the Dutch agricultural soils. All results were aggregated to LAU2 units (municipality). An area at the scale of LAU2 units was considered affected by significant natural handicaps if at least 66% of the Utilised Agricultural Areas met at least one of the biophysical criteria. In total 109 LAU2 units were considered a Less Favoured Area.

Key words: Less Favoured Areas, natural handicaps, biophysical criteria

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Inhoud

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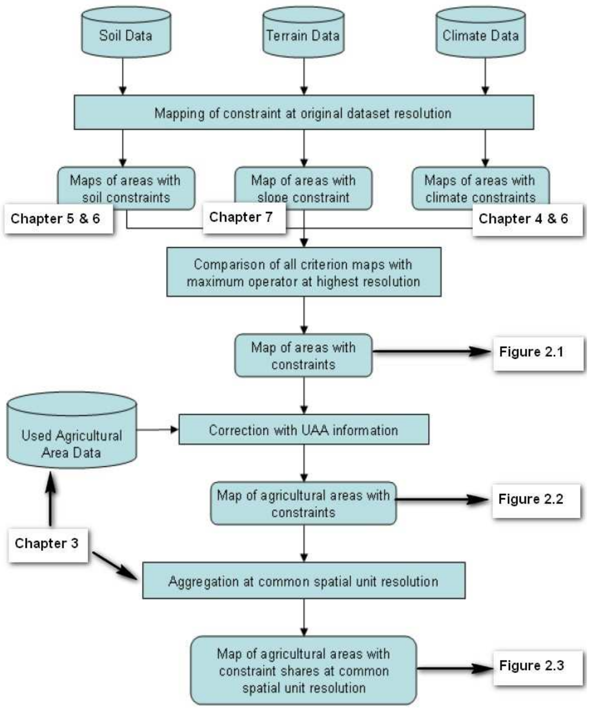
1 Introduction

In order to assess agricultural areas with natural handicaps, the European Commission proposed a set of biophysical criteria. The Ministry of Agriculture, Nature Management and Food Quality asked Alterra to elaborate the consequences of the biophysical criteria for the Dutch agricultural soils. In this report all criteria are applied to the Dutch agricultural areas. The interpretation of the criteria is mainly based on the Technical Annex (EU, COM(2009) 161 final), in combination with the JRC reports by Böttcher et al. (2009) and Van Orshoven et al. (2008).

In this report we provide:

- A description of the methodology and the data used.
- Additional information about the administrative unit level and how Utilised Agricultural Areas (UAA) were selected.
- Maps for each relevant individual criterion excluding fine tuning.
- The indicators on which the fine tuning process was worked out and maps including fine tuning.
- An overlay for each relevant criterion with Less Favoured Areas (LFA) as assigned within article 20.

In the figure below (extracted from Böttcher et al., 2009) the workflow we followed is combined with references to Figures and Chapters. It can be used as a guide to find the separate maps and information. A full list of figures is provided at page 7.



Since the Netherlands until now only indicated Less Favoured Areas based on article 20, in the overlays (chapter 8) the relevant biophysical criteria were only compared to the results of that article.

2 Results: final maps (all handicaps combined)

In this chapter all results from all handicaps are combined to present maps of areas with at least one constraint. The workflow scheme, as proposed by Böttcher et al (2009 p.24) was followed to derive these maps. The methodology, source data and results (maps) for all separate handicaps are presented in the following chapters.

In Figure 2.1 all areas that meet at least one of the criteria are combined in one map. Then the map of Figure 2.1 was combined with the UAA, resulting in agricultural areas with constraints (Figure 2.2). Finally, the results were aggregated at Local Administrative Unit 2 (LAU2) level. When areas with constraints exceeded 66% of the total UAA within a LAU2 unit this unit was considered a Less Favoured Area (Figure 2.3). In Table 1 all LAU2 units considered affected by significant natural handicaps (LFA) and the percentage of the area with constraints are presented.

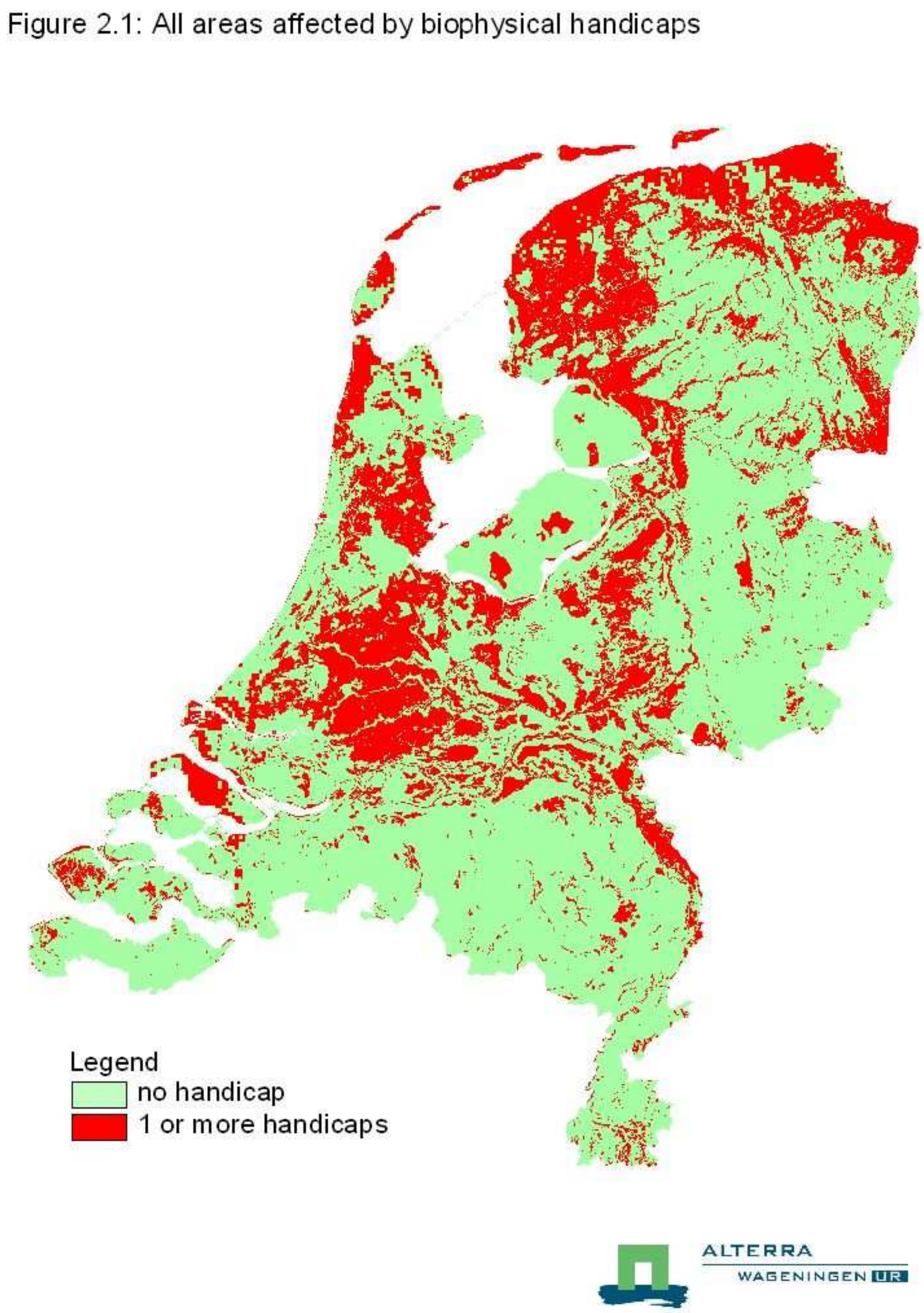


Figure 2.1 All areas affected by at least 1 biophysical handicap. A combination of four relevant criteria: drainage, texture and stoniness, chemical properties and slope

Figure 2.2: Utilised Agricultural Areas (UAA) affected by biophysical handicaps

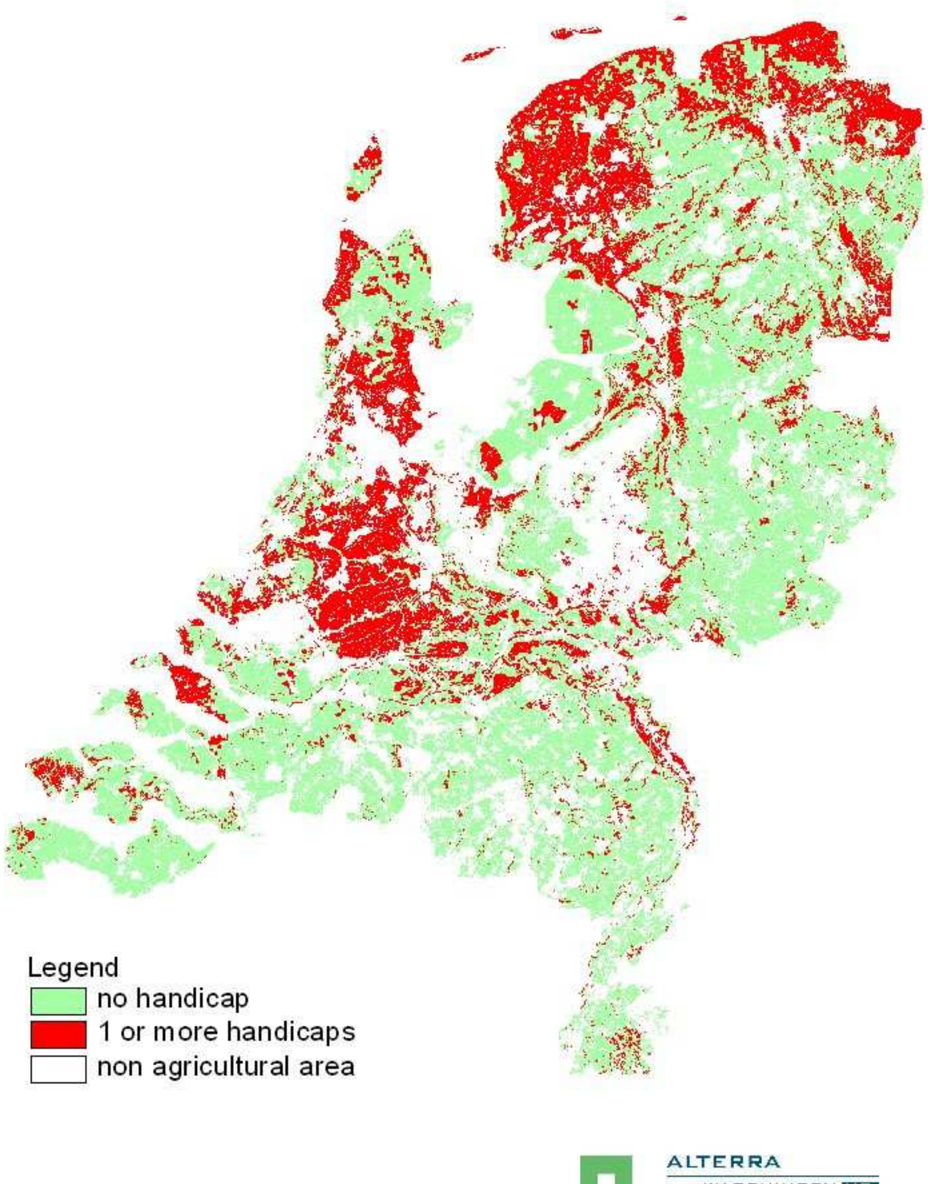


Figure 2.2 Results from Figure 2.1 combined with Utilised agricultural areas (UAA)

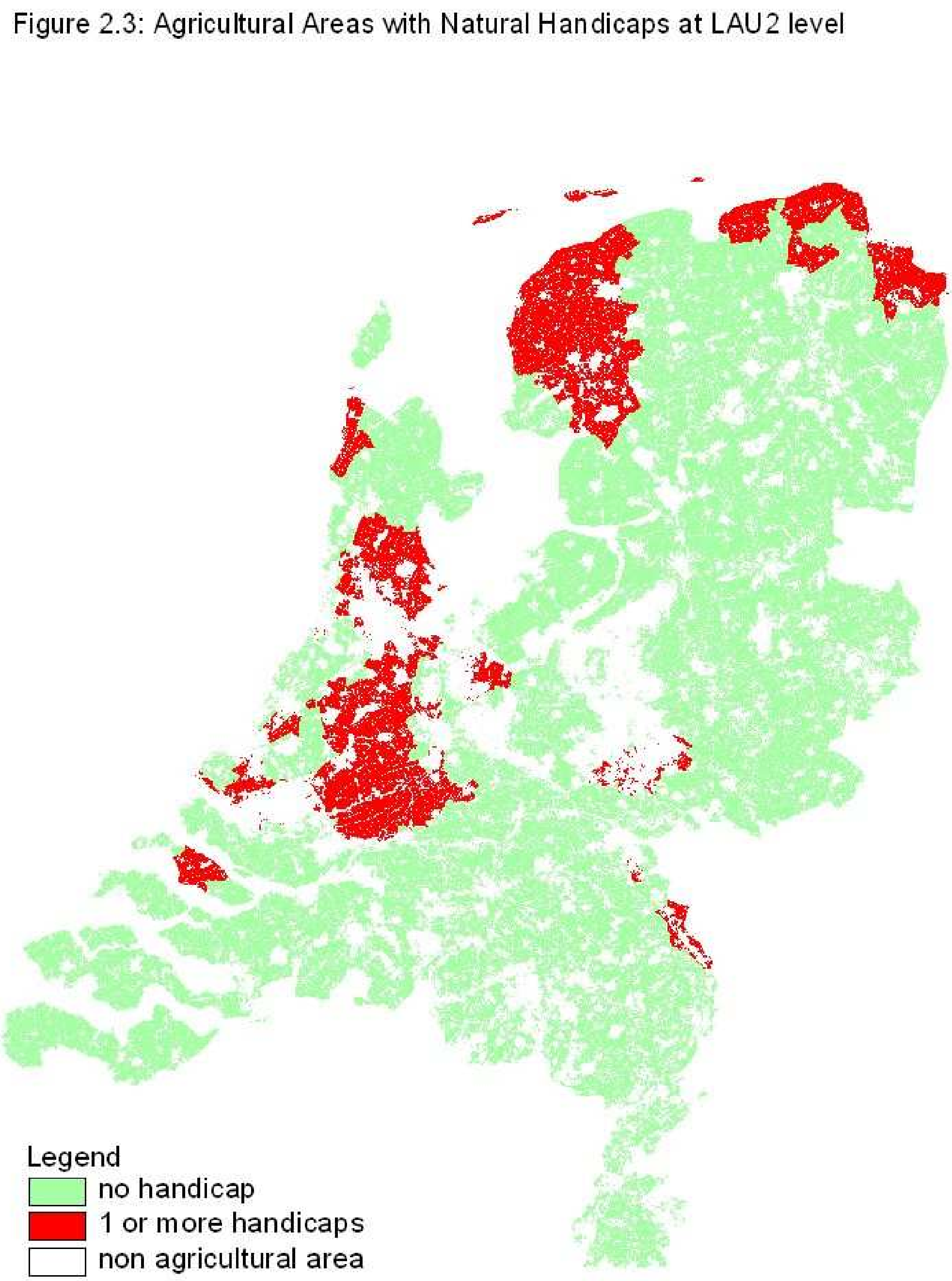


Figure 2.3 All LAU2 units with at least 66% of the UAA as affected by natural handicaps

Table 1 LAU2 units with at least 66% of UAA indicated as affected by natural handicaps.

LAU2- unit (municipality)	% of UUA indicated as LFA
BOSKOOP	99.9
REEUWIJK	99.8
ROZENDAAL	99.7
OUDER-AMSTEL	99.5
OOSTZAAN	98.9
VLIST	98.5
SLIEDRECHT	98.5
BERGAMBACHT	98.4
DIRKSLAND	98.4
DEN HELDER	97.7
DE RONDE VENEN	97.6
PURMEREND	97.4
ZEEVANG	97.3
WEESP	97.1
LANDSMEER	97.1
TERSCHELLING	97.0
OUDEWATER	96.7
DIEMEN	96.6
GOUDA	96.6
PAPENDRECHT	96.5
NIEUW-LEKKERLAND	96.2
WORMERLAND	95.5
WATERLAND	95.4
NEDERLEK	95.3
ALPHEN AAN DEN RIJN	95.2
NIEUWERKERK AD ijssel	95.1
WYMBRITSERADIEL	95.0
GIESSENLANDEN	94.5
LITTENSERADIEL	94.5
LIESVELD	94.4
NIEUWKOOP	94.2
AMELAND	94.1
GRAFT-DE RIJP	93.0
ABCOUDE	92.9
BODEGRAVEN	92.8
SCHOONHOVEN	92.7
HET BILDT	92.6
BREUKELEN	92.4
HUIZEN	92.3
LOPIK	92.3
RIJSWIJK	92.1
MOORDRECHT	92.1
OUDERKERK	91.5
WOERDEN	91.1
BLARICUM	91.1
EEMNES	90.5
SCHIERMONNIKOOG	90.0
HAARLEMMERLIEDE CA	89.9
GRAAFSTROOM	89.6
HARDINXVELD-GIESSENDAM	89.1
REIDERLAND	88.7
BOARNSTERHIM	88.7
SNEEK	88.0
BUNSCHOTEN	87.6
EDAM-VOLENDAM	87.5

LAU2- unit (municipality)	% of UUA indicated as LFA
RENKUM	86.9
ZEDERIK	86.6
LEMSTERLAND	86.5
AMSTERDAM	86.4
EEMSMOND	86.2
JACOBSWOUDE	85.1
MAASSLUIS	84.8
ZIJPE	84.5
MAARSSEN	83.9
FERWERDERADIEL	83.1
LEIDSCHENDAM-voorburg	83.1
LAREN	82.8
BAARN	82.3
MIDDEN-DELFLAND	82.3
TEN BOER	81.0
MONTFOORT	80.6
VOORSCHOTEN	80.2
DELFZIJL	80.2
ZAANSTAD	79.9
NIEUWEGEIN	79.5
ZOETERWOUDE	79.4
MOOK EN MIDDELAAR	79.4
BOLSWARD	78.8
MENALDUMADEEL	78.8
VLAARDINGEN	78.6
BERGEN LB	78.0
MUIDEN	77.9
CAPELLE AAN DEN IJSSEL	77.9
HARLINGEN	77.7
BEDUM	77.2
DELFT	76.4
FRANEKERADEEL	76.3
KRIMPEN AAN DEN IJSSEL	75.2
SCHIEDAM	75.1
VLIELAND	75.0
DE MARNE	74.9
ROTTERDAM	74.8
SCHEEMDA	74.5
AMSTELVEEN	71.8
LEERDAM	71.7
MIDDELHARNIS	71.4
UITGEEST	71.2
VIANEN	71.2
WUNSERADIEL	70.9
WESTERVOORT	70.8
SKARSTERLAN	70.0
BEEMSTER	68.7
RHEDEN	68.5
LEEUWARDERADEEL	68.5
CULEMBORG	68.0
SCHERMER	67.8
HEEMSTEDE	66.8
ARNHEM	66.4
LEEUWARDEN	66.2

3 Scale and administrative level

To accurately assess the areas constrained by natural handicaps it is important to map at an adequate administrative level, with the spatial and semantic resolution capturing the characteristics of the agricultural land in the area at the territorial level LAU2 or as close as possible to LAU2. According to the Eurostat website[1] in the Netherlands LAU2 level is represented by municipalities. Figure 1.1 shows all Dutch municipalities. This map is based on ´Gemeentegrenzen_2008_BirdGIS´.

Figure 3.1 All municipalities (LAU2-units) in the Netherlands.

[1] http://ec.europa.eu/eurostat/ramon/nuts/excel_files/NL_LAU_2007.xls

The Utilised Agricultural Areas (UAA) are derived from the land use database of the Netherlands (LGN). The most recent version of that database (2007) was used. Only grassland and arable land were selected and these areas are shown in figure 1.2

Figure 3.2 Utilised Agricultural Areas : grassland and arable land

Scale

The results of the assessments based on single criteria were transformed into grids with 5 x 5 m^2 cells. These grids were combined in order to create the map of areas with constraints. Data on salinity were only available in a 1km^2 grid. Data on climate were available at several weather stations. Since none of the criteria was met anyway, transforming the results into spatial data was not worth the effort.

4 Climate

The criteria for climatic conditions leading to natural handicaps for agriculture in the Netherlands are compared to temperature data from seven stations of the Royal Dutch Meteorological Institute (KNMI). For each station data the ´normal´ values between 1971 en 2000 were used to determine the length of the growing season, the thermal-time sum and the number of days with heat stress.

Data source:

KNMI website[2], for seven weather stations spread through the country:

- Eelde
- Leeuwarden
- De Kooy
- Twente
- De Bilt
- Maastricht
- Vlissingen

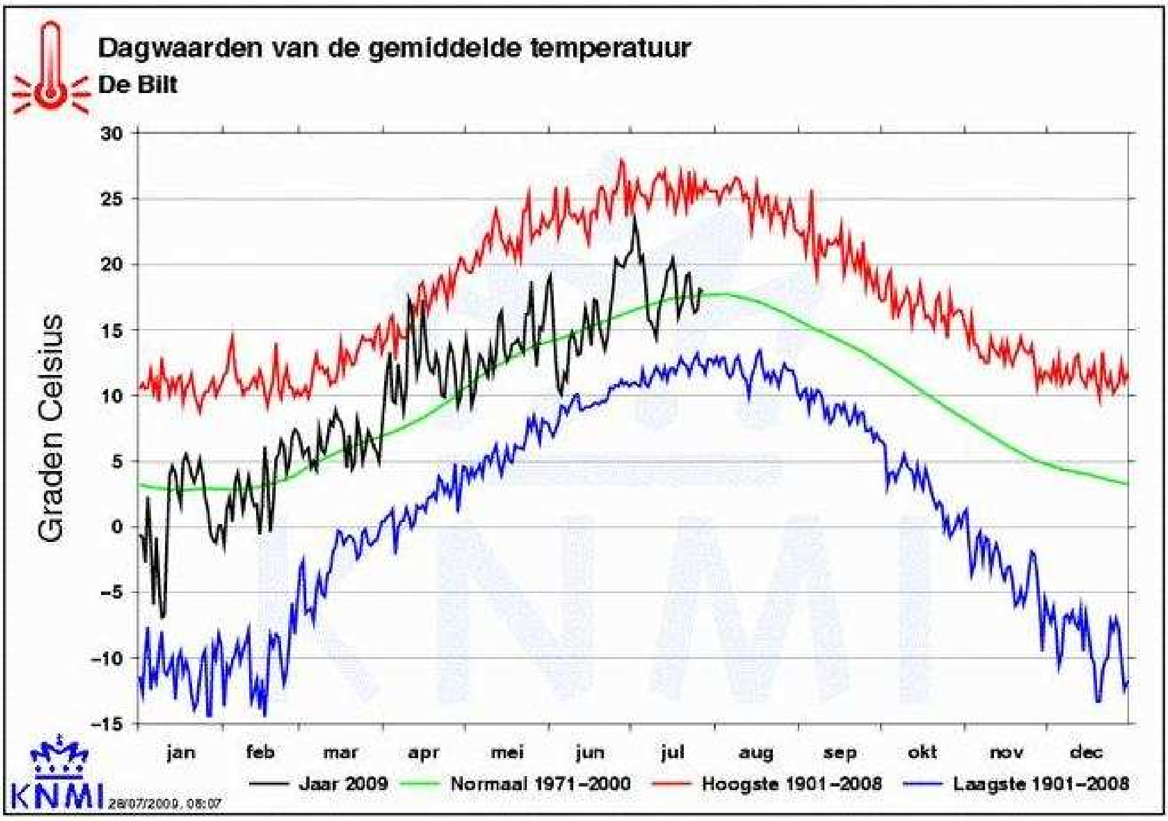


Figure 4.1 Example of meteorological data. Mean temperature per day. The green line represents the ´normal (average) temperature´ over 30 years (1971-2000).

2 http://www.knmi.nl/klimatologie/grafieken/jaar/index.cgi?station=380&graphtype=dag&element=tg

4.1 Low Temperature

For both length of growing period and thermal-time sum the threshold is never met. In the Netherlands low temperature is no handicap.

4.1.1 Length of Growing Period

Definition:
Length of Growing Period defined by number of days with daily average temperature > 5 °C:

Threshold:
<= 180 days

Method:
Daily average temperature graphs were compared to the threshold

Result:

Den Helder (de Kooy):	approx. march 13th to dec. 10th	→ 272 days
De Bilt:	approx. march 7th to nov. 25th	→ 263 days
Leeuwarden:	approx. march 13th to nov. 25th	→ 257 days
Groningen (Eelde):	approx. march 20th to nov. 25th	→ 250 days
Twente:	approx. march 10th to nov. 20th	→ 255 days
Vlissingen:	approx. march 7th to dec. 12th	→ 280 days
Maastricht:	approx. march 7th to nov. 25th	→ 263 days

The threshold (<= 180 days) is not exceeded at any weather station.

4.1.2 Thermal-time sum

Definition:
Thermal-time sum for Growing Period defined by accumulated daily average temperature > 5 °C:

Threshold:
<= 1500 degree-days

Method:
Daily average temperature of all days within the growing season were added.

Result:

Den Helder:	3173 degree-days	Twente:	3000 degree-days
Groningen:	2977 degree-days	Vlissingen:	3434 degree-days
De Bilt:	3198 degree-days	Maastricht:	3259 degree-days
Leeuwarden:	3016 degree-days		

The threshold (<= 1500 degree-days) is not met at any weather station.

4.2 Heat Stress

Definition:
Number and length of continuous periods (number of days) within the growing period for which daily maximum temperature (Tmax) exceeds the threshold:

Threshold:
One or more periods of at least 10 consecutive days with daily Tmax > 35°C

Method:
Daily average temperature data were compared to threshold

Result:

Den Helder (de Kooy):	0 days > 35 ºC
De Bilt:	0 days > 35 ºC
Leeuwarden:	0 days > 35 ºC
Groningen (Eelde):	0 days > 35 ºC
Twenthe:	0 days > 35 ºC
Vlissingen:	0 days > 35 ºC
Maastricht:	0 days > 35 ºC

The threshold (>= 10 consecutive days) is not exceeded for any weather station.

5 Soil

5.1 Drainage

Definition
Land areas that are water logged for significant duration of the year (lack of gaseous oxygen in soil for root growth or land not accessible for tillage)

Threshold
20% yield reduction because of Poorly drained soil

Source
Soil map of the Netherlands, scale 1 : 50.000 (bod50_2006)
HELP-tables 1987

Method
A water logged situation is a result of high groundwater tables, occurring in low areas where soils have no external drainage. To assess soils that are poorly drained, all polygons with ground water table (Gt) I en II were selected from the soil map of the Netherlands, scale 1 : 50.000 (bod50_2006). Gt I means that the average groundwater table fluctuates between a average highest ground water table of less that 20 cm below the soil surface and a average lowest groundwater table of less that 50 cm depth. Gt II means that the groundwater table fluctuates between the average highest ground water table of less than 40 cm depth and a lowest groundwater table between 50 and 80 cm depth (see also table below). The HELP-tables (1987) indicate that areas with these ground water tables (even for low budget crops, such as grass) suffer for at least 20% yield depression due to water damage.

Depth of ground water	Groundwater table (Gt)						
(cm below surface)	I	II	III	IV	V	VI	VII
Mean highest ground water	<20	<40	<40	>40	<40	40-80	>80
Mean lowest ground water	<50	50-80	80-120	80-120	>120	>120	(>160)

In addition to the soils with Gt I or II all polygons “Associatie petgaten” en “veengebied in ontginning” (indicated AP and AVo) were added to the selection of poorly drained soils. Although these polygons have no registered ground water table, because of a complex or an association of two or more soil units, it is known that they are very poorly drained. This also applies to soils in frequently flooded plains that are situated outside dikes (“uiterwaarden” and “buitendijkse polders”).

Result

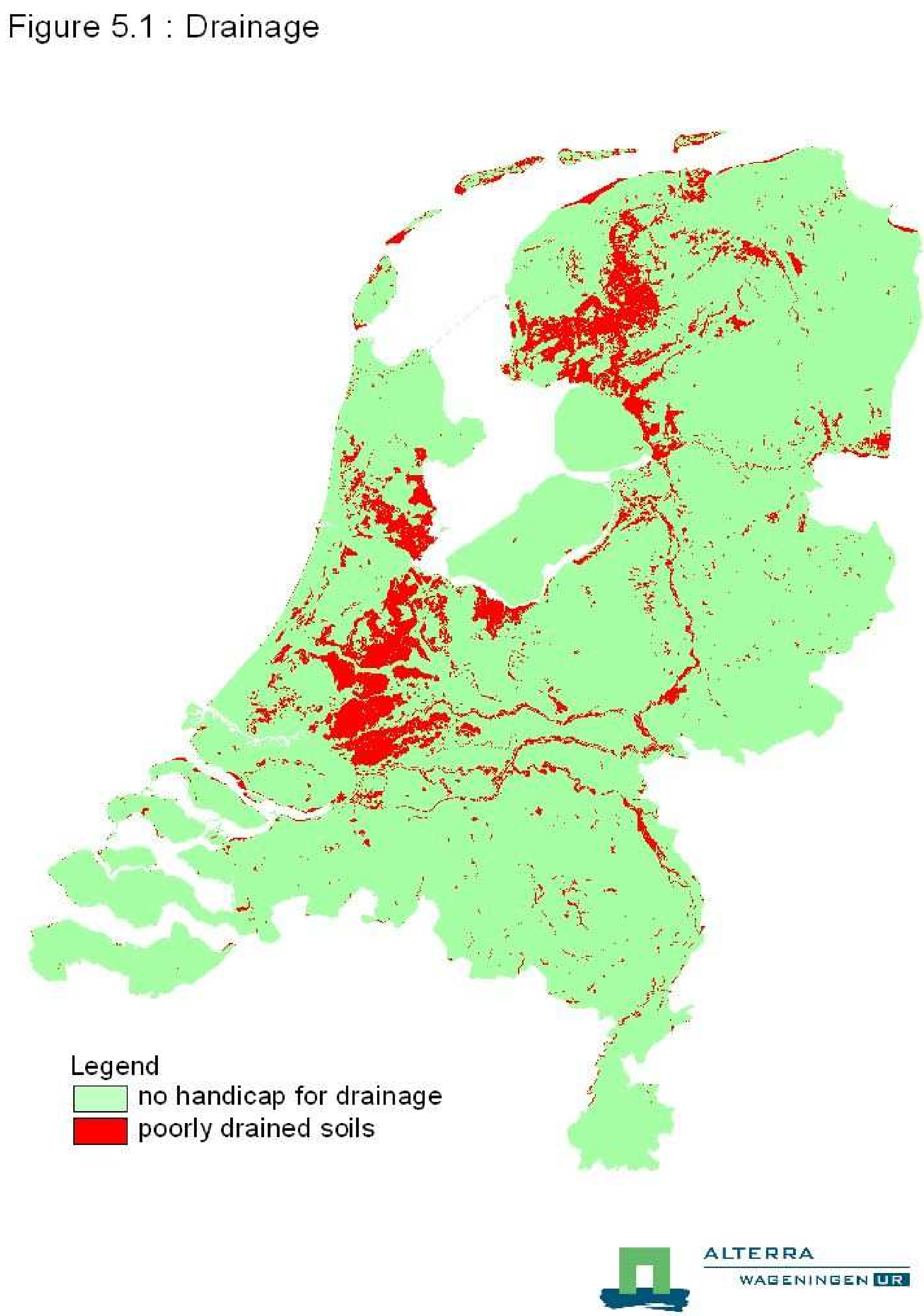


Figure 5.1 All poorly drained areas

Fine tuning

The current edition of the Dutch soil map consists of data from different age. In some areas soil drainage was already improved when soil and groundwater were surveyed, in other areas the installation of drainage systems was performed more recently. Data about the period when the drainage systems have been installed in all the areas with high groundwater tables are not available. It is also unknown whether drainage was improved before or after the soil survey was performed.

In the first case (drainage had been improved before the soil survey) no fine tuning is needed. The soils still have high groundwater tables (Gt I or II) even with an improved drainage system and are thus poorly drained. These are mainly peat soils. The second category consists of soils that were drained after the soil survey. Theoretically, in these areas the handicap might have been overcome since the soil survey. However, in these soil types (peat or heavy clay) the effect of drainage is limited and will at most result in a Gt III if there is any effect at all. That means according to the threshold derived from the HELP-tables that these areas possibly should be excluded from the LFA.

However, since data about the change in Gt after soil survey is not available and because areas where possibly drainage was improved resulting in a change only from Gt II to Gt III, no areas were excluded from the LFA. Even in the areas where Gt changed after improvement drainage, soils are still ´somewhat poorly drained´ (Van Orshoven et al.., 2008, p. 32) and can only be used as grassland.

5.2 Texture and Stoniness

Definition

Relative abundance of clay, silt, sand, organic matter (weight %) and coarse material (volumetric %) fractions in topsoil material (for national and international classification see supplement 4).

Threshold

Soil texture is said to be severely limiting if any of the following conditions are present:

(i) more than 15 % volume of coarse fragments (> 2 mm) of any kind in topsoil or *(see § 5.2.1)*

(ii) average texture class of rooting zone is
  a. unsorted, coarse or medium sand, loamy coarse sand *(see § 5.2.2)* or
  b. heavy clay (> 60% clay) *(see §5.2.3)* or

(iii) organic soil as defined with organic matter (>30%) over a depth of more than 40 cm either extending down from the surface or taken cumulatively within the upper 80 cm of the soil *(see §5.2.4)* or

(iv) texture class of clay, silty clay, or sandy clay with vertic properties *(see §5.2.5)* or;

(v) any proportion of rock outcrops, boulders (largest dimension above or equal to 60 cm) within 15 cm of the surface *(see §5.2.6)*.

Result

When the application of all above sub criteria are combined the areas where texture is severely limiting can be shown. The result is presented in Figure 5.2

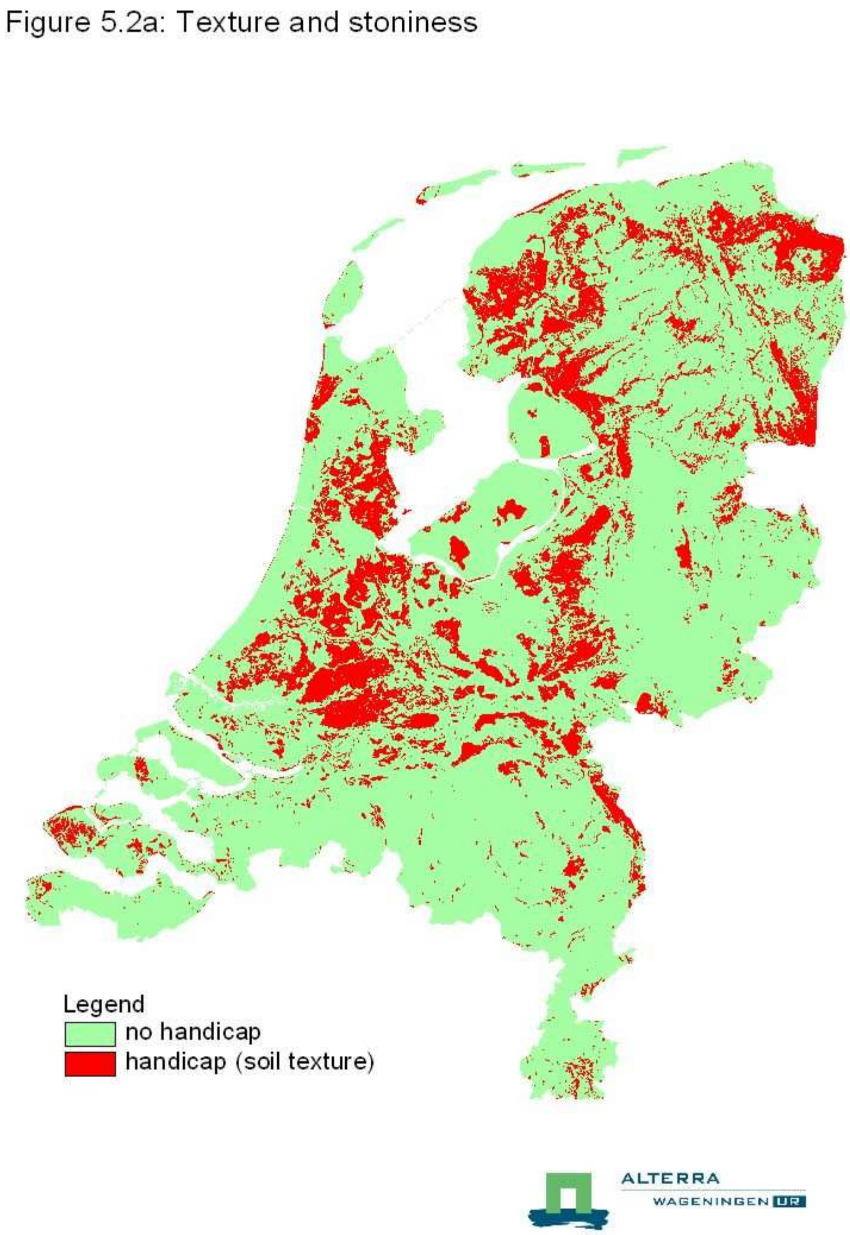


Figure 5.2a: All areas that meet at least one threshold within the criterion Texture and stoniness

Fine tuning

Data on average yields in the areas with constraints were not available. However, it can be assumed that where arable crops are grown on these soil with less optimal natural properties, the handicap has been overcome. On the other hand, when on these soils (permanent) grasslands are situated, it is plausible that the handicaps haven not been overcome, for grass is a less profitable 'crop'.

In figure 5.2b the areas with constraints, as shown in Figure 5.2a, are combined with land use. In orange the areas with grassland, in red all areas with arable crops are shown. Following the above described arguments, the areas with texture as a natural handicap after fine-tuning, are only those areas that are presented in Figure 5.2c.

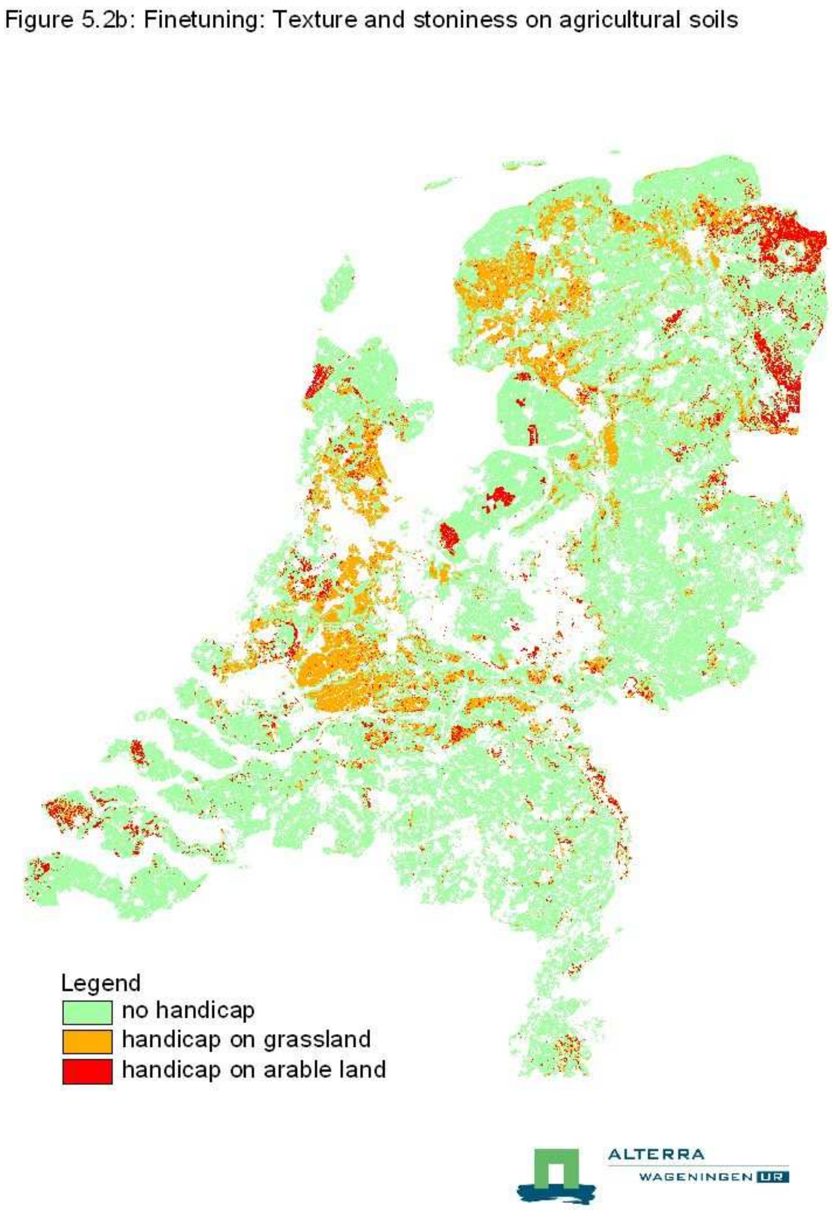


Figure 5.2b Agricultural areas with a handicap Texture and stoniness. Arable land is distinguished from grassland as a step in the fine tuning process and excluded from the LFA

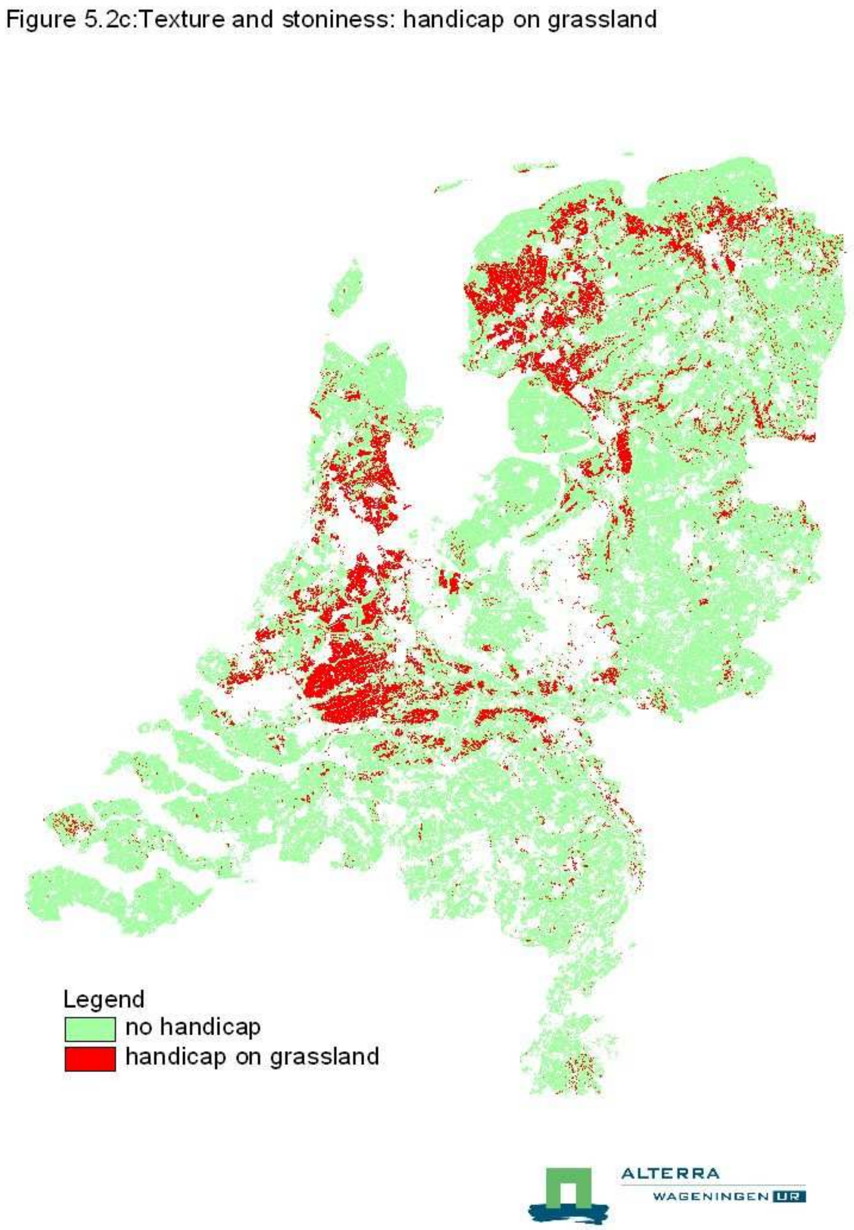


Figure 5.2c Result of fine tuning: : Agricultural areas (grassland) with a handicap Texture and stoniness

5.2.1 Coarse material

Threshold
15% of topsoil volume is coarse material (> 2 mm)

Source
Soil map of the Netherlands, scale 1 : 50.000 (bod50_2006)

Method
We selected all polygons from the soil map that met one of the following criteria:

- particle size between 2-64 mm in the upper 40 cm (a "g" in topsoil description)
- particle size > 64 mm in the topsoil ("m" in topsoil description)
- gravel soils (indicated by "FG" in the legend of the soil map)
- "vuursteeneluvium" soils (indicated by "FG"). These soils are situated only in the south of the province Limburg.

Result

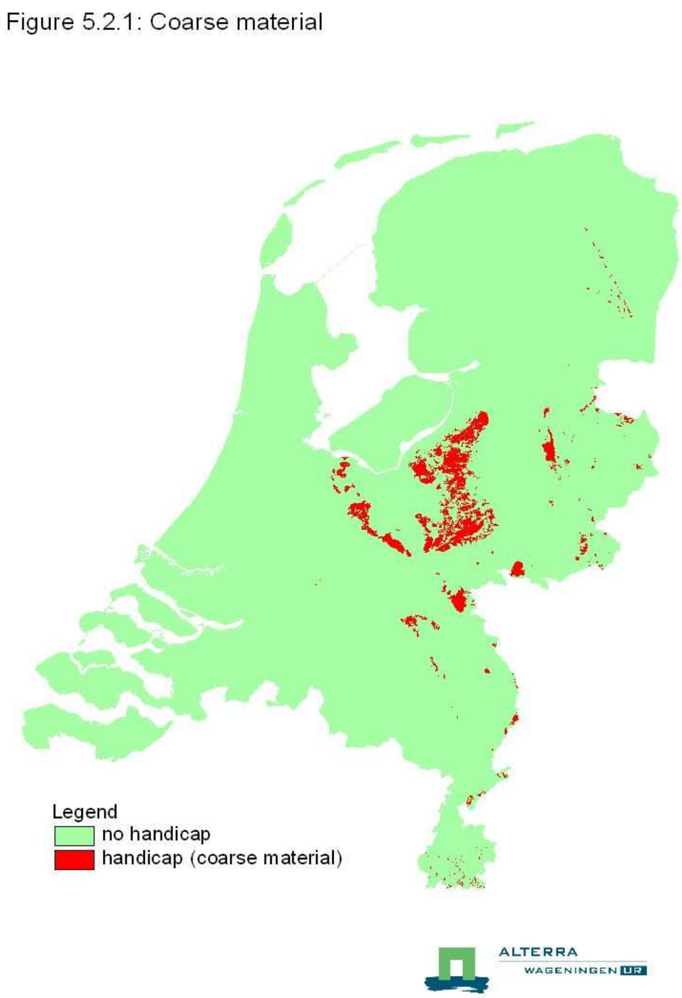


Figure 5.2.1 Handicap of coarse material as part of Texture and Stoniness

5.2.2 Coarse or medium sand

Threshold
Unsorted, coarse or medium sand, loamy coarse sand

Source
Soil map of the Netherlands (bod50_2006)

Method
We selected all polygons with texture of the sand fraction between 210 and 2000 μm in the topsoil ("30" in the numerical part of the legend code)

Result

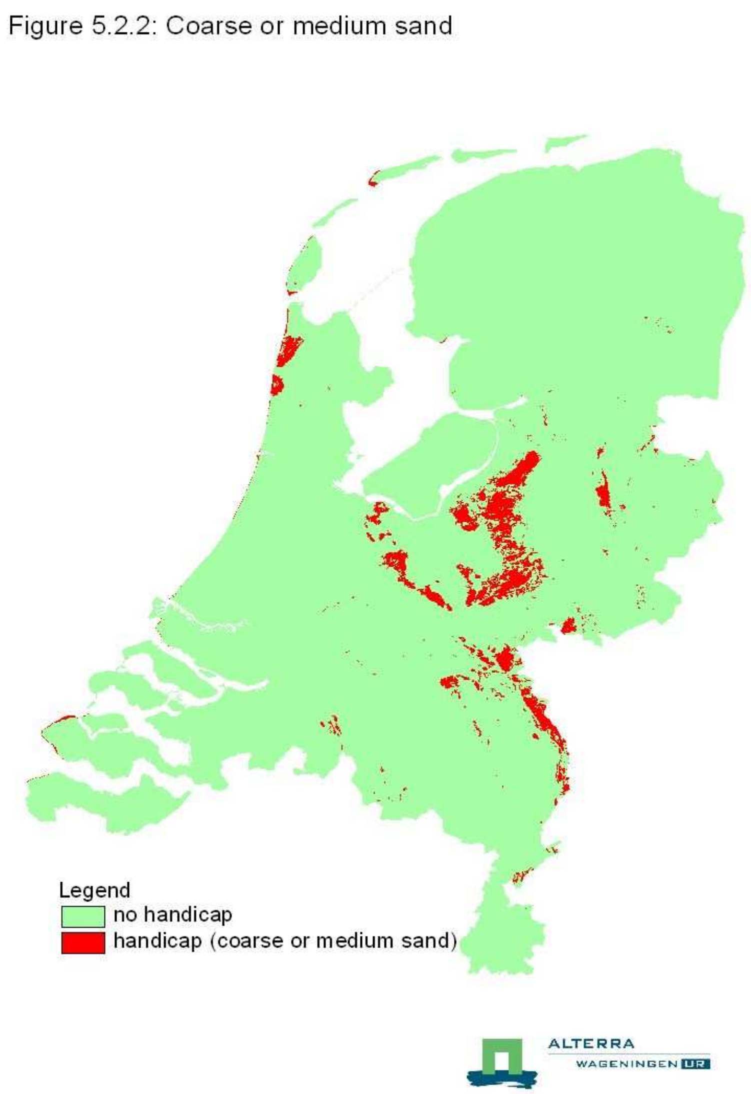


Figure 5.2.2 Handicap of coarse and medium sand as part of Texture and Stoniness

5.2.3 Heavy clay

Threshold
Heavy clay (>60% clay)

Source
1:50 000 soil map of the Netherlands (bod50_2006) and for each soil unit (legend) a description of the most frequent (standard) soil profile (de Vries, 1999).

Method
The soil classification system in the Netherlands distinguishes moderately heavy clay (< 50% clay) from very heavy clay (> 50% clay). To distinguish soils with more than 60% clay, the method of de Vries (1999) was followed: the soil map was combined with the standard profile properties as recorded in the Dutch Soil Information System and subsequently transformed into 5 x 5 m^2 grid cells. Only grid cells with a clay content in the topsoil of > 60% were selected.

Result

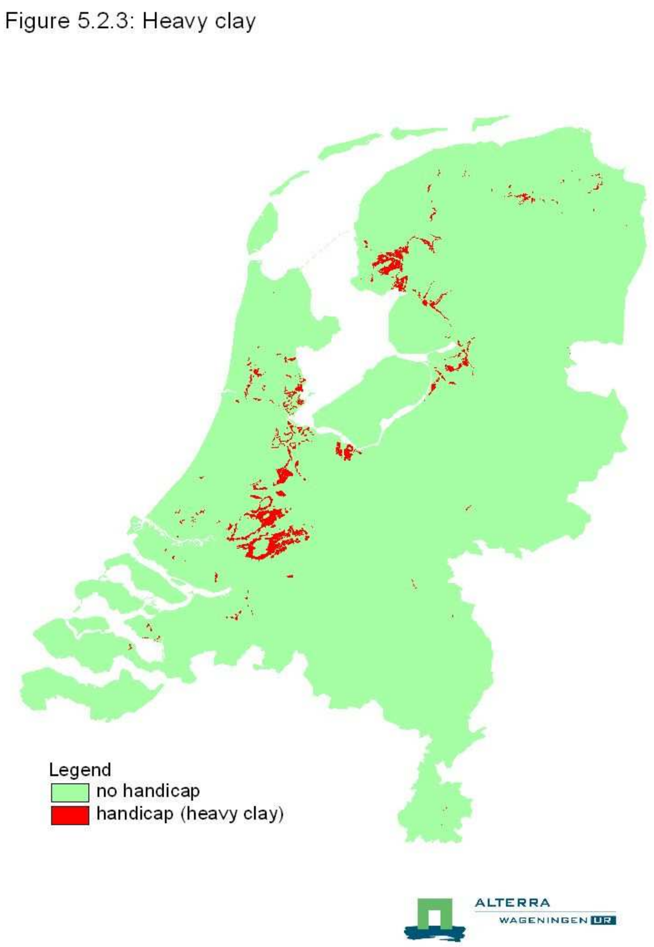


Figure 5.2.3 All areas with handicap of heavy clay as part of Texture and Stoniness

5.2.4 Organic soil

Threshold
Organic soil (>30% (weight) organic matter)

Source
1:50 000 soil map of the Netherlands (bod50_2006) and for each soil unit (legend) a description of the most frequent (standard) soil profile (SC654).

Method
The threshold of 30% organic matter is no distinguishing property in the Dutch soil classification system. Therefore the method of de Vries (1999) was followed: the soil map was combined with the standard profile properties as recorded in the Dutch Soil Information System and subsequently transformed into 25m^2 grid cells. Only grid cells with an organic matter content in the topsoil of > 30% were selected.

Result

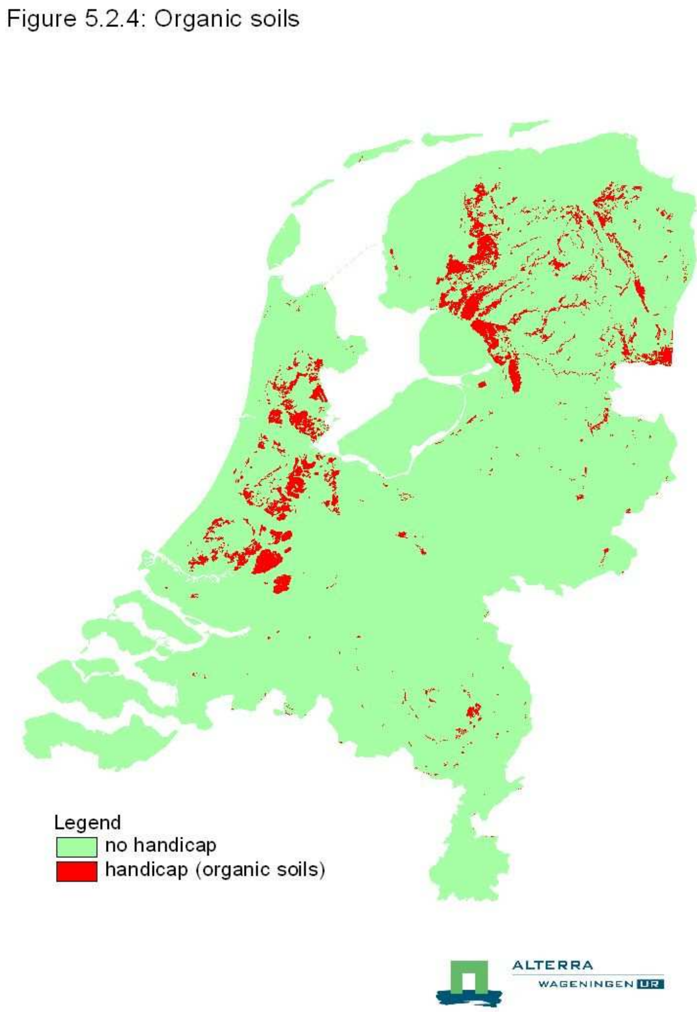


Figure 5.2.4 All organic soils as part of Texture and Stoniness

5.2.5 Vertic properties

Threshold:
Vertisol, clay, silty clay or sandy clay with vertic properties.

Source:
1: 50 000 soil map of the Netherlands (bod50_2006)
Van den Akker and Van Putten (1995)

Method:
According to van den Akker and van Putten (1995) soils with heavy or severe problems from vertic properties are soils with a groundwater table (Gt) dryer (other) than I, II or II* in combination with one the following properties:

- clay (lutum) percentage higher or equal 35%
- peat soils
- immature (slack) soils

All soils that meet above criteria have been selected from the soil map 1:50 000. The result has been transformed into a 25m^2 grid.

Result:

Figure 5.2.5: Vertic properties

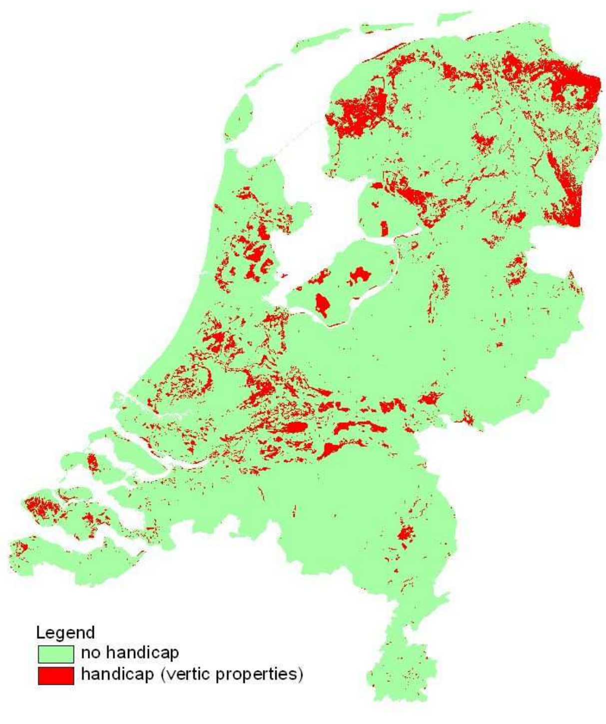


Figure 5.2.5 Elaboration of vertic properties as part of Texture and Stoniness

5.2.6 Rock outcrop

Threshold
Rock outcrop, boulder within 15 cm of the surface

Source
1:50 000 soil map of the Netherlands (bod50_2006)

Method
On the Dutch soil map the only distinguished rock outcrops are related to Rendzina soils. We used the soil map of the Netherlands, scale 1 : 50.000 (bod50_2006) and selected the polygons with “KM” (rendzina) and “AHk” (“kalksteenhelling” soils) in the classification code.

In the Netherlands soils with a hard pan also exist. In those soils accumulation of iron oxides occurs due to seepage resulting in a hard pan (“rodoornige” soils). However, in the database of the Dutch soil map only soils enriched with iron oxide can be selected. Since that does not always mean that there is a hard pan, rodoornige soil can not be distinguished. We therefore did not include this type of soil in the selection.

Result

Figure 5.2.6 Elaboration of rock outcrop as part of Texture and Stoniness

5.3 Rooting depth

Definition
Rooting depth is the maximum depth from the soil surface to where most of the plant roots can extend. It is defined by the effective soil depth above any barrier to root extension, excluding impediments to root extension such as compact (massive) structure.

Threshold
Severely limiting physical rooting depth: < 30 cm

Source
1:50 000 soil map of the Netherlands (bod50_2006)

Method
In the Netherland rooting depth is delimited by a strong transition of pH, poor aeration or high bulk density within 30 cm. Aeration is mostly delimited by water logging, which has already been described in §5.1 (Drainage). The limitations of an unsuitable pH in the subsoil have mostly been overcome. The limitations caused by subsoil compaction may be severe, but actual data about the scale at which this problem may occur are not (yet) available.

Therefore, rooting depth has not been further elaborated and no maps are produced. At this moment, this criterion is considered not relevant in the Netherlands.

5.4 Chemical properties

Definition

Presence of salts, exchangeable sodium and gypsum (toxicity) in the topsoil.

Result

Only the presence of salts is considered a limiting factor for agricultural production. So the map (figure 5.4) only consists of data from §5.4.1 (Salinity)

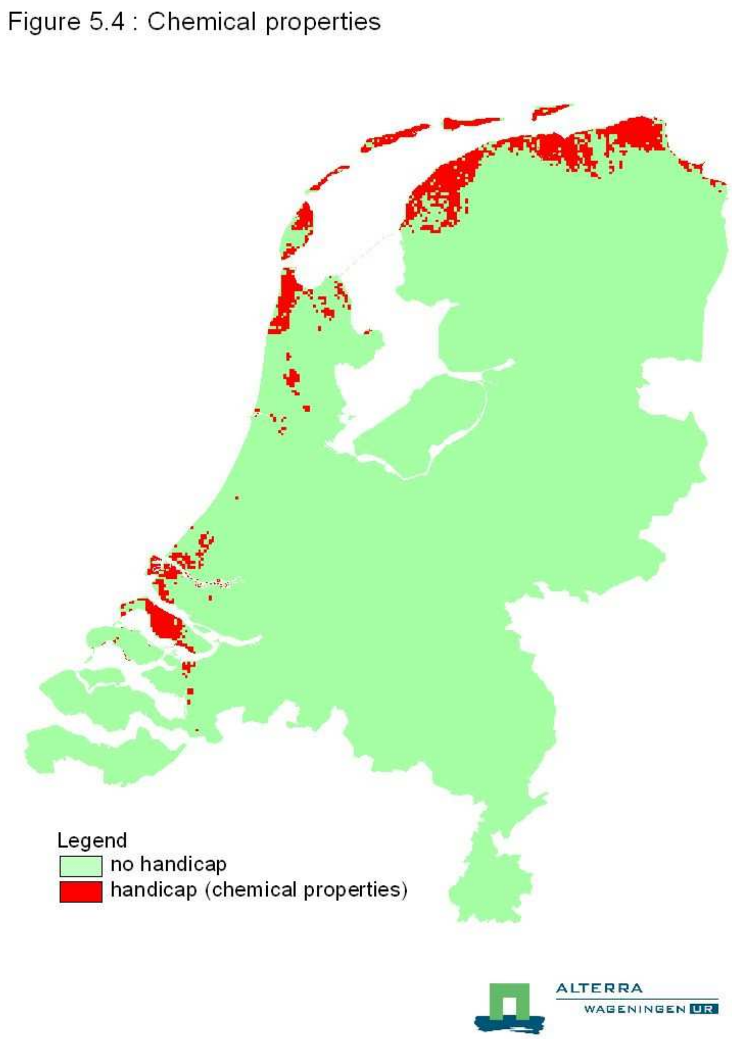


Figure 5.4 All areas with handicap chemical properties (salinity)

Fine-tuning

Data on average yields or livestock density in the areas with constraints were not available. However, chloride contents of more than 3000 mg/l are high enough to cause significant yield depressions, both in arable crops and grasslands. Therefore no extra fine tuning is elaborated.

5.4.1 Salinity

Threshold:
Salinity: Electrical conductivity > 4 deci-Siemens per meter (dS/m)

Source:
At present only a 1km^2 map is available for large parts of the country, but lacking the south western islands (Zeeland). This map with chloride content just below the topsoil (C_od_ref_t2z) is produced by Deltares (Oude Essink et al., 2009, Kwadijk et al., 2007 and Stuurman et al., 2008).
Additionally we use the 1:50 000 soil map of the Netherlands (bod50_2006)

Method:
The map with chloride concentrations just below the topsoil gives a rough indication of the spatial distribution of salinity as natural handicap. The map consists of 1km^2 grid cells with four classes of salinity: 0-300, 300-1000, 1000-3000 and >3000 mg Cl/l). The threshold of 4 dS/m corresponds to 1250 mg Cl/l. To be sure that only the areas with severe limitations were selected, only grid cells with > 3000 mg Cl/l were considered. That level corresponds to salt water.

Because on this map the province of Zeeland is not worked out yet, we also used the soil map of the Netherlands, scale 1 : 50.000 (bod50_2006) and selected all polygons with an "n" in the soil description code (topsoil). The 'n' indicates that on those locations plants indicating salt were present when the survey was performed.

Result:
See Figure 5.4

5.4.2 Sodicity

Threshold:
Sodicity: Exchangeable Sodium Percentage > 6 (ESP)

Source:
In the Netherlands sodium is not considered to cause problems.

5.4.3 Gypsum

Threshold:
Gypsum: > 15%

Source:
In the Netherlands gypsum is not considered to cause problems.

6 Soil and Climate

6.1 Soil Moisture Balance

Definition:
Number of days within the growing period, as defined by temperature > 5°C (LGPt5), for which the amount of precipitation and water available in the soil profile exceeds half of the potential evapotranspiration.

Threshold:
≤ 90 days

Source:
The hydraulic data set of the Netherlands calculated by SWAP model (version 3.2; Kroes et al., 2008). For this dataset 6405 different units (with a unique combination of hydrological and soil properties) were used as input for the SWAP model in which the hydrology is simulated for a series of 35 Years (1971-2005). This dataset is available on a decade base.

Method:
Within the data set only data on water availability in the soil profile (rooting depth – flux coherent layers), precipitation and potential evapotranspiration were considered. For each year only the period of the growing season (Apr-Oct) was further analyzed. Within those periods the average number of decades per year where the below described criterion (dry conditions) was met:

$$\text{Precipitation} + \text{Water available water in rooting depth} - \text{Flux coherent layers} < 0.5 * \text{Potential Evapotranspiration} \quad [1]$$

Result:
Soil Moisture Balance is only a handicap in case dry conditions as described above (formula [1]) occur for 90 or more days. In the hydraulic data set dry conditions occur at least once in 4780 units. The average number of decades per year with dry conditions never exceeded 4.5 (= 45 days) per year.

Based on these results it was concluded that the period with dry conditions never exceeded the threshold of 90 days. Soil moisture balance is therefore considered no natural handicap in the Netherlands.

7 Terrain

7.1 Slope

Definition
Change of elevation with respect to planimetric distance (%).

Threshold
> 15%

Source
Dutch digital terrain model (AHN; 25 m2 grid)

Method
All grids with a slope percentage of >15% were selected.

Result

Figure 7 All areas with natural handicap Slope

8 Comparison to LFA based on article 20

One of the required elements of the elaboration of the revised article 19 is a comparison to the current LFA. So far, the Netherlands only indicated areas as LFA based on article 20. Therefore, in the overlays as presented in this chapter only the relevant biophysical criteria are compared to the LFA indicated in that article. Overlays are made for Drainage, Texture and Stoniness, Chemical Properties and Slope. Since the requirement for presenting these overlays (presentation ´Required Elements to be Supplied to the Commission from Member State Simulations´, 28 May 2009) was part of the first set of maps, i.e. those maps where all relevant individual criteria are presented, the overlays were not corrected for UAA or aggregated at the LAU2 level.

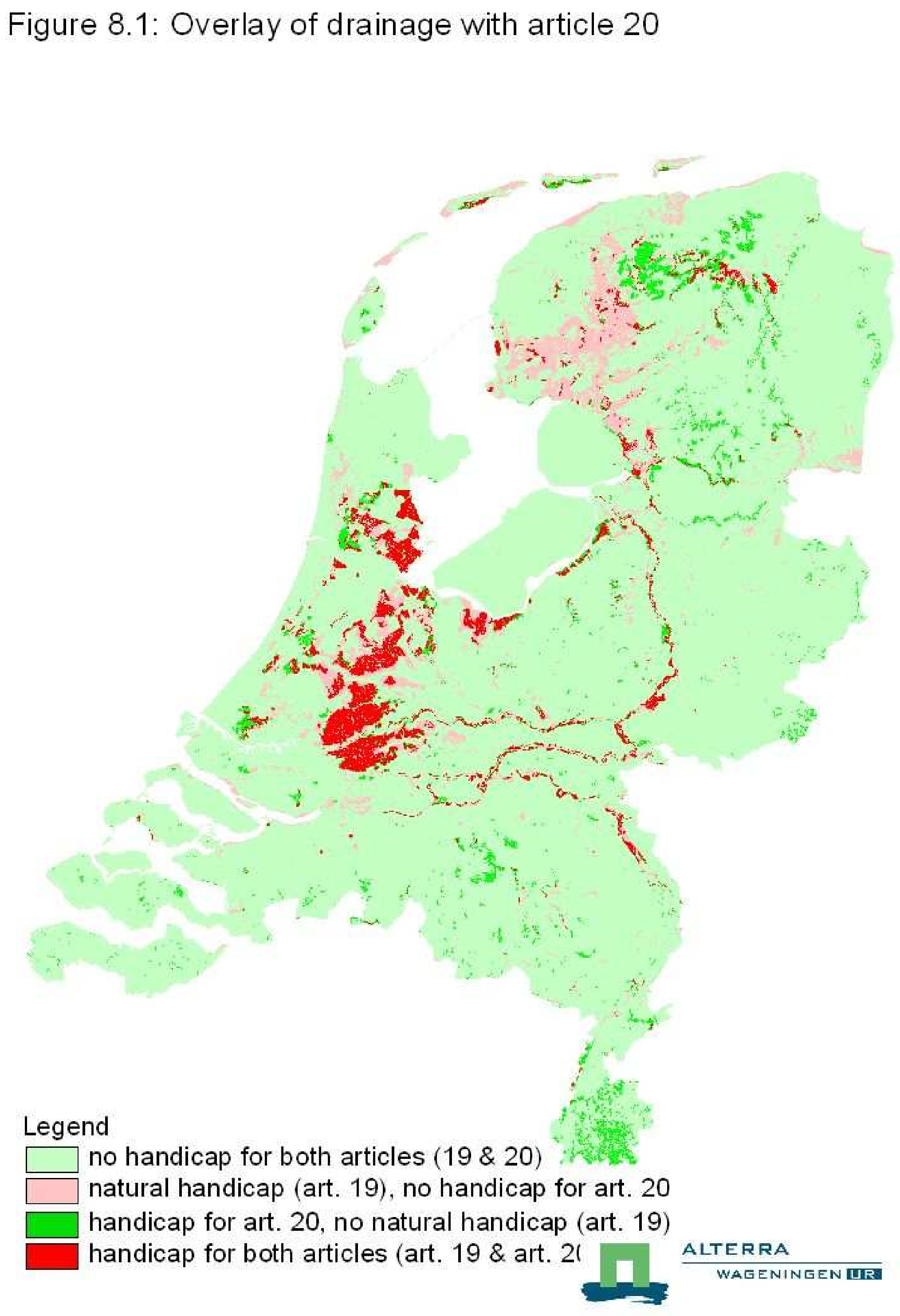


Figure 8.1 Overlay of the biophysical criterion Drainage with LFA from article 20

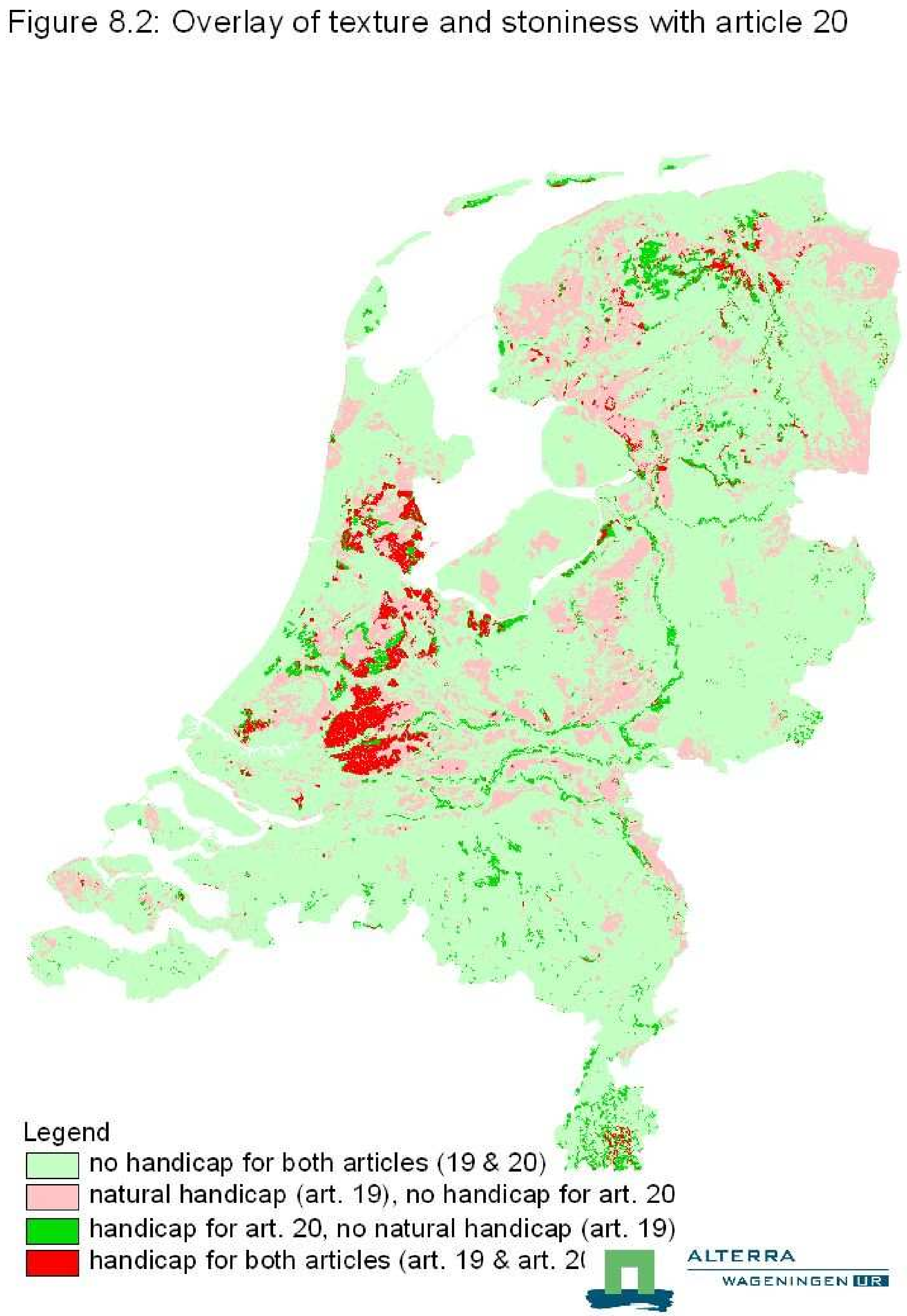


Figure 8.2 Overlay of the biophysical criterion Texture and Stoniness with LFA from article 20

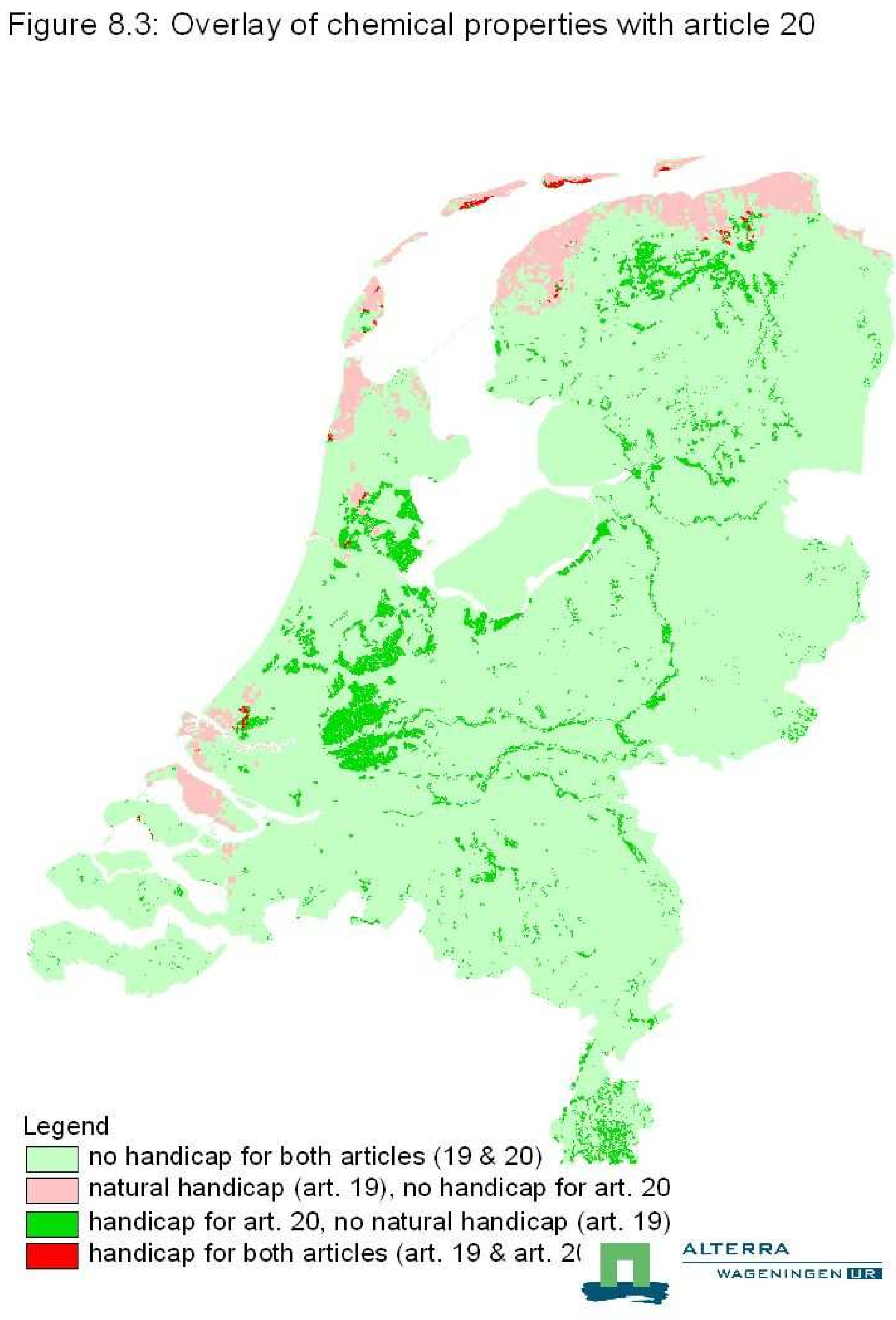


Figure 8.3 Overlay of the biophysical criterion Chemical Properties with LFA from article 20

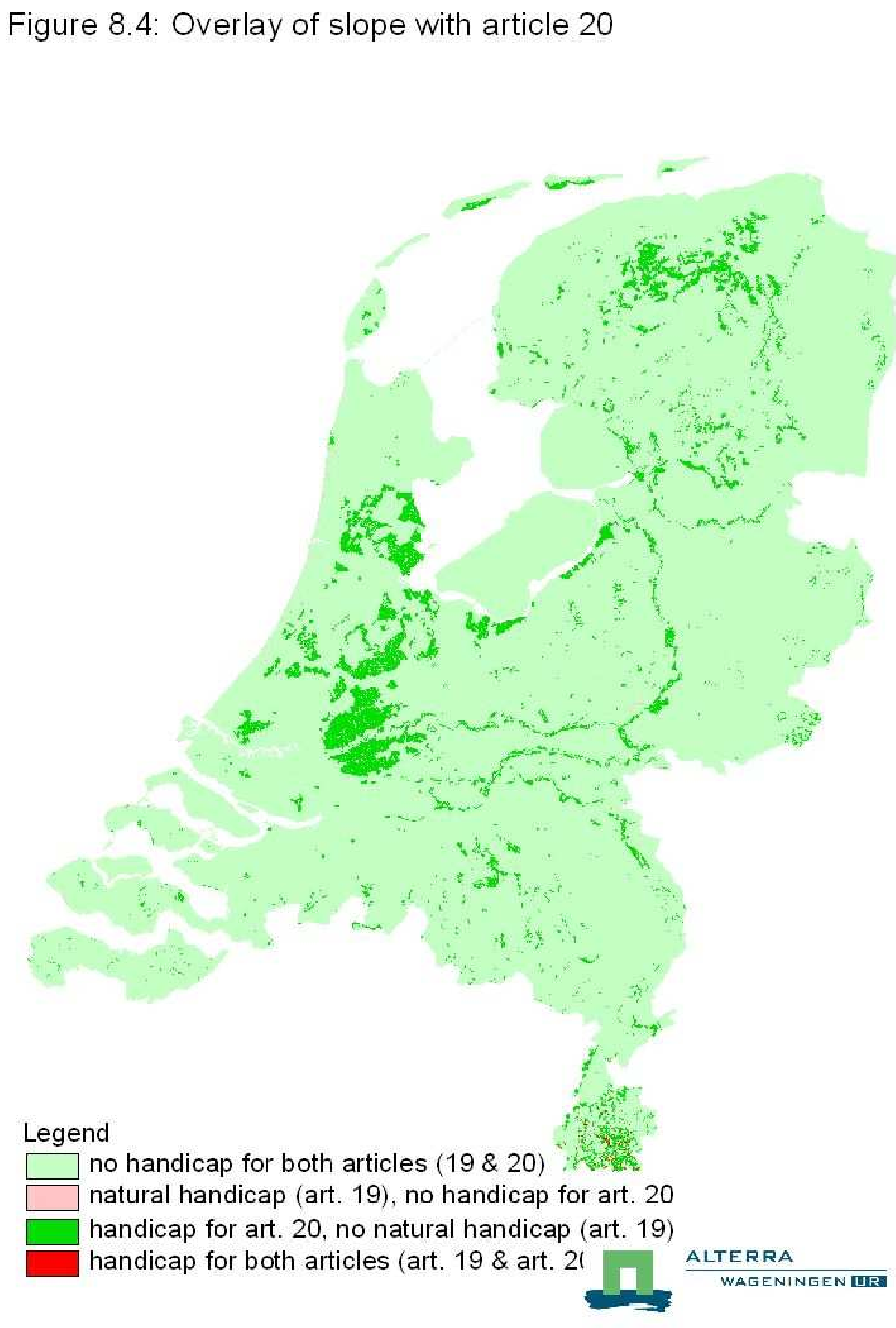


Figure 8.4 Overlay of the biophysical criterion Slope with LFA from article 20

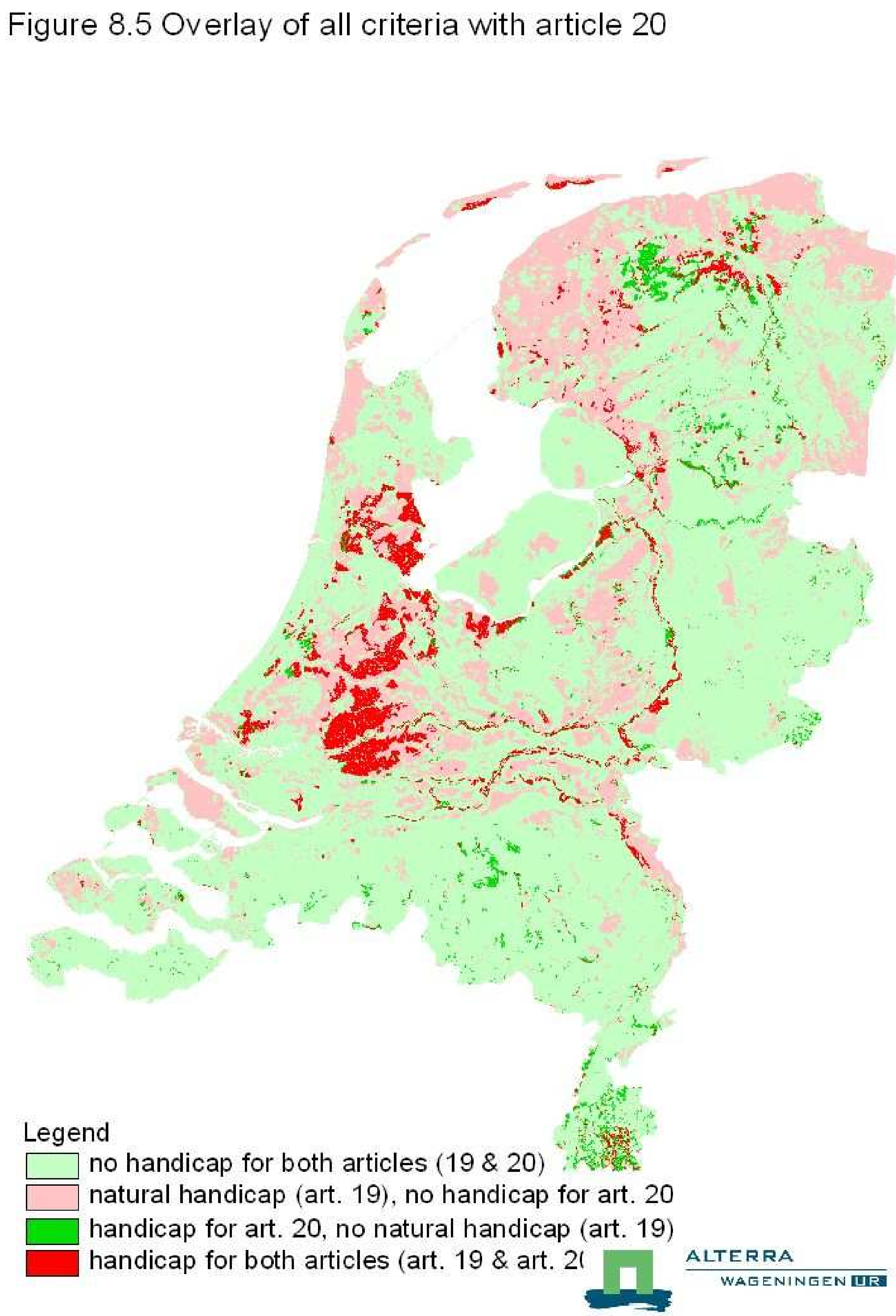


Figure 8.5 Overlay of all relevant biophysical criteria with LFA from article 20

9 Literature

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