Drainage filters a new targeted mitigation strategy

Drainage losses of nutrients accounts nationally for:
- 50-60% of agricultural N losses -> locally up to 90%
- Aprox. 33% of agricultural P losses

NLES

Rootzone loss
60 kg N/ha

6 kg N/ha

33 kg N/ha

Drainage filter

60 kg N/ha

Surface-water N-retention

DK-model

Groundwater reduction ~90%

http://trends.nitrat.dk/

Oxideret
Reduceret

Mark

Drænrør

Fjord

Vandløb

Sø

Våd
område

SEGES
Lavpermeabelt lag
Grundvandsmagasin   · · · Partikler
Ådalsmagasin   Oxideret
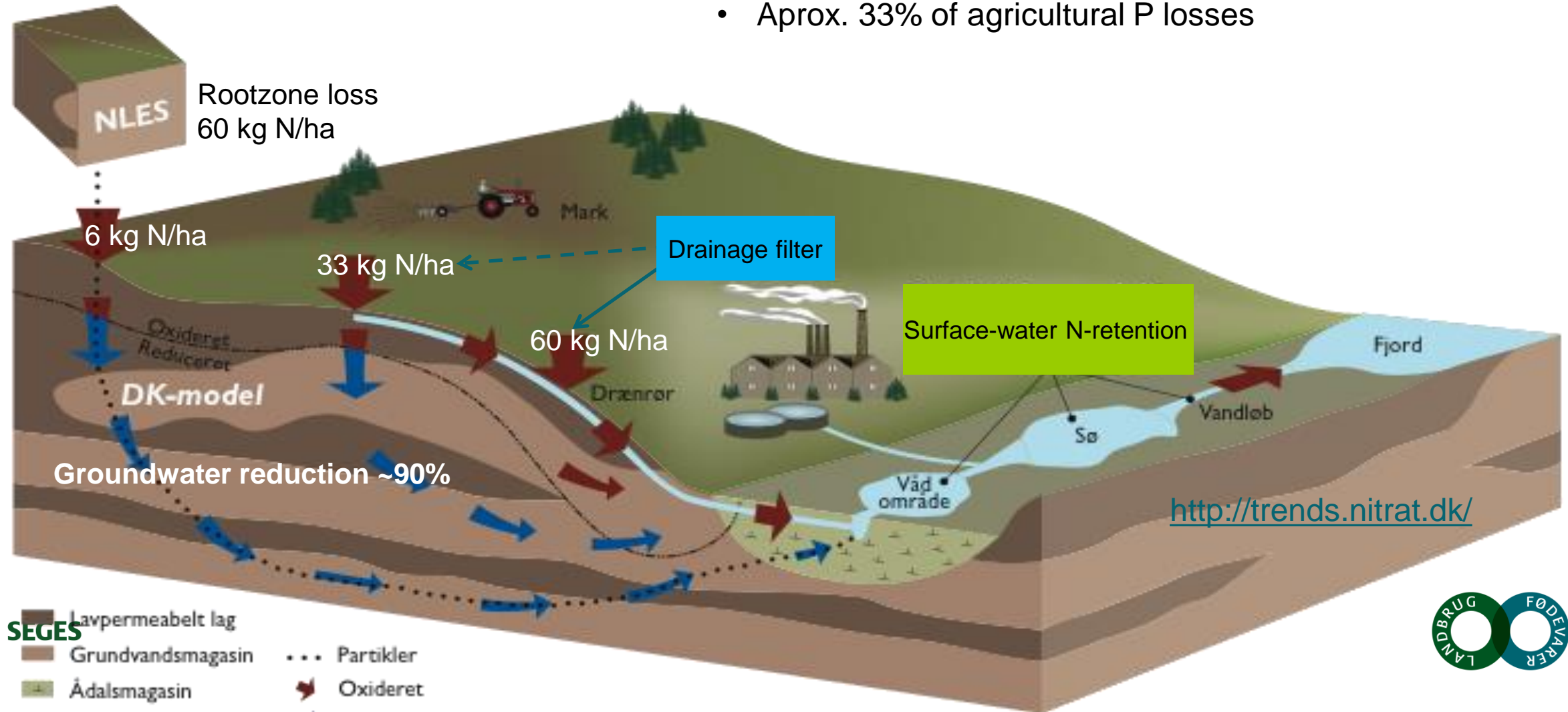
Implementation strategy

Where should we implement targeted drainage measures to ensure a cost-efficient mitigation strategy?

VO — VÅDOMRÅDE

MV — MINIVÅDOMRÅDE

AD — AFBRUDT DRÆN

Kjærgaard, 2018

SEGES

Strategy for implementing targeted drainage measures

Criteria

1. Reduction requirement (coastal targets)

2. **Suitability of agricultural areas**

3. N-nutrient losses by drainage - quantitative significant

4. Quantitative environmental impact on coastal water (N)

SEGES

Suitability of agricultural areas

- Drainage discharge dominated
- Lowland groundwater discharge areas not suitable
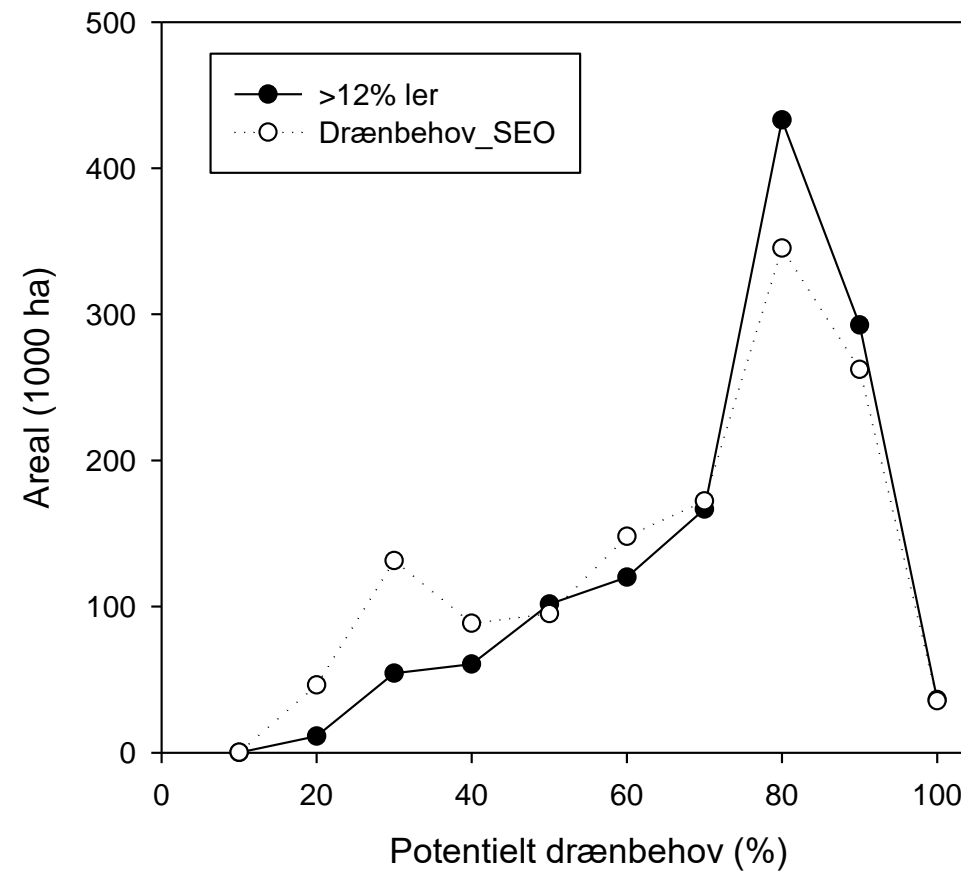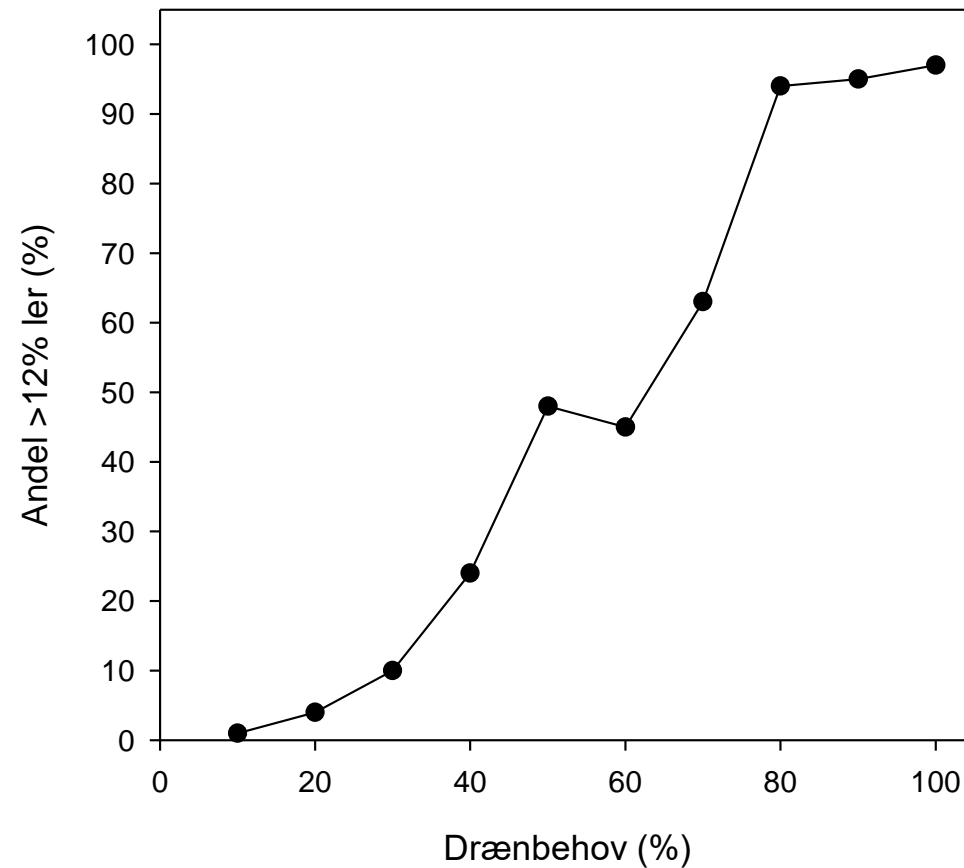

http://trends.nitrat.dk/
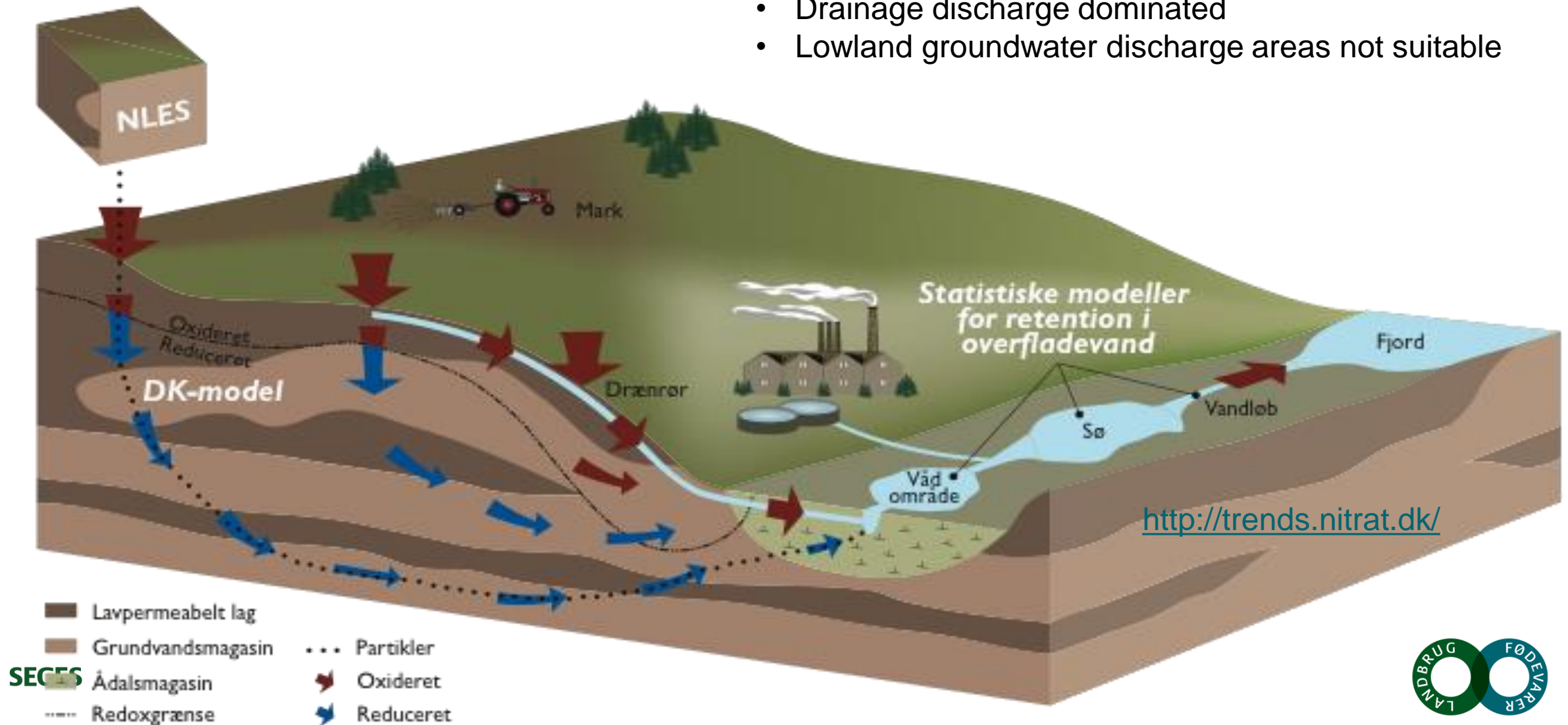
Suitability of agricultural areas

Threshold subsurface clay content -> discriminating between drainage vs groundwater losses

Photo: M. Habekost
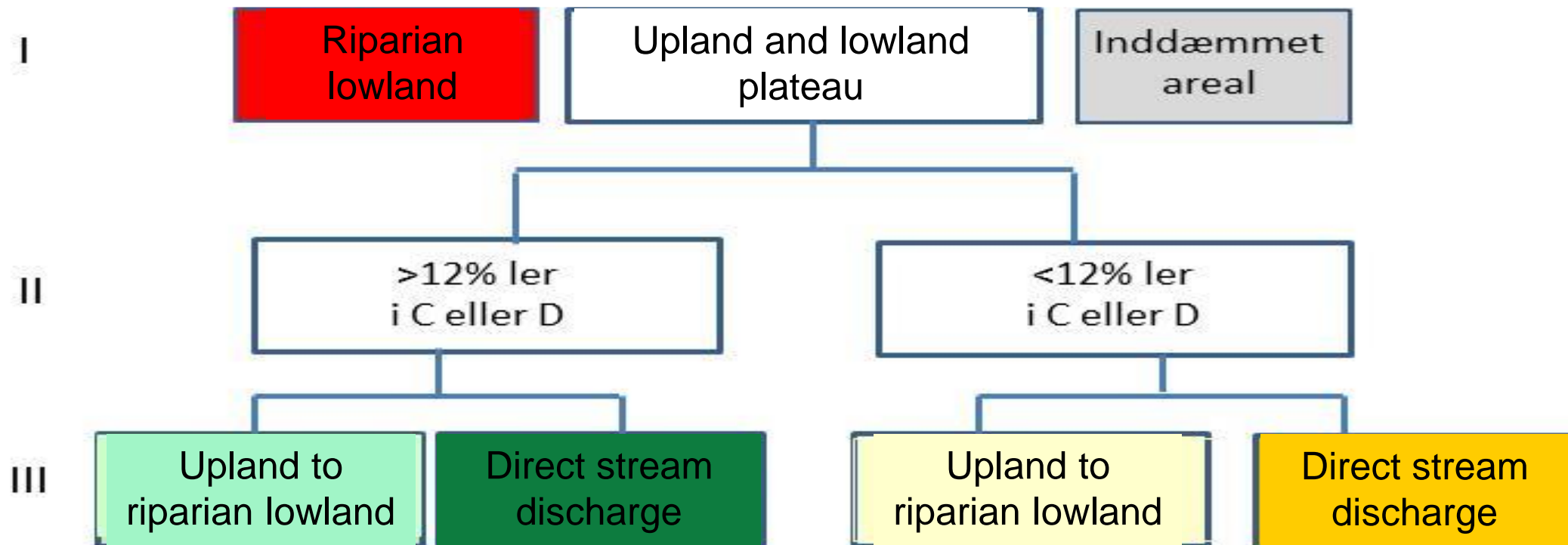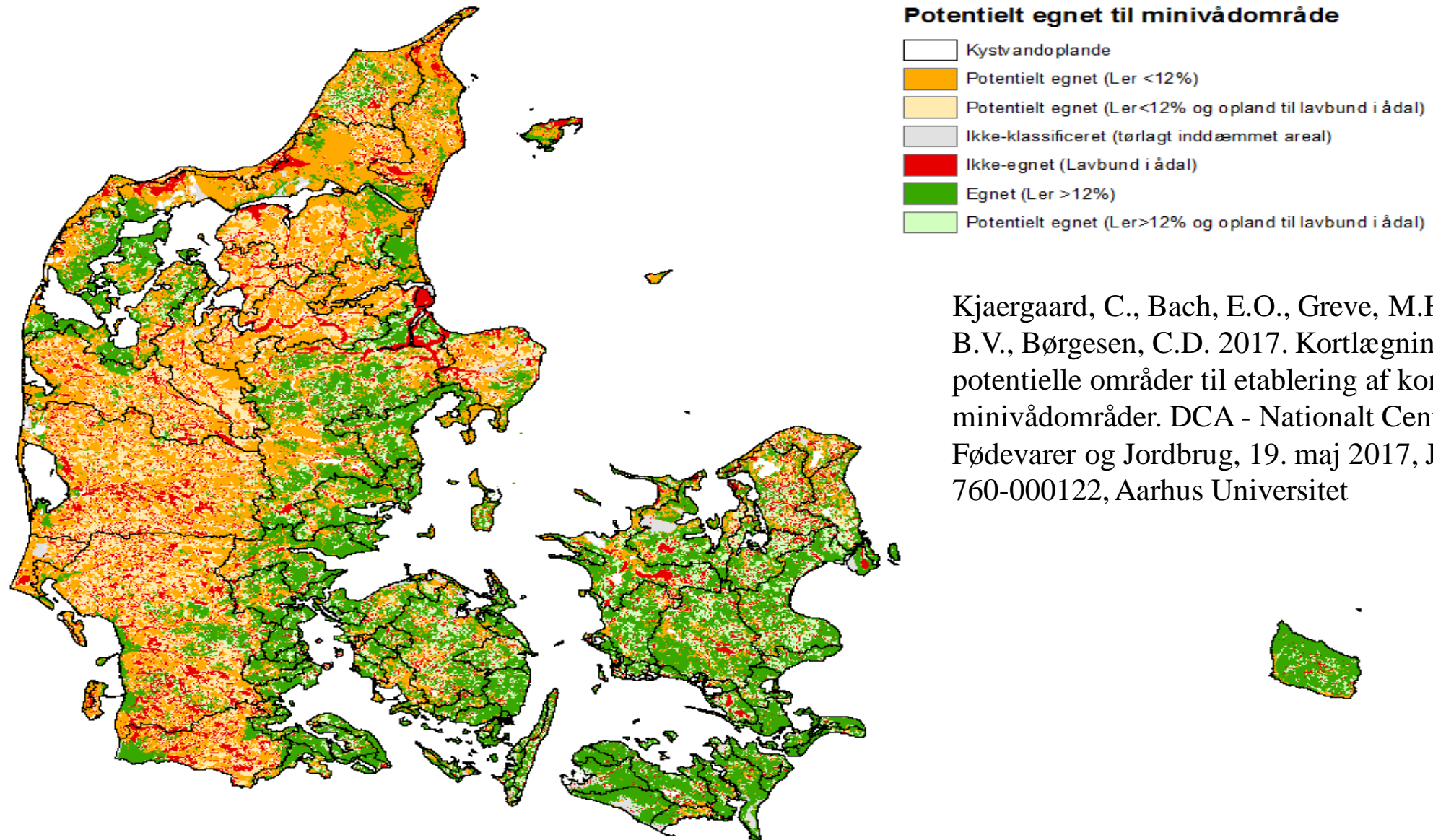
SEGES

Drainage classes (12% clay threshold)

Kjærgaard et al, 2017

Nationalt suitability map for implementing drainage measures

Kjaergaard, C., Bach, E.O., Greve, M.H., Iversen, B.V., Børgesen, C.D. 2017. Kortlægning af potentielle områder til etablering af konstruerede minivådområder. DCA - Nationalt Center for Fødevarer og Jordbrug, 19. maj 2017, J. nr. 2017-760-000122, Aarhus Universitet

Nationalt suitability map for implementing drainage measures

Potentielt egnet til minivådområde

- Kystvandoplande
- Potentielt egnet (Ler <12%)
- Potentielt egnet (Ler<12% og opland til lavbund i ådal)
- Ikke-klassificeret (tørlagt inddæmmet areal)
- Ikke-egnet (Lavbund i ådal)
- Egnet (Ler >12%)
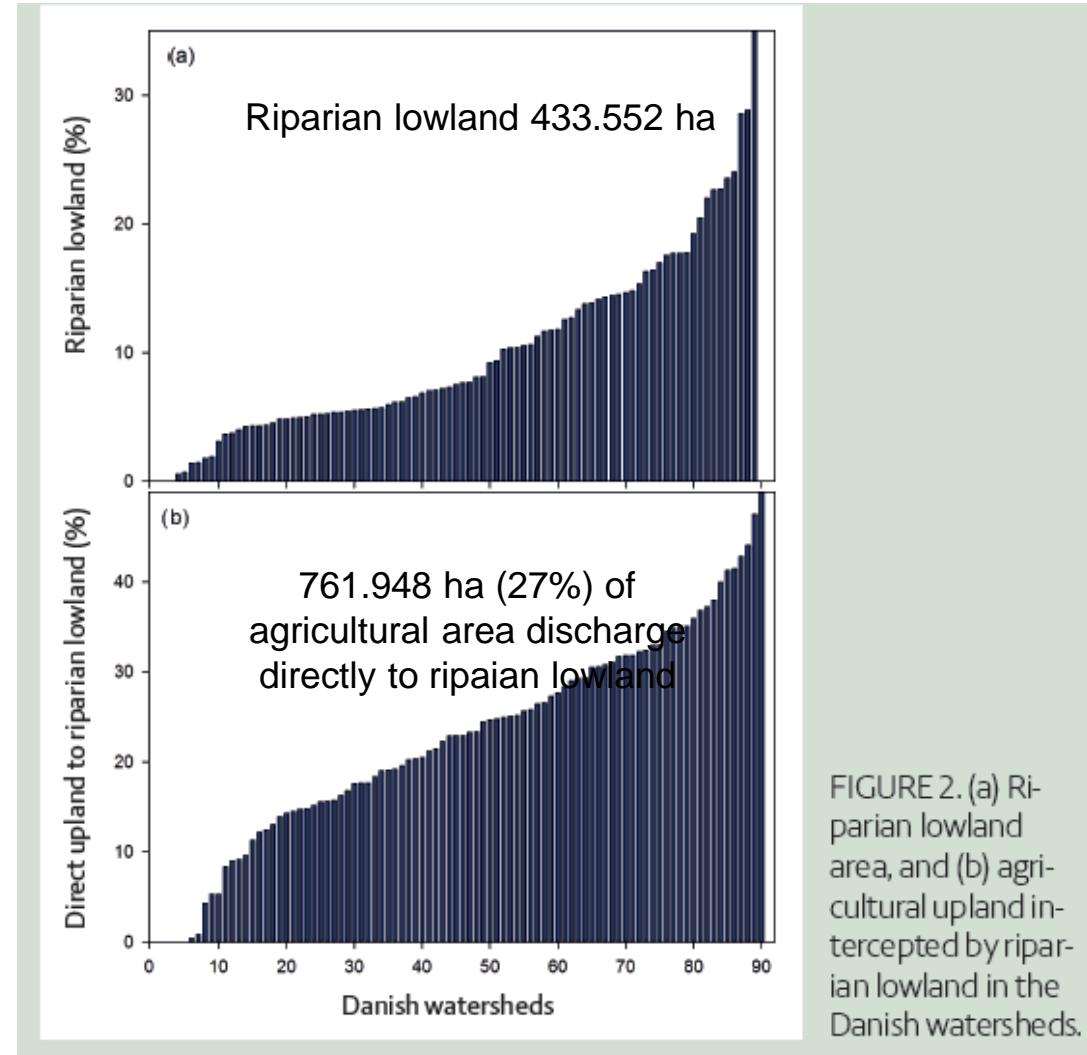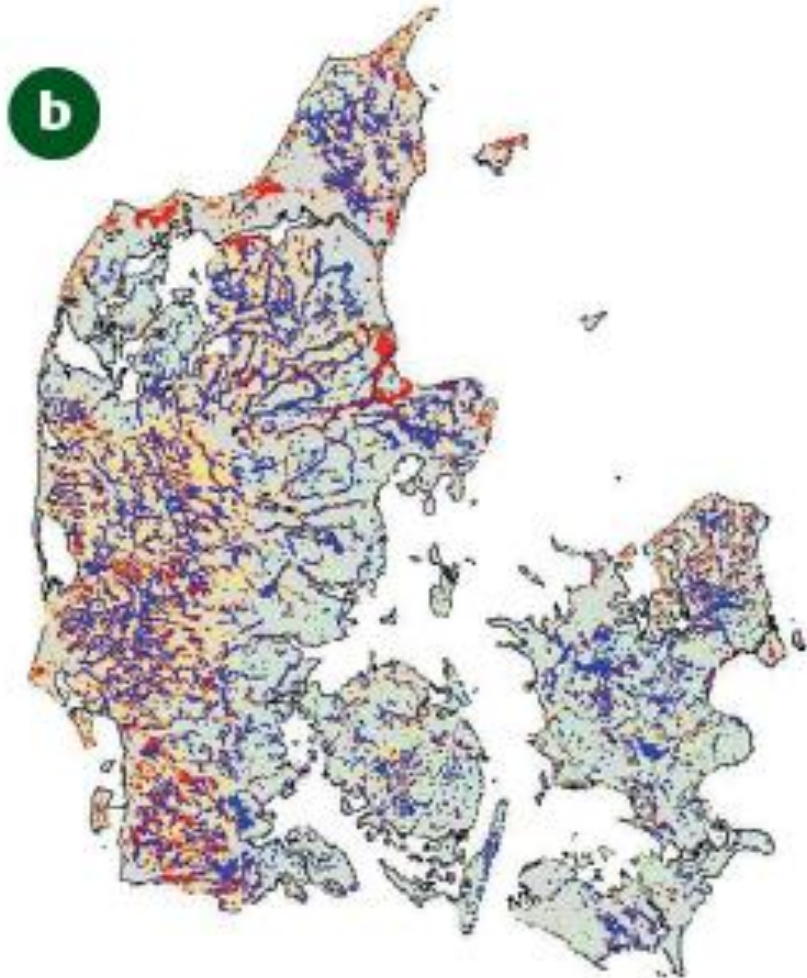- Potentielt egnet (Ler>12% og opland til lavbund i ådal)

Kjaergaard, C., Bach, E.O., Greve, M.H., Iversen, B.V., Børgesen, C.D. 2017. Kortlægning af potentielle områder til etablering af konstruerede minivådområder. DCA - Nationalt Center for Fødevarer og Jordbrug, 19. maj 2017, J. nr. 2017-760-000122, Aarhus Universitet

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Riparian lowland and uplands

Dronefoto: SEGES

SEGES

Significance of the N-reduction potential using riparian lowland

Riparian lowland 433.552 ha

761.948 ha (27%) of agricultural area discharge directly to ripaian lowland

FIGURE 2. (a) Riparian lowland area, and (b) agricultural upland intercepted by riparian lowland in the Danish watersheds.

SEGES

Kjærgaard, C. & Hørfarter R. 2018. Potential significance of of riparian lowlands on nitrogen fluxes from agricultural drainage in Danish watersheds. Presentation BONUS, Gdansk, Polen 14-16, March 2018.

Nationalt suitability map for implementing drainage measures

2.1 Inputdata

- Ler-procent: Clay (raster 30,4* 30,4 meter) - Institut for Agroøkologi, Aarhus Universitet
- Lavbund: Wetlands (raster 30,4* 30,4 meter) – Institut for Agroøkologi, Aarhus Universitet
- Valley bottom flatness index (raster 30,4* 30,4 meter) – Institut for Agorøkologi, Aarhus Universitet
- Landskabselementer (vektor 1:100.000) – Institut for Agroøkologi, Aarhus Universitet
- Georegioner – Institut for Agro økologi, Aarhus Universitet
- Højdemodel: DHyM/Rain (raster 1,6* 1,6 meter) - hydrologisk højdemodel downloadet fra kortforsyningen i december 2015 http://kortforsyningen.dk/content/hoejdemodel-nu-med-vand
- Vand: Vandløb, søer og kystlinje (vektor 1:10.000) GeoDanmark http://www.geodanmark.dk/ downloadet fra kortforsyningen 7. juli 2016 http://download.kortforsyningen.dk/content/geodanmark
- Oplande: Kystvandoplande (vektor) – Naturstyrelsen, Miljø- og Fødevareministeriet
- Retentionskort: (vektor) - Naturstyrelsen, Miljø- og Fødevareministeriet
- Markblok-data: Blokkortet 2015: (vektor 1:10.000) – NaturErhvervstyrrelsen, Miljø- og Fødevareministeriet

Kjaergaard, C., Bach, E.O., Greve, M.H., Iversen, B.V., Børgesen, C.D. 2017. Kortlægning af potentielle områder til etablering af konstruerede minivådområder. DCA - Nationalt Center for Fødevarer og Jordbrug, 19. maj 2017, J. nr. 2017-760-000122, Aarhus Universitet
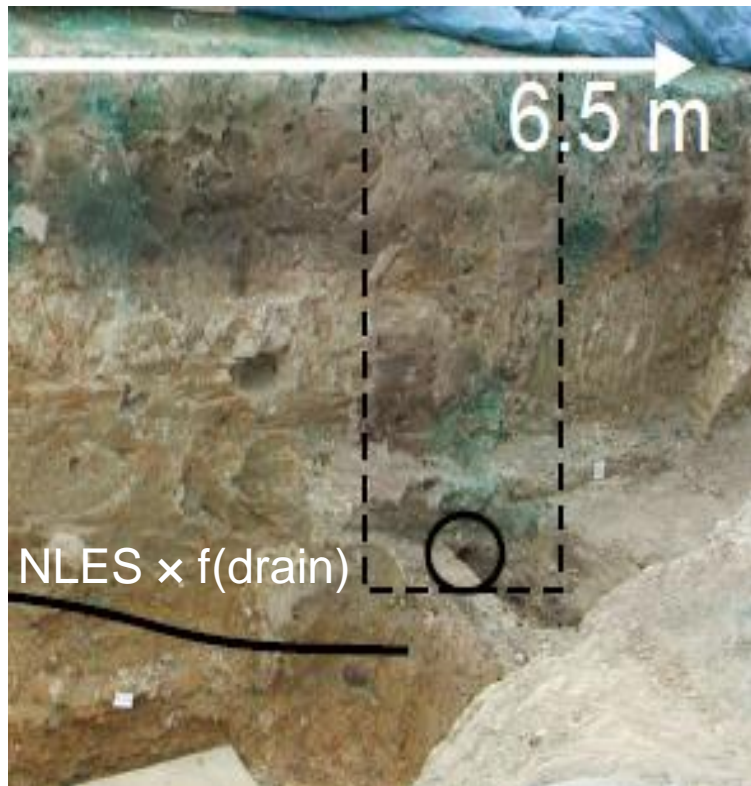
SEGES

Strategy for implementing targeted drainage measures
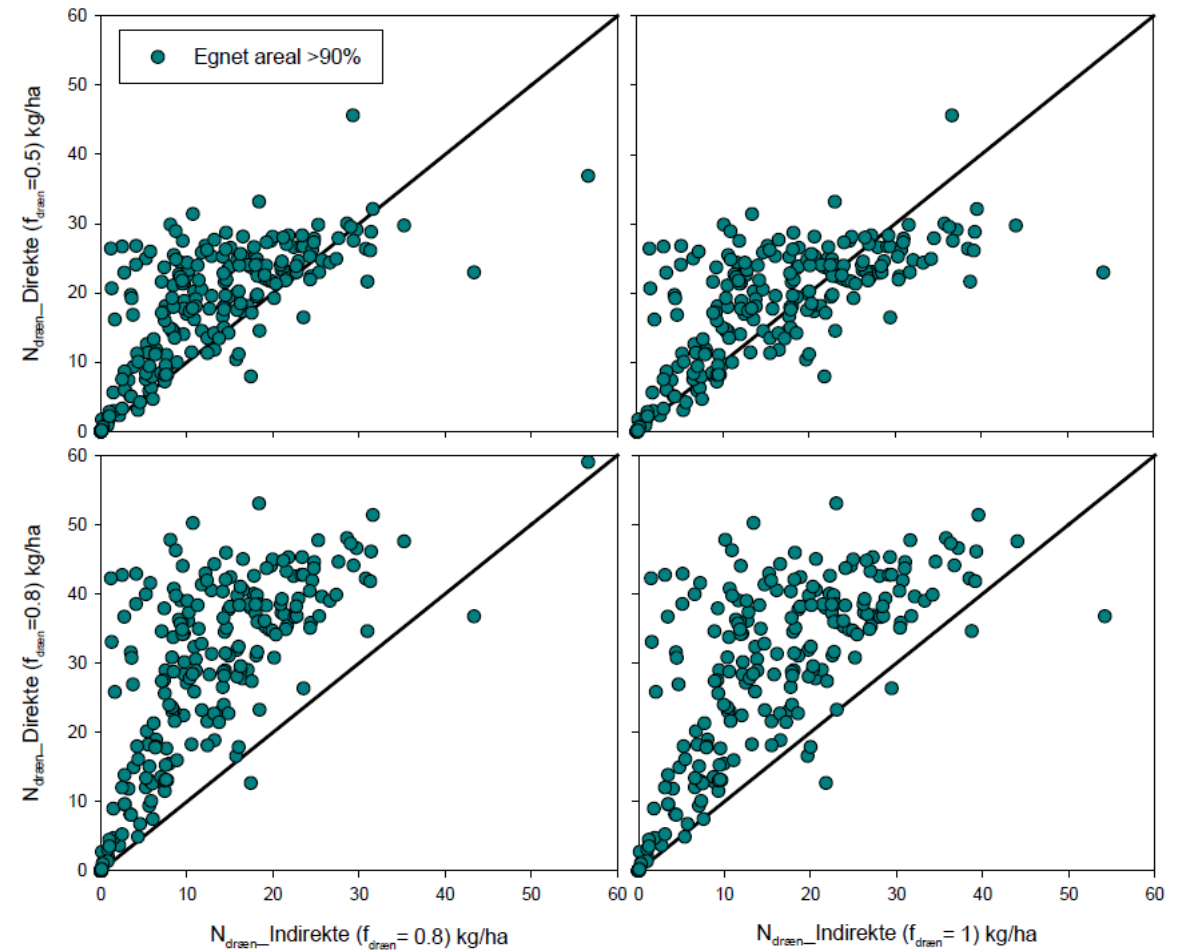
Criteria

1. Reduction requirement (coastal targets)

2. Suitability of agricultural areas

3. **N-nutrient losses by drainage - quantitative significant**

4. Quantitative environmental impact on coastal water (N)

SEGES

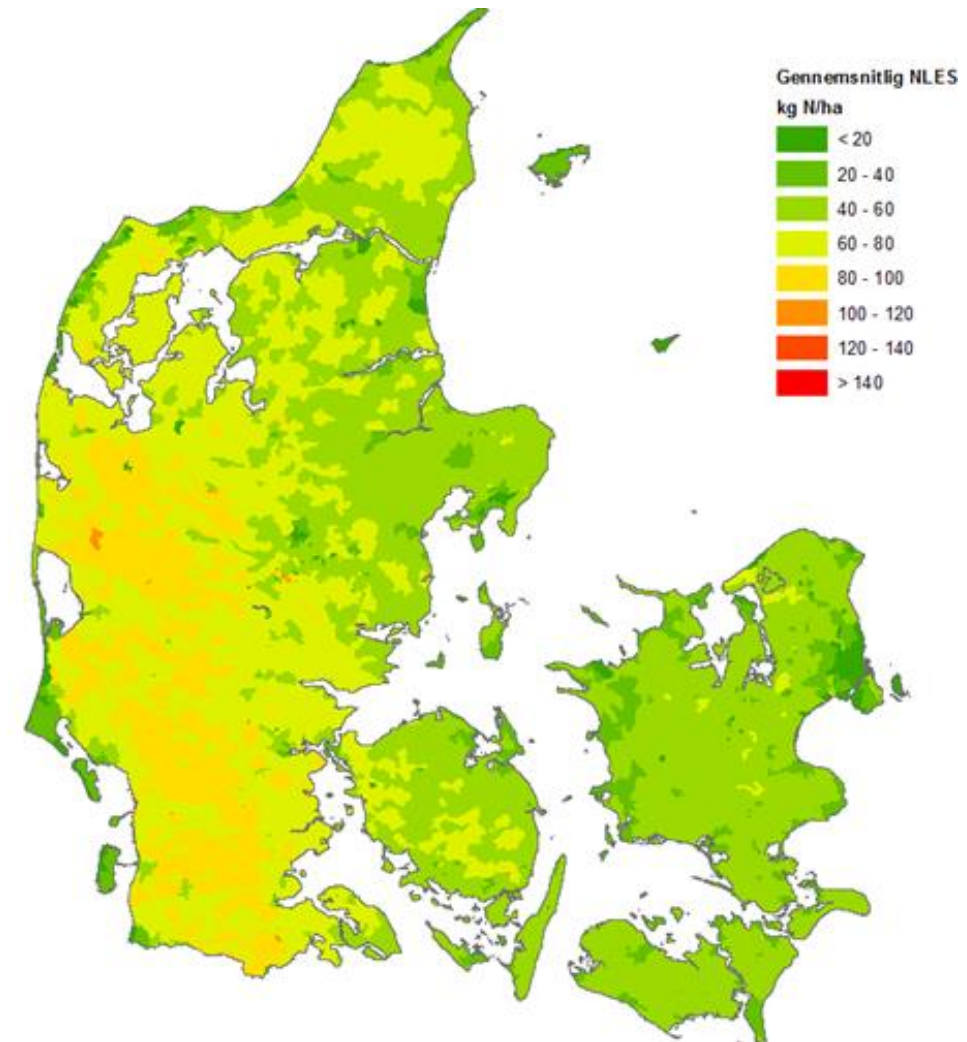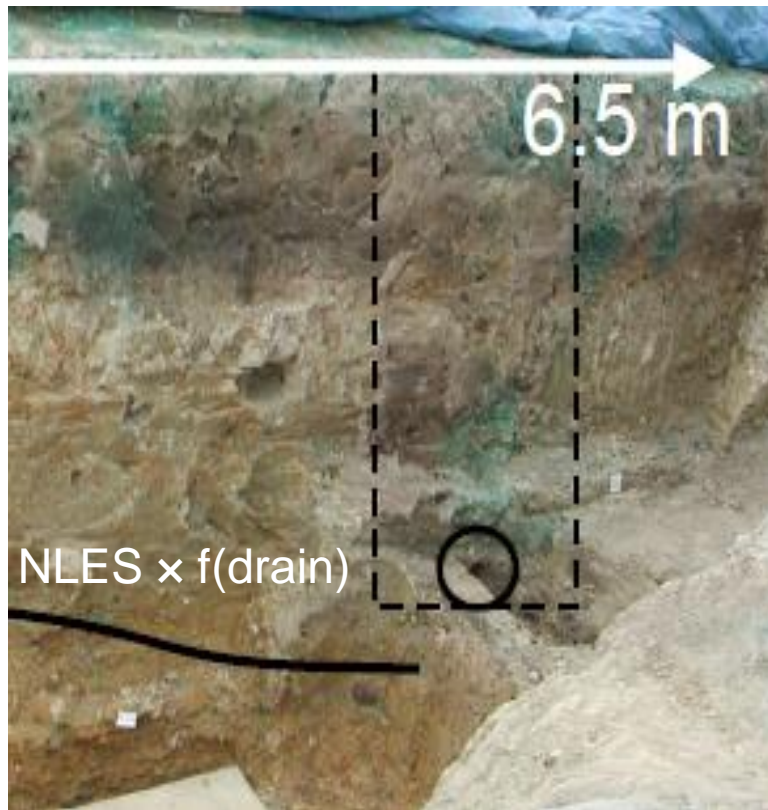# Strategy for implementing targeted measures

N-losses from rootzone

Estimating f(drain)

Kjaergaard & Børgesen, C.D. 2017. Udarbejdelse af minivådområdeeffekt (kg N pr ha minivådområde) på ID15-oplandsniveau. DCA - Nationalt Center for Fødevarer og Jordbrug, 7. April 2017, J. nr. 2017-760-000042, Aarhus Universitet

Strategy for implementing targeted measures

N-loss from the rootzone corrected for the drainage fraction

N-losses from rootzone

6.5 m

NLES × f(drain)

Gennemsnitlig NLES
kg N/ha

- < 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- > 140

SEGES

Strategy for implementing targeted drainage measures

Criteria

1. Reduction requirement (coastal targets)

2. Suitability of agricultural areas

3. N-nutrient losses by drainage - quantitative significant

4. **Quantitative environmental impact on coastal water (N)**
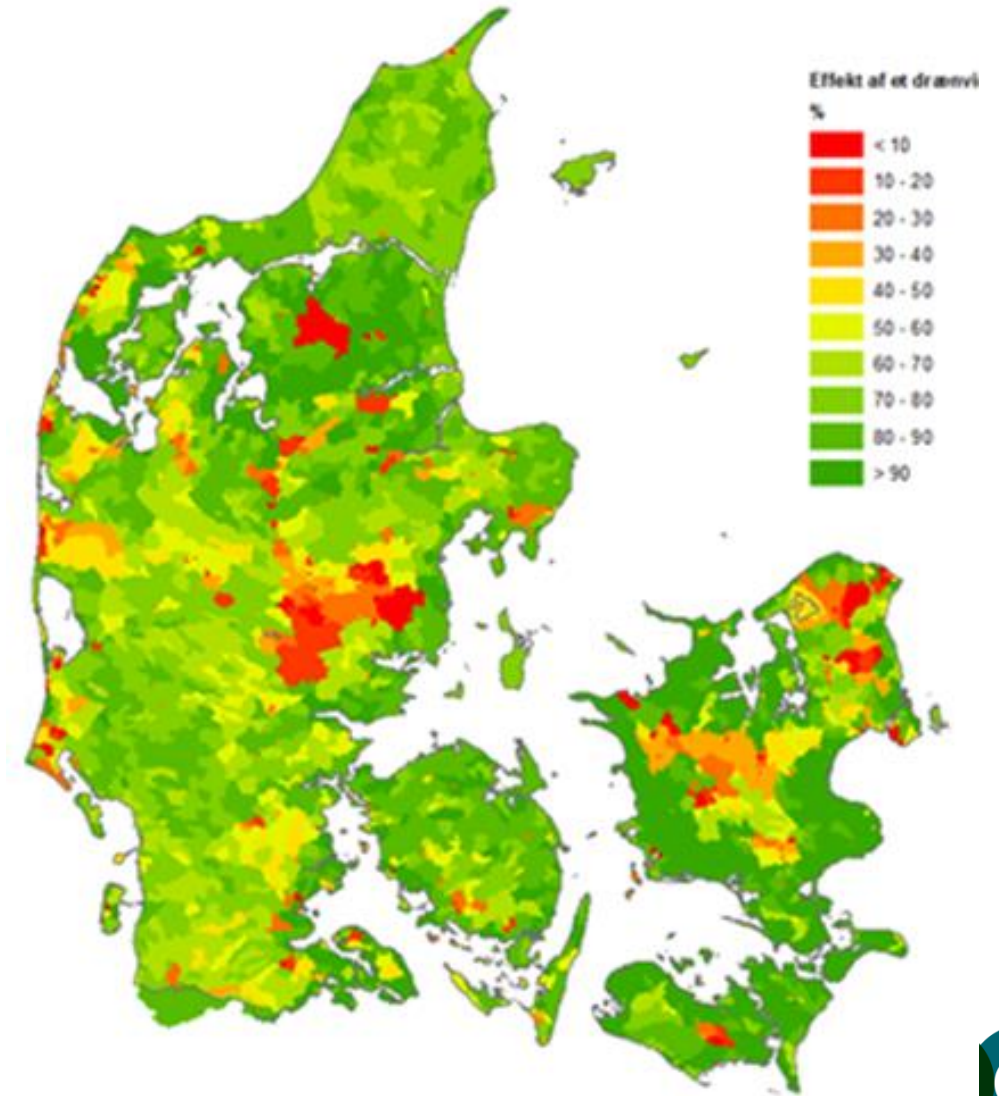
SEGES

Quantitative impact on coastal water

N-reduction in surface water from 0-100%

http://trends.nitrat.dk/
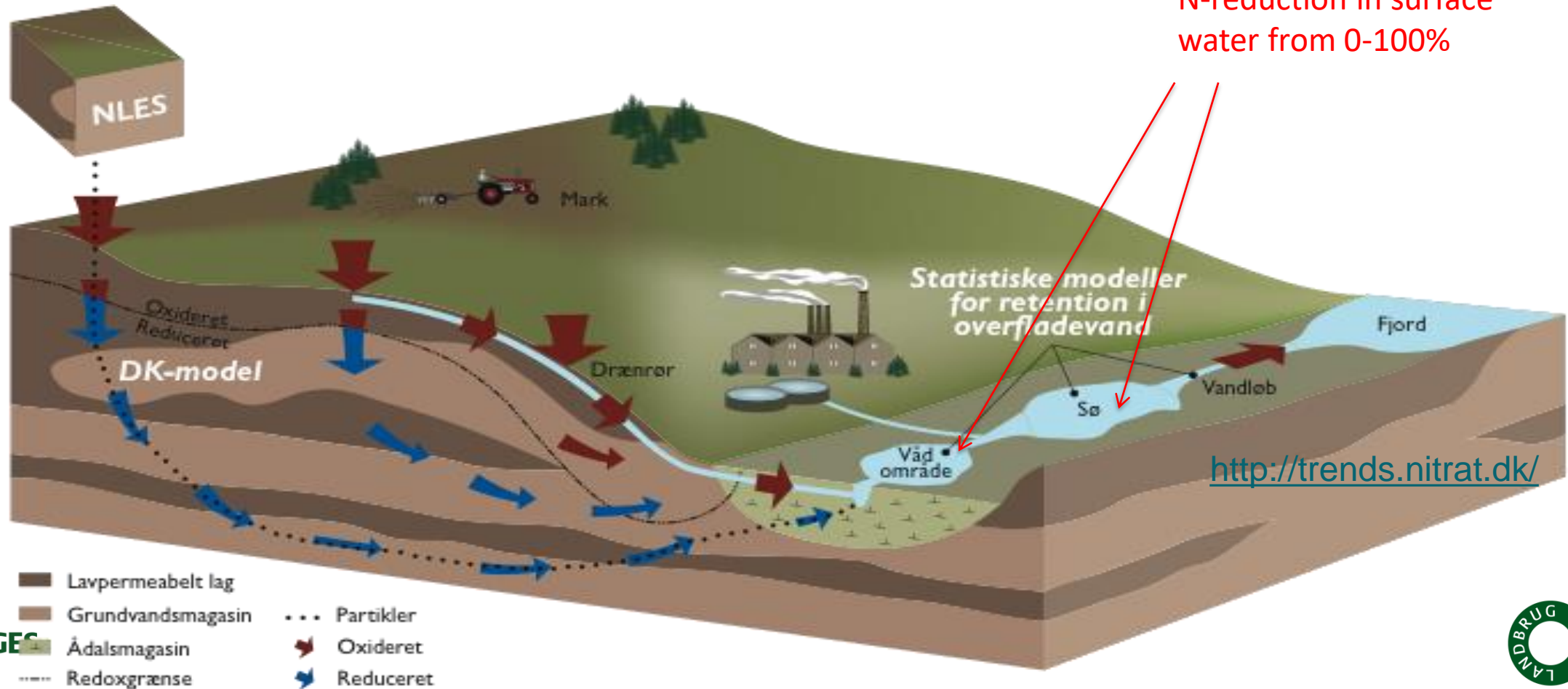
Quantitative impact on coastal water
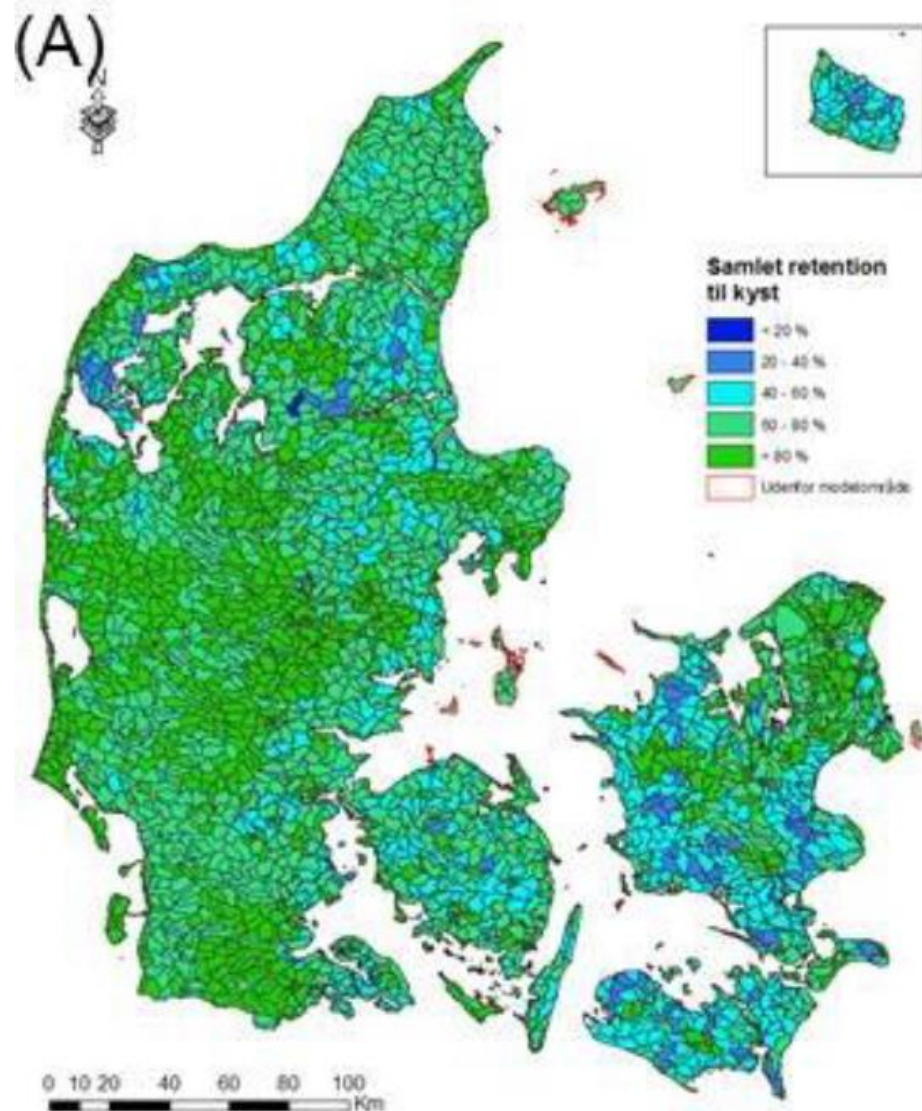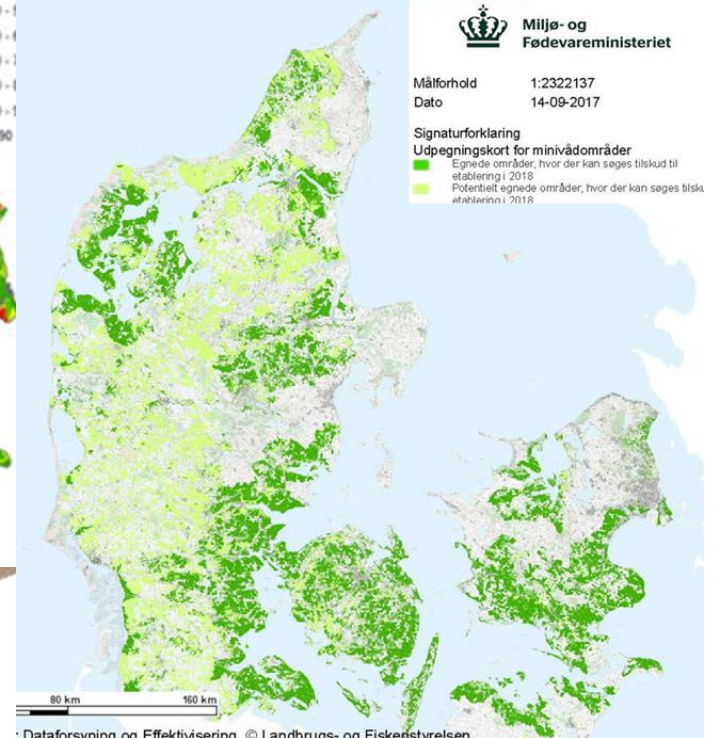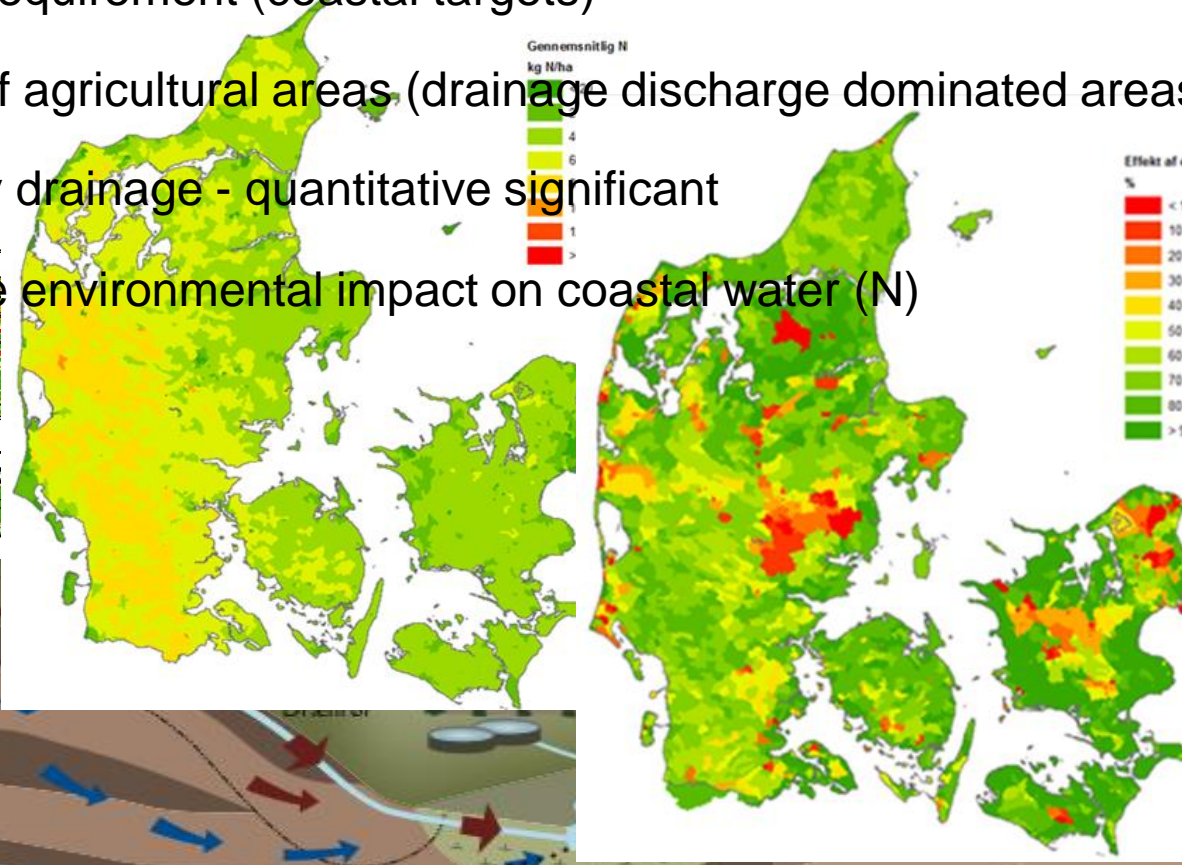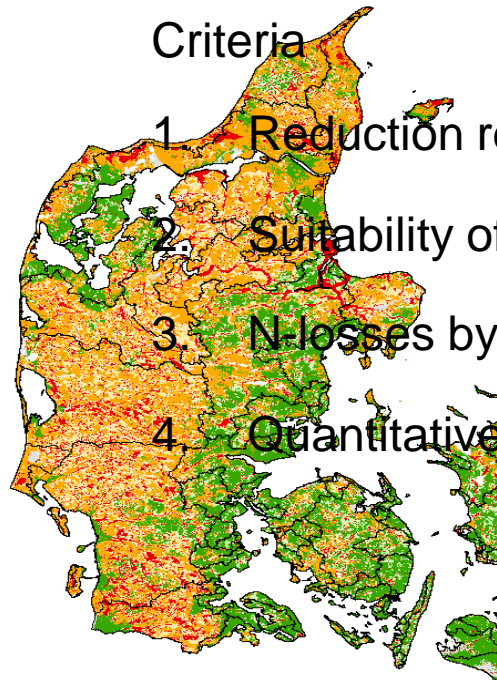

Højberg et al., 2019

Kjærgaard & Børgesen, 2017

National deignation maps for implementing drainage filters

Criteria

1. Reduction requirement (coastal targets)

2. Suitability of agricultural areas (drainage discharge dominated areas)

3. N-losses by drainage - quantitative significant

4. Quantitative environmental impact on coastal water (N)
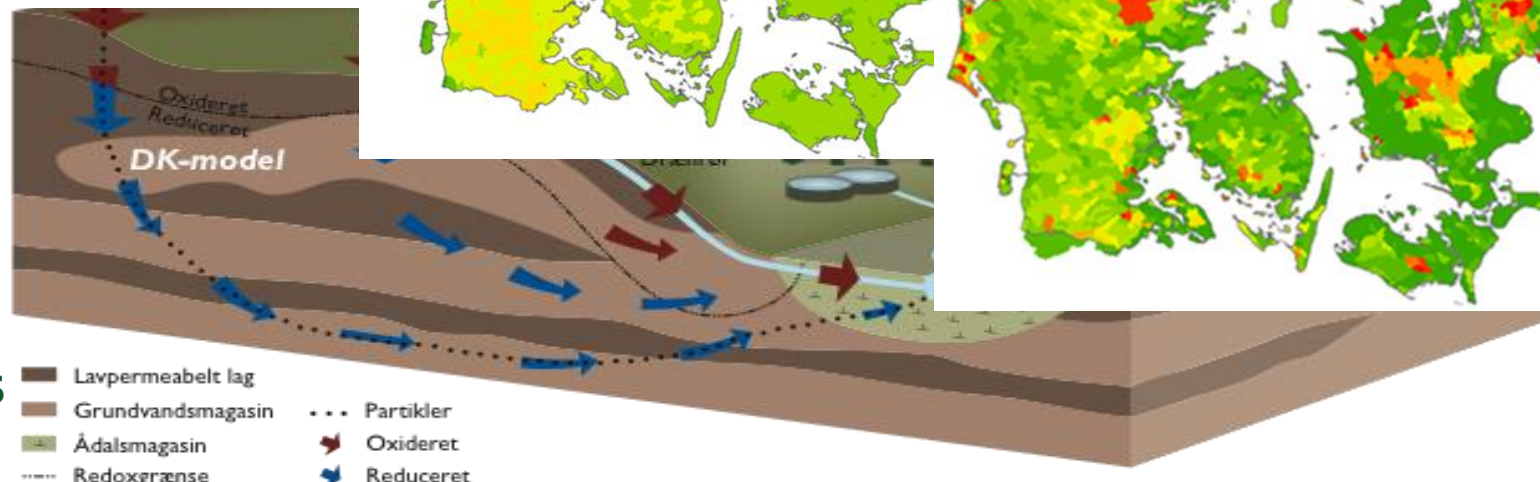
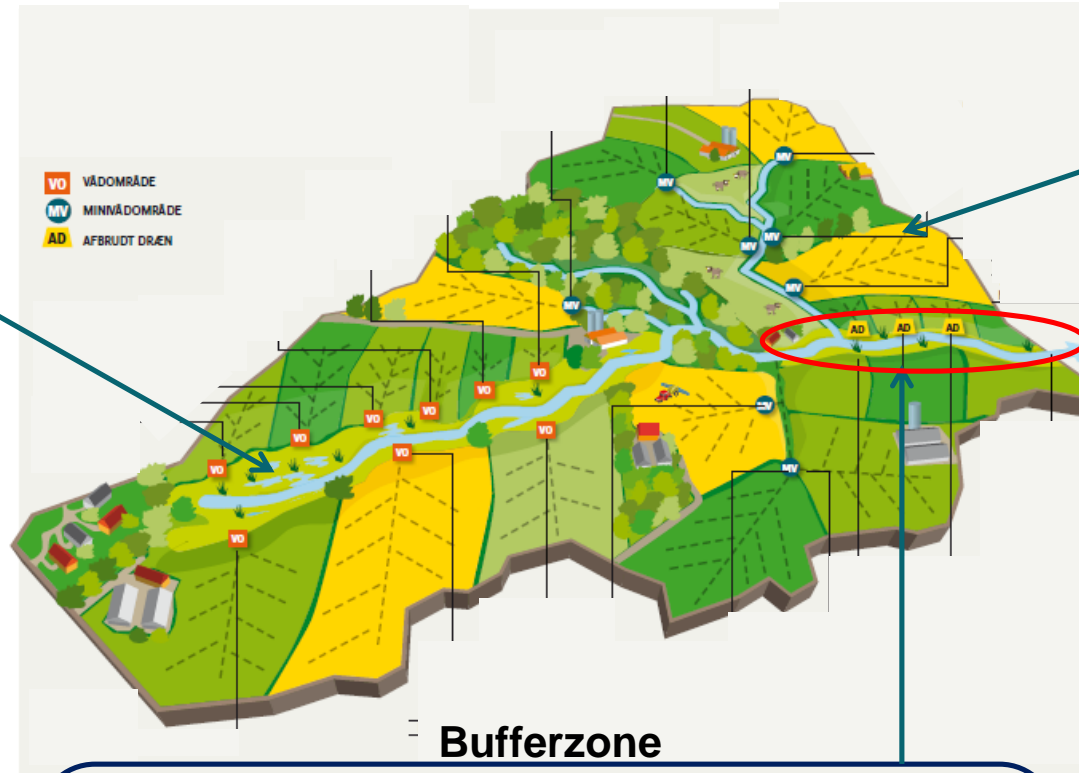# Case: Mitigation strategy – Norsminde Fjord catchment
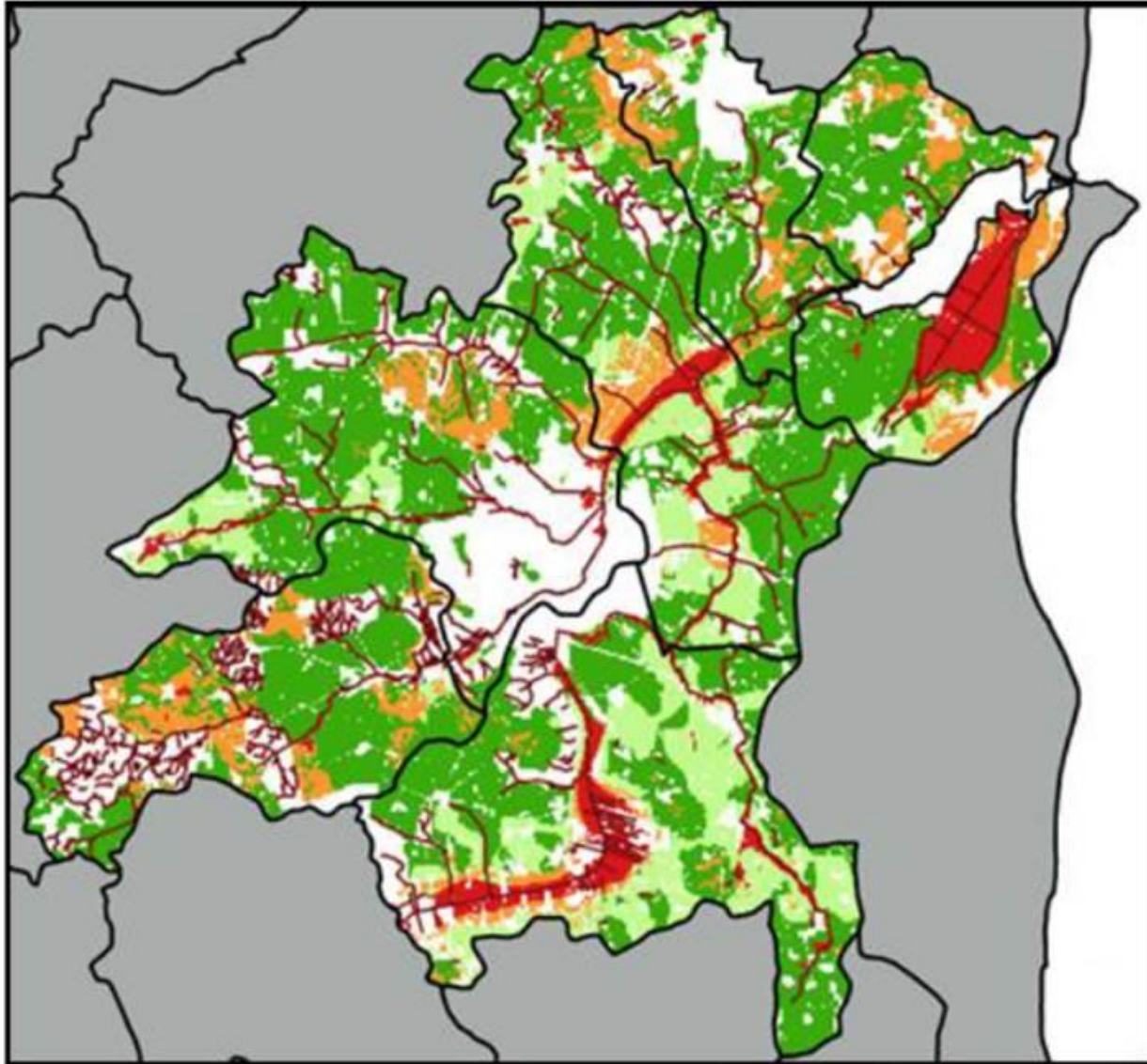
Catchment (10.100 ha) including six ID15 subcatcments (1500 ha units)

ID15 subcatchment	Suitable for CWs (%)	Upland drained to riparian lowland (%)	Riparian lowland (%)
43600028	61	4,4	16
43600041	50	33	11
43600042	75	11	2,5
43600043	61	22	6,2
43600051	73	1,1	0,9
43602599	72	5,4	1,1
Total	4.815 (63)	1.224 (16)	541 (7)

Kjærgaard, C., Hoffmann, C.C., Iversen, B.V. 2017. Filtre i landskabet øger retentionen. I: Filtre i landskabet, Vand & Jord, nr. 3, s. 106-110

Visions for the targeted nutrient mitigation – restore landscape filters

Riparian lowland

Constructed wetlands

VO — VÅDOMRÅDE
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Bufferzone