Fact sheet: Targeted land conversion – a Danish case study on nitrogen reduction

dNmark research alliance

Summary

Intense use of nitrogen (N) in the agricultural sector has caused various environmental problems. Despite effective national policy measures, initiated in the mid 80es, these problems such as eutrophication of terrestrial and aquatic ecosystems and groundwater reservoirs persist. Environmental N-sensitivity is not equally distributes across the Danish landscape. This is mainly due to spatial variation in local environmental characteristics, N retention of the soil from source to recipient, and existing pollution in the recipient.

The Danish water management plans has described one coastal N reduction goal (NRG) for each of the 90 coastal catchments in Denmark. This enables development of new methods using targeted solutions to define which areas - in this case the so called Id15 catchments - could be taken out of production (converted to forest or permanent grassland) and thereby only leach 12 kg N/ha/yr to reach coastal NRG.

Aims

- Exemplify a simple regionalized targeted method to select suitable catchments for conversion to reach the coastal nitrogen reduction goals (NRG).
- Define most suitable areas for conversion - hotspots (this will not meet the NRG).
- Give recommendations on how to prioritize land conversion.

Regionalized targeted catchment selection

A method was developed to detect high priority areas for land conversion within each coastal catchment depending on 3 local priority attributes: 1) coastal N load (NLoad),2) naturalness (Nat), and 3) field land rent (LRent) (Fig. 1a), and 4 scenario priority attributes: 1) equal weighted scenario (Equal), 2) greening and protection of aquatic environments (GreenEnvi), 3) terrestrial ecosystems biodiversity improvement (TerreEco), and 4) agro-based bioeconomy (AgronEcon) (Fig. 1a). Each priority attribute was sorted (Fig. 1b) and used for stepwise selection of the most suitable Id15's for conversion until the NRG was fulfilled (Fig. 1c) - high NLoad, high Nat or low LRent were given highest priority. Area characteristics were compared for each priority attribute, and areas most suitable for land conversion were detected - hotspots (Fig. 1d).

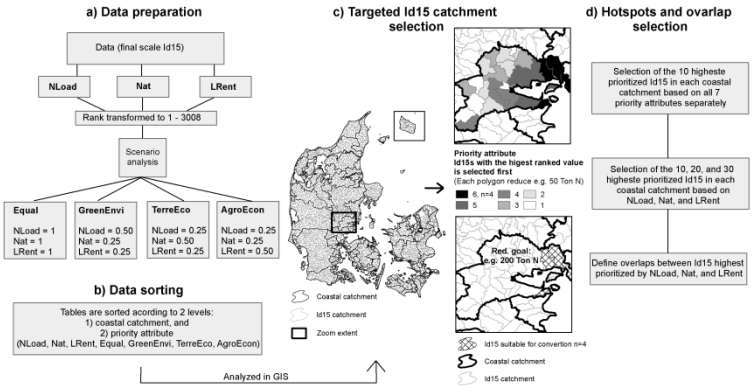

Figure 1.

Results

Total area and hotspots, using the different priority attributes for Id15 catchment selection, show varying spatial distributions (Fig. 2), and varying area characteristics (Table 1). Hotspots where Nload, Nat, and LRent are equally taken into consideration are primary areas to initiate land conversion if not all recommended should be converted (Fig. 3). Selection based on GreenEnvi has the lowest cost followed by NLoad, but a larger area should be converted using GreenEnvi compared to NLoad (Table 1).

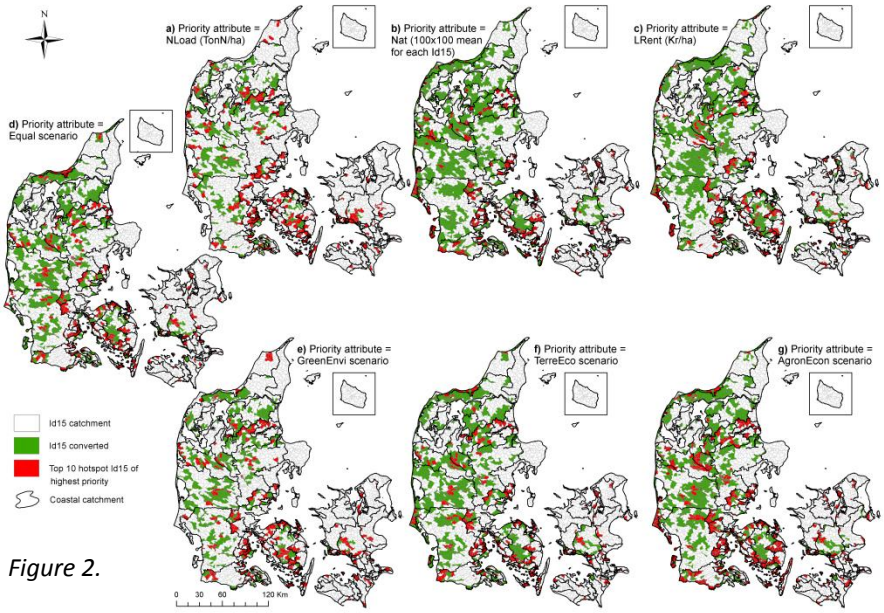

Figure 2.

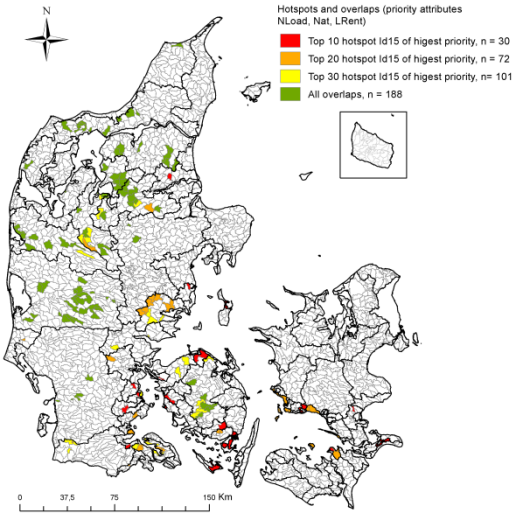

Figure 3.

Table 1.

Priority attribute	#Id15	Farm area (1000 Ha)	Farm type (1000 Ha)				Ton			Sum			
			Crops	Dairy cattle	Grazing animals	Pig farm	Nload now	Nload conversion	Nload red. of conversion	Land rent (mill. Kr.)	Wilderness	Bio-score	Natural-ness
Nload	**597**	**622**	254	150	19	148	15405	2970	12435	**2588**	82109	576	322
Nat	1194	976	**413**	**243**	**37**	**198**	15229	3022	12207	3682	**193237**	**2864**	**758**
Lrent	1320	987	**455**	**217**	**41**	**182**	15339	3052	12287	3213	**192238**	**3077**	**755**
Equal	940	777	338	187	31	150	15276	3006	12270	2751	148102	2195	581
GreenEnvi	**699**	**674**	290	163	24	140	15267	2974	12293	**2531**	103980	990	408
TerreEco	1046	842	363	206	33	165	15246	3004	12242	3037	168377	2642	661
AgroEcon	1068	823	371	192	33	153	15181	2982	12199	2768	165287	2698	649

Hotspot selection

- Converted land range from 23-37% of the farm area. These numbers are too high for realistic management planning (Table 1).
- We have defined hotspots that illustrate the most suitable areas for each priority attribute (Fig. 2) as well as for NLoad, Nat, and LRent combined (Fig. 3).

Future recommendations

- Using an economic perspective we recommend the GreenEnvi scenario (where also Nat and LRent is considered) which has the lowest cost (Table 1).
- The tradeoff is that GreenEnvi needs more land to reach the NRG compared to e.g. using the priority attribute NLoad.
- Other perspectives can be considered.

More information

Mette Vestergaard Odgaard
mette.vestergaardodgaard@agro.au.dk

Christen Duus Børgesen
christen.borgesen@agro.au.dk

Tommy Dalgaard
tommy.dalgaard@agro.au.dk

Jørgen Eivind Olesen
jeo@agro.au.dk

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK