

Modifying the *Pennsylvania P-index* to reflect Danish conditions (ver. 1)

by

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Starting point: the *Pennsylvania P-index*

Modifications only when necessitated by
specific Danish conditions

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Pennsylvania P-index

Part A Screening tool

Part B Source factors

Part C Transport factors

Interpretation of P-index values

< 60 : low risk

60 - 80 : medium risk

>80 : high risk



Pennsylvania P-index: erosion and surface runoff
are the most important transport factors

In Denmark:

- erosion is of relatively minor importance;
- artificial drains are important conveyors of P from cultivated land to surface waters;
- leaching of P from coarse textured soils (might be) a problem



A modified Danish P-index

PART A – SCREENING TOOL

	Evaluation Category	
Soil Test P	> 200 mg P kg ⁻¹	If yes to either factor then proceed to Part B
Contributing Distance	< 45m	
Contributing Distance	> 45m AND field artificially drained	

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PART B – SOURCE FACTORS

Soil test P	Soil Test P (mg P kg ⁻¹) (Olsen-P translated to Mehlich-III-P)				
	Soil Test P Rating = 0.20 * Soil Test P (mg P kg ⁻¹) for mineral soil				
Fertilizer P rate	Fertilizer P (kg ha ⁻¹)				
Manure P rate	Manure P (kg ha ⁻¹)				
P source application method	0.2 Placed or injected 5cm or more deep	0.4 incorporated < 1 week	0.6 incorporated >1 week or not incorporated April-October	0.8 Incorporated > 1 week or not incorporated Nov.-March	1.0 Surface applied to frozen or snow covered soil
Fertilizer Rating = Rate x Method					
Manure P availability	0.5 Treated manure/Biosolids	0.8 Dairy	1.0 Poultry/Pigs		
Manure Rating = Rate x Method x Availability					
Source Factor = Soil Test P Rating + Fertilizer Rating + Manure Rating					

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PART C - TRANSPORT FACTORS

Erosion	Soil Loss (tonnes ha ⁻¹)				
Runoff potential	0 Very low	2 Low	4 Medium	6 High	8 Very high
Leaching Potential	2 sandy soil	4 loamy soil	6 organic soil		
Subsurface Drainage	0 No artificial drains	2 Field is artificially drained			
Contributing Distance	8 < 45 m	0 > 45 m			
Modified Connectivity	0.03 Riparian buffer = 2 m Erosion Negligible	0.24 Riparian buffer = 2 m Erosion Medium	0.65 Riparian buffer = 2 m Erosion High		
	0.02 Riparian buffer > 2 m Erosion Negligible	0.20 Riparian buffer > 2 m Erosion Medium	0.59 Riparian buffer > 2 m Erosion High		
Transport Factor = [(Erosion + Runoff Potential + Contributing Distance)*Modified Connectivity + (Sub-surface Drainage + Leaching Potential)/22]					
Phosphorus Index Value = 2 x Source Factor x Transport Factor					

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The modified Danish P-index applied on the Odense Fjord catchment

Information on crops and on application of manure and fertilizers available at the field block level (average size 9 ha)

Mapping of soil profiles, soil types, geology, artificially drained areas

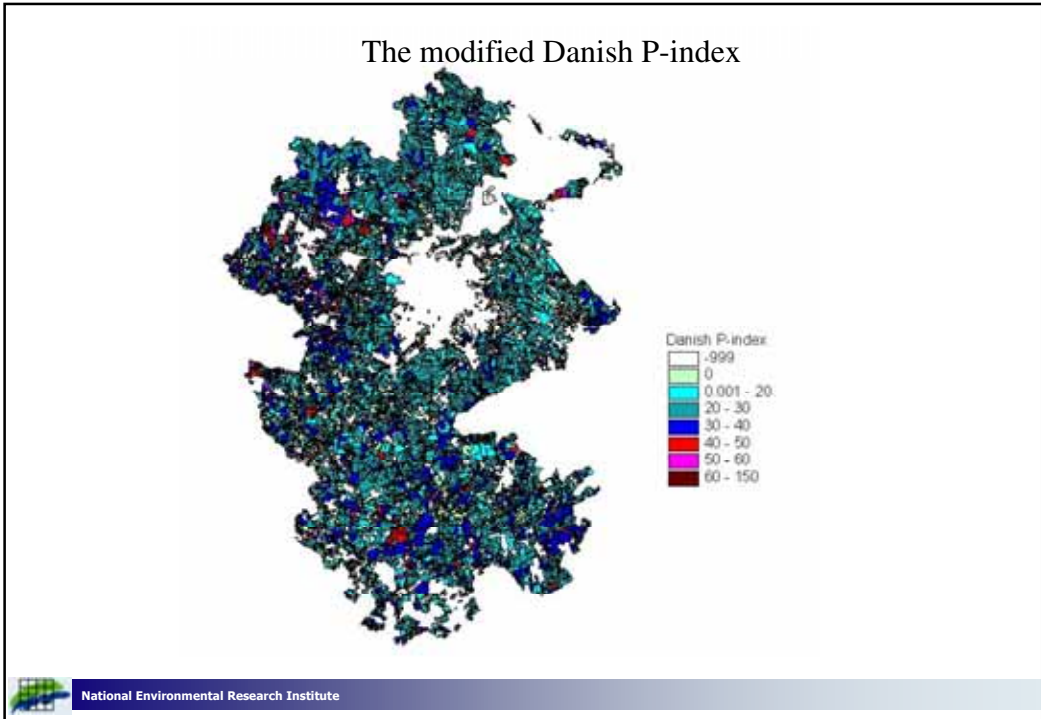
Erosion calculated with USLE based on a 10 m DEM

P-status: Regional average (Soil test P-data unavailable; pedotransfer not possible)

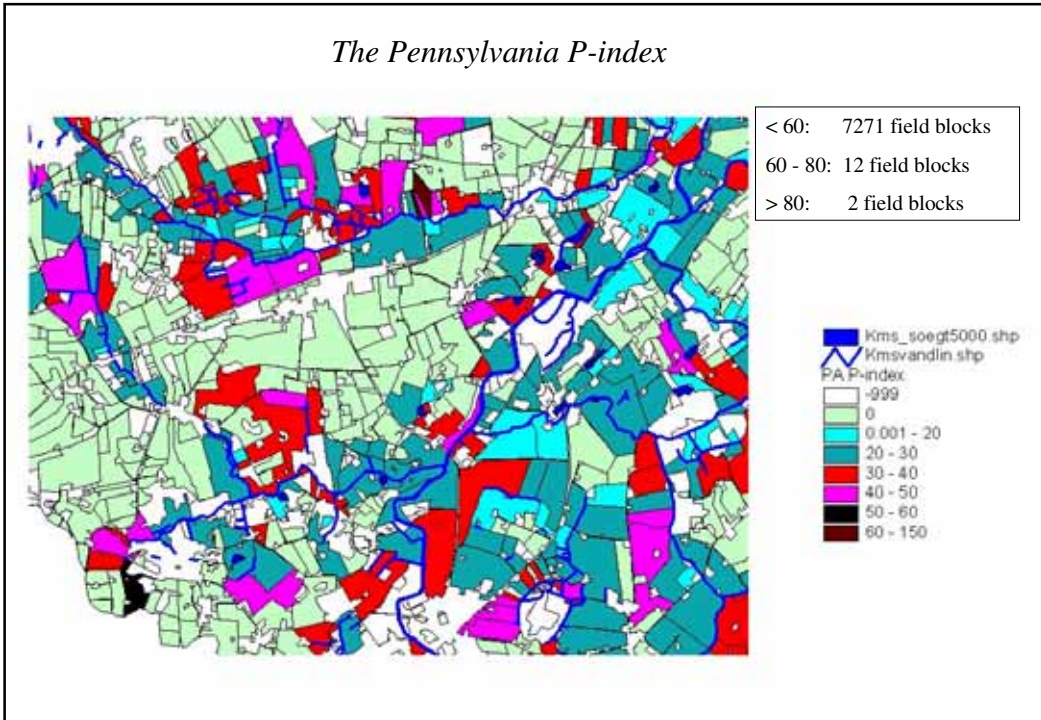
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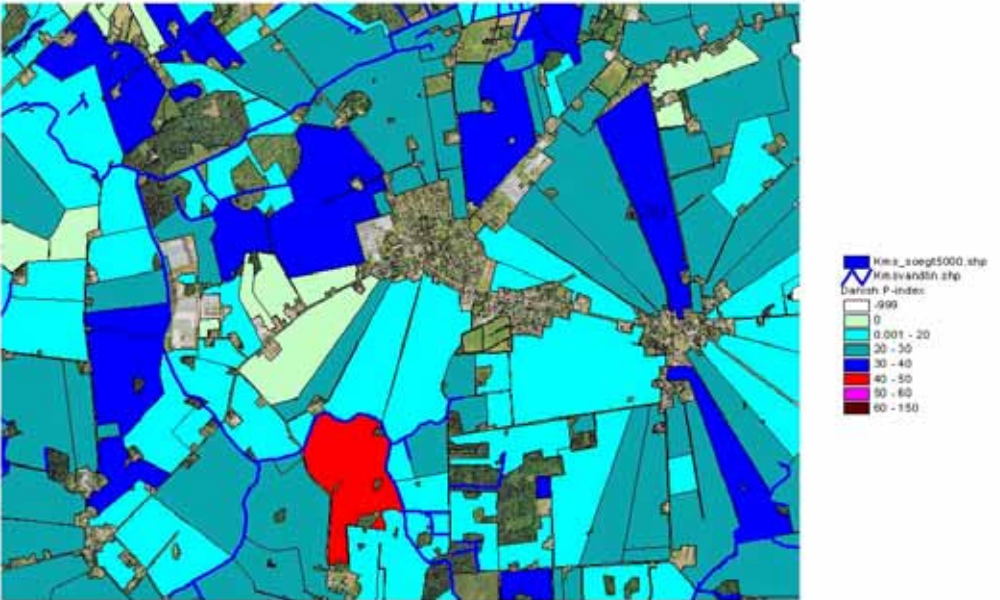
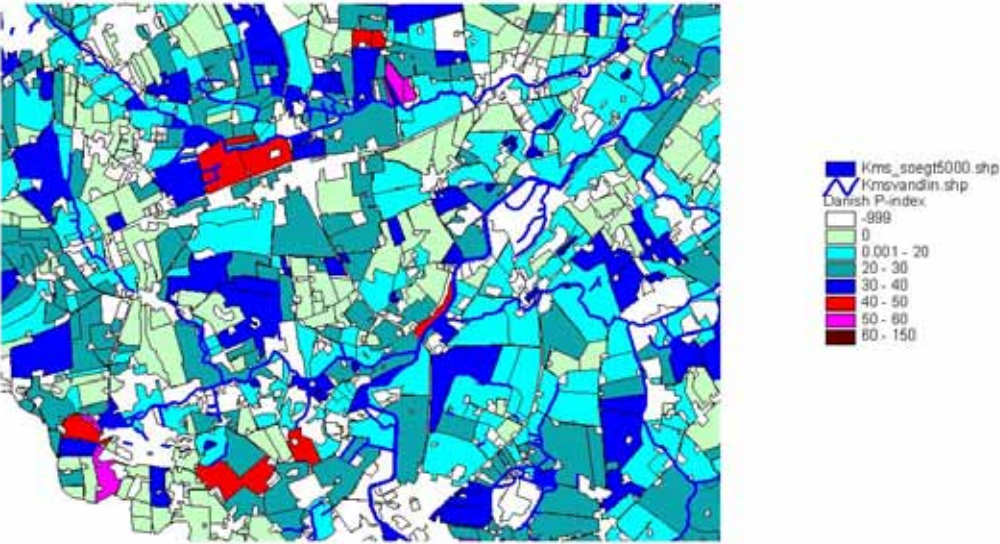
The modified Danish P-index



The Pennsylvania P-index



The modified Danish P-index

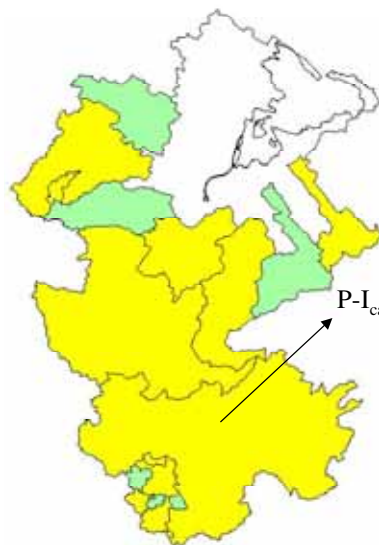


Using an un-validated P-index is questionable (even though a full validation can never be achieved)

An interpretation of the P-index should be constructed based on the validation



Testing the modified Danish P-index



The Odense Fjord catchment:
12 sub-catchments with measured losses of TP during 1998 - 2002

$$P-I_{\text{catchment}} = \frac{\sum (P-I_{\text{field}} \cdot \text{Area}_{\text{field}})}{\text{Area}_{\text{catchment}}}$$

Deloplande.s
Odf.shp



Testing the modified Danish P-index

Can $P-I_{\text{catchment}}$ correctly rank measured catchment losses of P ?

Is there a linear correlation between $P-I_{\text{catchment}}$ and (logarithmic) catchment losses of TP ($\text{kg ha}^{-1} \text{ yr}^{-1}$) corrected for point source contributions ?

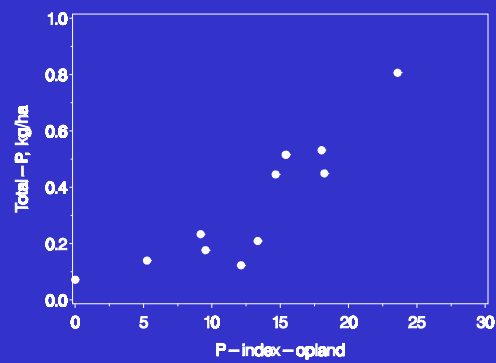
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Testing the modified Danish P-index

	1999	2002	1998 – 2002
	R^2	R^2	R^2
Danish P-index (v.1)	0.70	0.90	0.82



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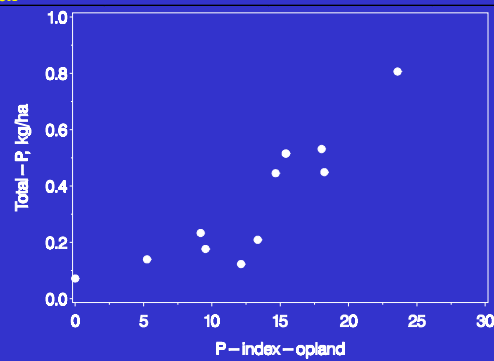


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*** TP_corr_a

Testing the modified Danish P-index

	1999	2002	1998 – 2002
	R ²	R ²	R ²
Danish P-index (v.1)	0.70	0.90	0.82
Pennsylvania P-index	0.58	0.65	0.68



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*** TP_corr_a

Reservations

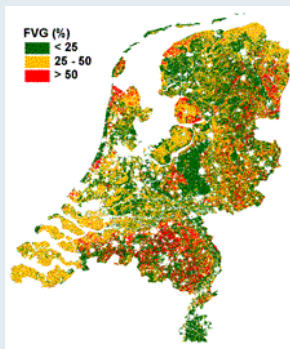
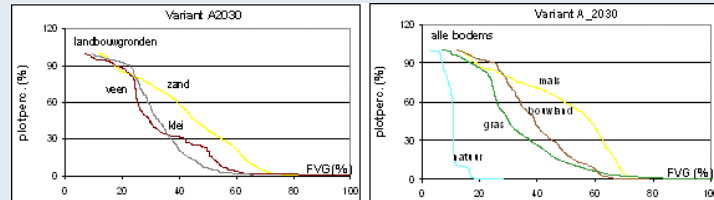
- OK at the catchment level does not necessarily mean OK at the field level
- Leaching - we need knowledge on what's going on in the subsoil of coarse textured soils having received large quanta of manure during decades
- Macropores - we need knowledge on the extent of macropore flow and how to distinguish between soil types
- Soil P status - we need information on soil P status at the field level nationwide
- Bank erosion - not included
- Testing on other catchment types
- Validation/testing at the field level - interpretation of index-values

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Fosformætningsgrad i de hollandske jorder



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Kortlægning af P-tabs-risiko i oplandet til Skive Fjord og Limfjorden

Viborg Amt, Nordjyllands Amt, Danmarks Miljøundersøgelser, ConTerra, Danmarks JordbrugsForskning

- Forbedret jordbundsbeskrivelse
- Kortlægning af dræning på højbund og lavbund
- Kortlægning af P-bindingskapacitet
- Kortlægning af afstanden til grundvandsspejl (Skive Fjord)
- Kortlægning af redox-grænsen (Skive Fjord)
- Indsamling af data på fosforstatus (Skive Fjord)

De nye korttemaer skal danne baggrund for en videreudvikling af P-indexet (ver. 2): forbedret beskrivelse af risiko for P-tab via udvaskning

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