Vannkvalitet i elver og bekker: trender, kunnskapsbehov og tiltakseffekter nasjonalt og internasjonalt

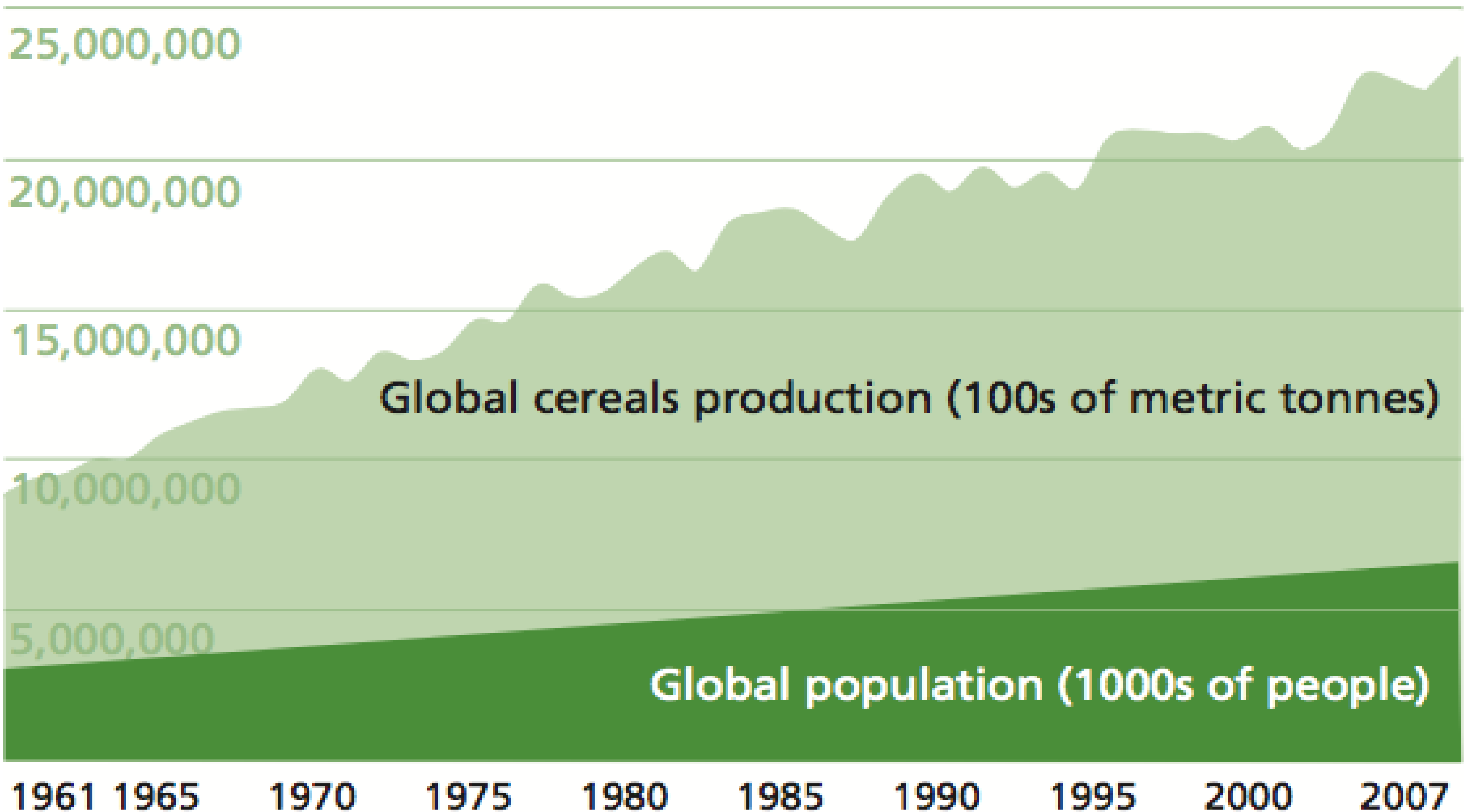
NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

Per Stålnacke
Forskningssjef
Vannressurser og hydrologi

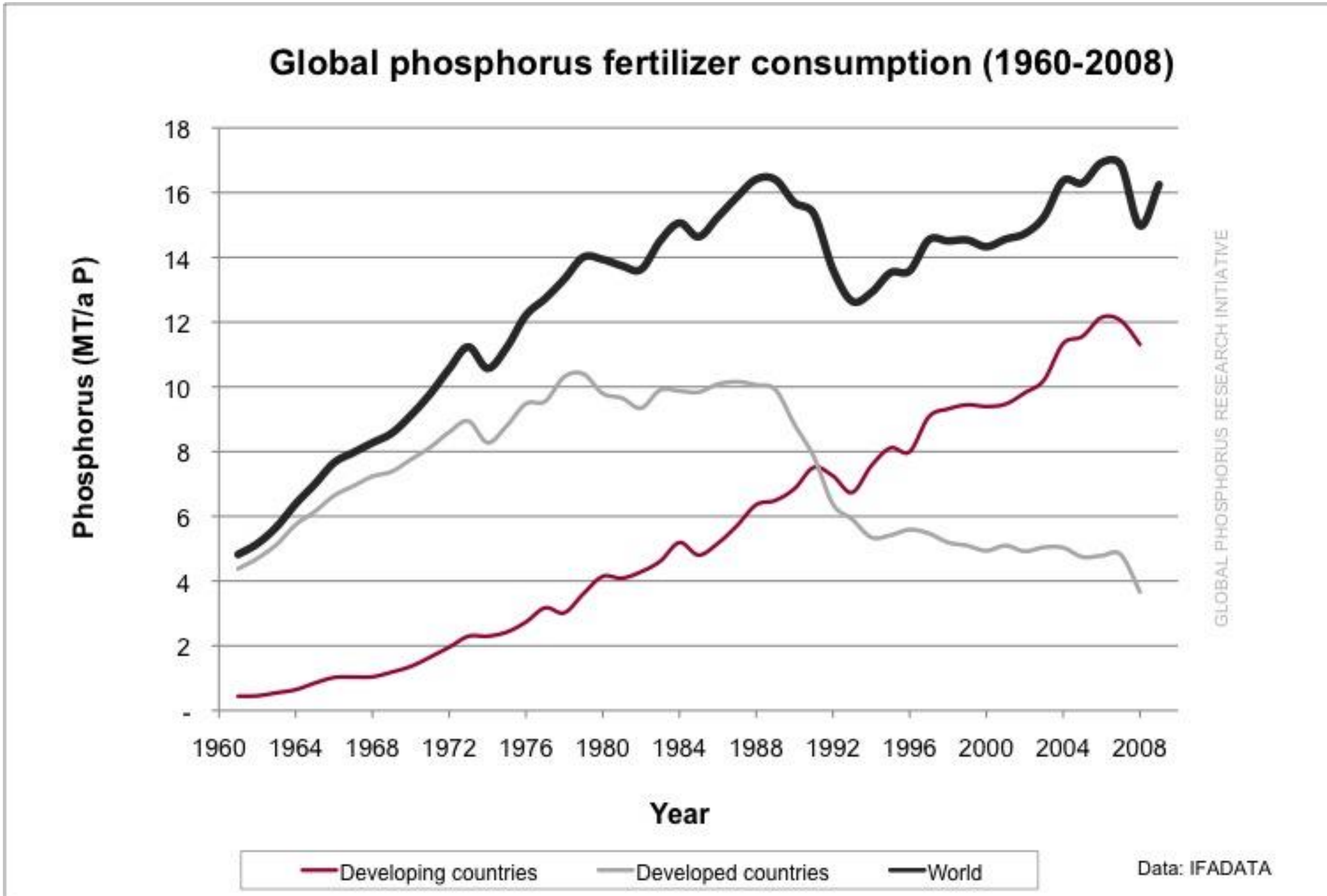
WATER QUALITY THREATS TO SOCIETY AND WELFARE – A QUASI LITERATURE REVIEW….

- **Water quality** is becoming a global concern of increasing significance, as risks of degradation **translate directly into social economic impacts** (*World Water Development Report 2012*)
- Globally, **fish** from inland waters is the sixth most **important supplier of animal protein**; ca 65% in Bangladesh, Cambodia and Uganda (Welcomme, 2010).
- **80% of sewage water** in developing countries are discharged untreated into water bodies (WHO&JMP, 2008)
- **Nitrate** from agriculture is the most common chemical contaminant in the **world's groundwater aquifers** (Morris et al., 2003)
- **Alarming nutrient pollution** of Chinese rivers as a result of agricultural transitions (Strokal et al. 2016)
- **water pollution has** worsened since the 1990s in the majority of rivers in Latin America, Africa and Asia (UNEP, 2016).

Global population and cereal production



Source: U.N. Food & Agriculture FAOSTAT database, U.S. Census International database


Global phosphorus fertilizer consumption (1960-2008)
Phosphorus (MT/a P)
18
16
14
12
10
8
6
4
2
-
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2004
2008
Year
GLOBAL PHOSPHORUS RESEARCH INITIATIVE
Developing countries
Developed countries
World
Data: IFADATA

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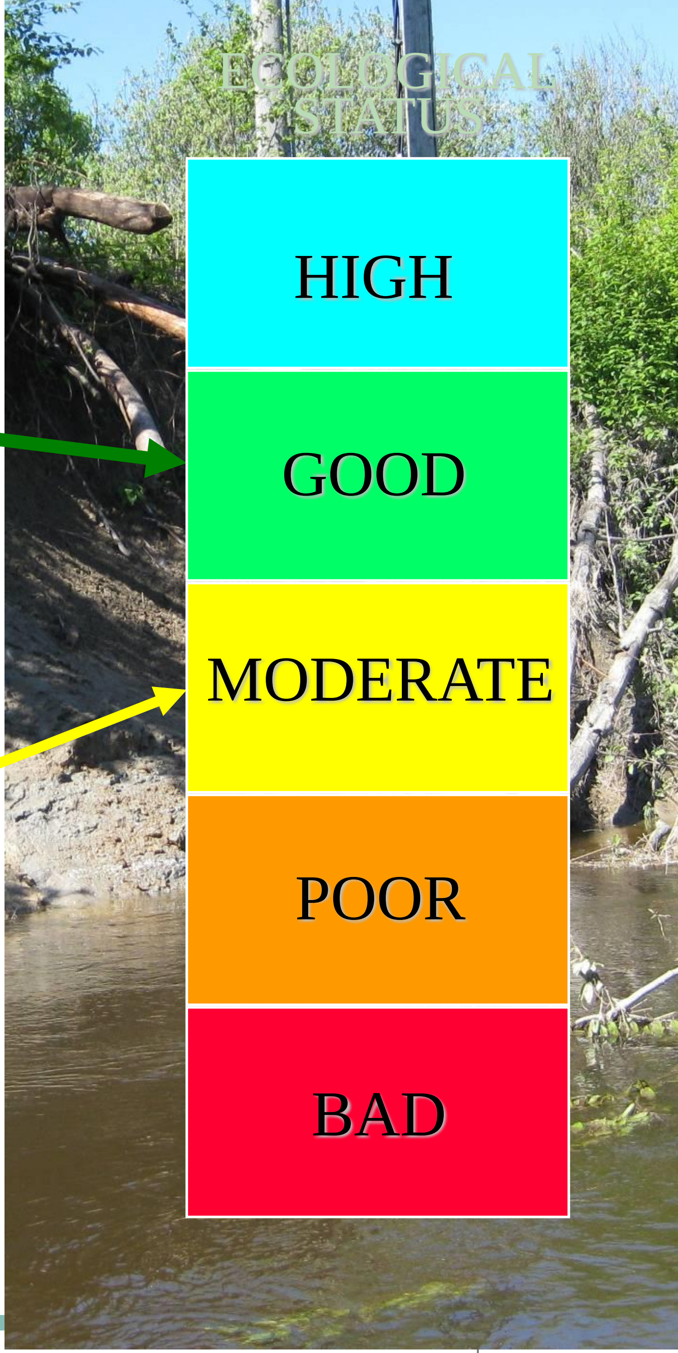
AGRICULTURE IMPORTANT FOR OUR WATER QUALITY!!!

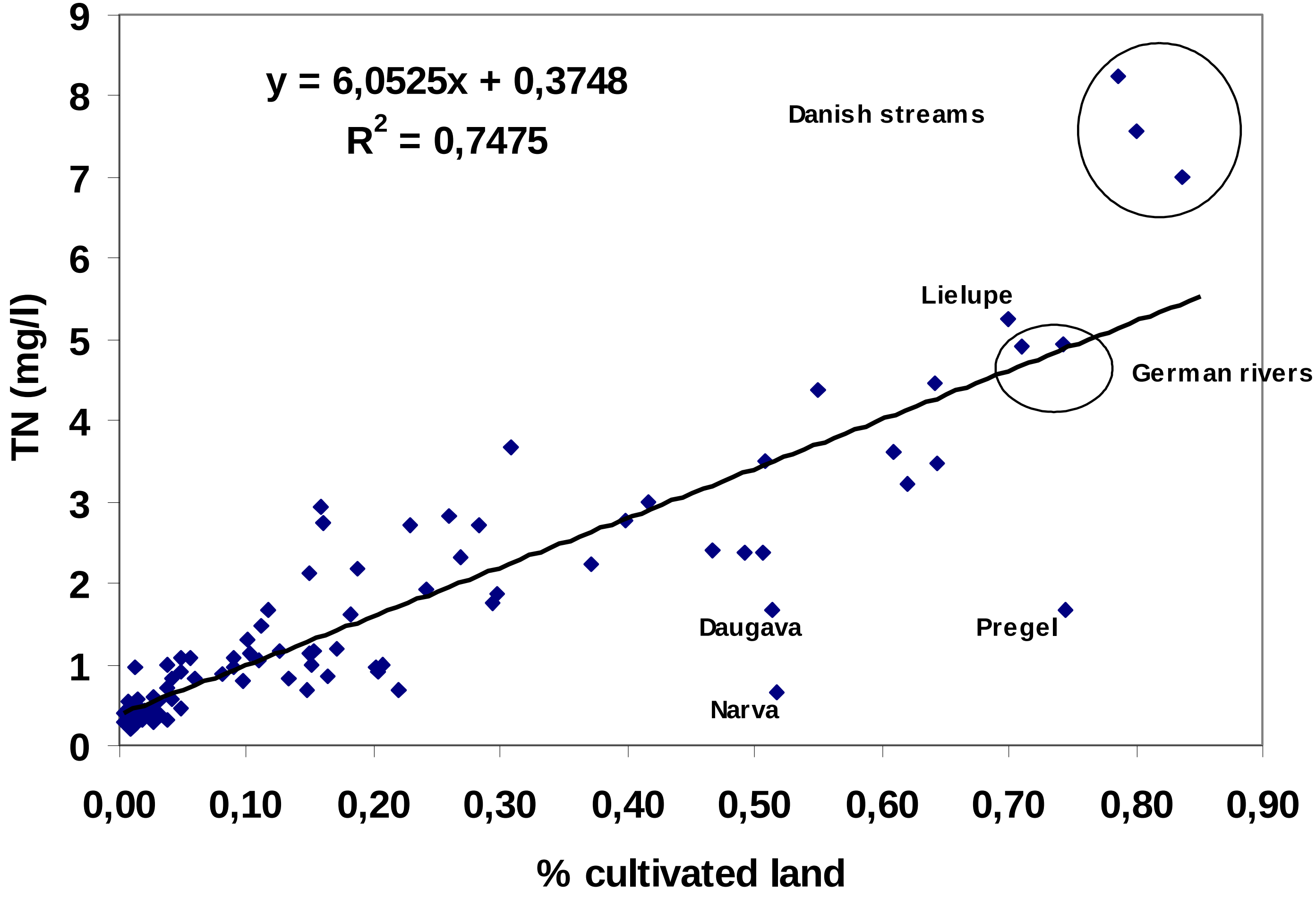
WFD AND MEAN CONCENTRATIONS:

- Mean concentrations defines status
- If biology shows good status then chemical parameters such as TP and TN must be checked.

If the mean concentration of TP or TN is *bad, poor or moderate*, the water body becomes in MODERATE status.



NITROGEN CONCENTRATIONS VS. LAND USE IN 107 BALTIC SEA RIVERS (STÅLNACKE ET AL. , 2015)



Baltic Sea, algea bloom

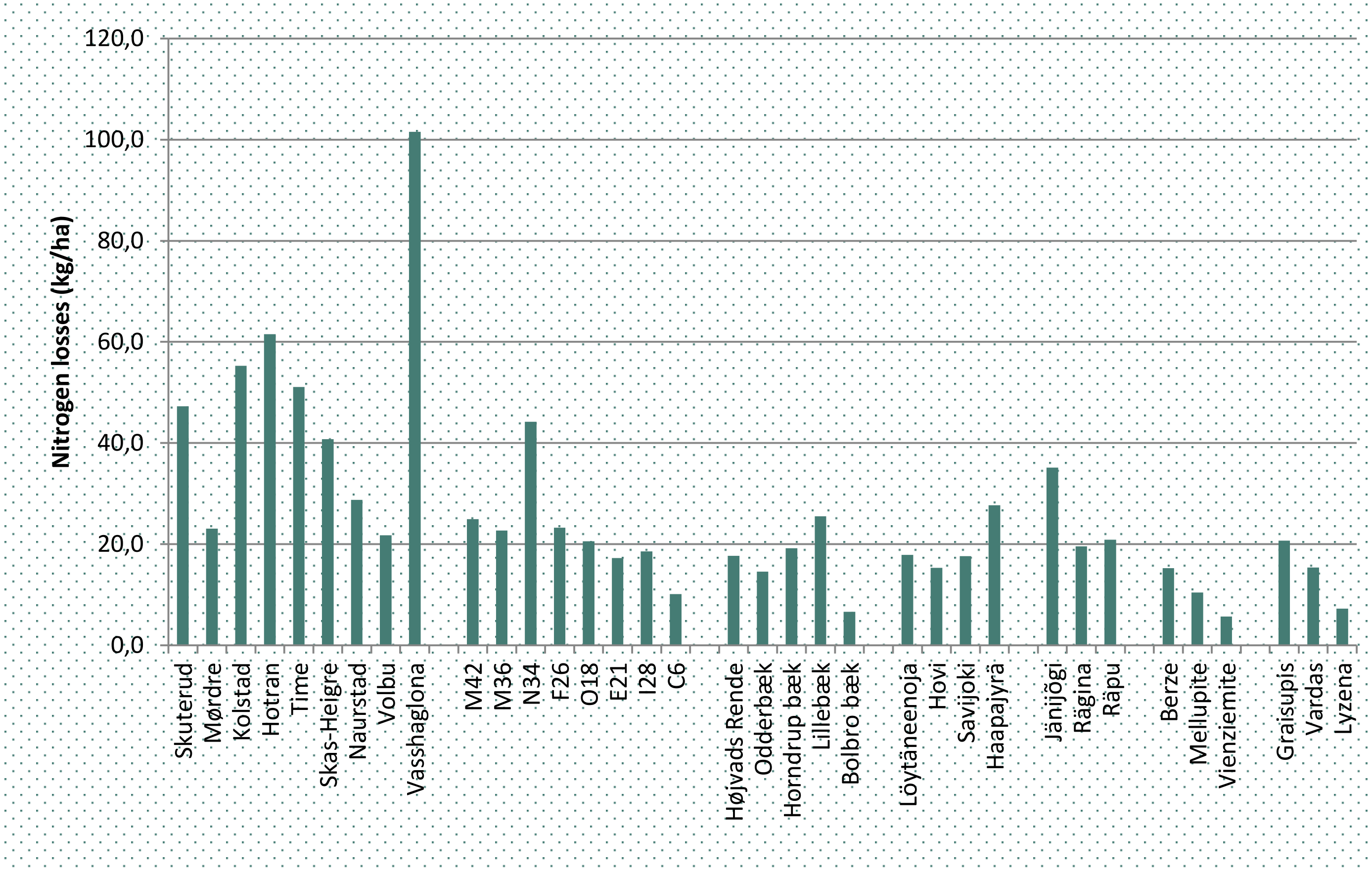
Baltic Sea. Photo: Räddningshelikopter 907/Sjöfartsverket http://www.dagbladet.no/nyheter/2008/07/27/541910.html

'KA ME NOREG?` *(WHAT ABOUT NORWAY?)*

SOIL EROSION IN CEREAL AREAS.
OLD/POOR DRAINAGE/HYDROTECHNICAL SYSTEMS

IN SOME AREAS IN SW NORWAY LIVESTOCK DENSITY IS AS HIGH AS IN THE NETHERLANDS

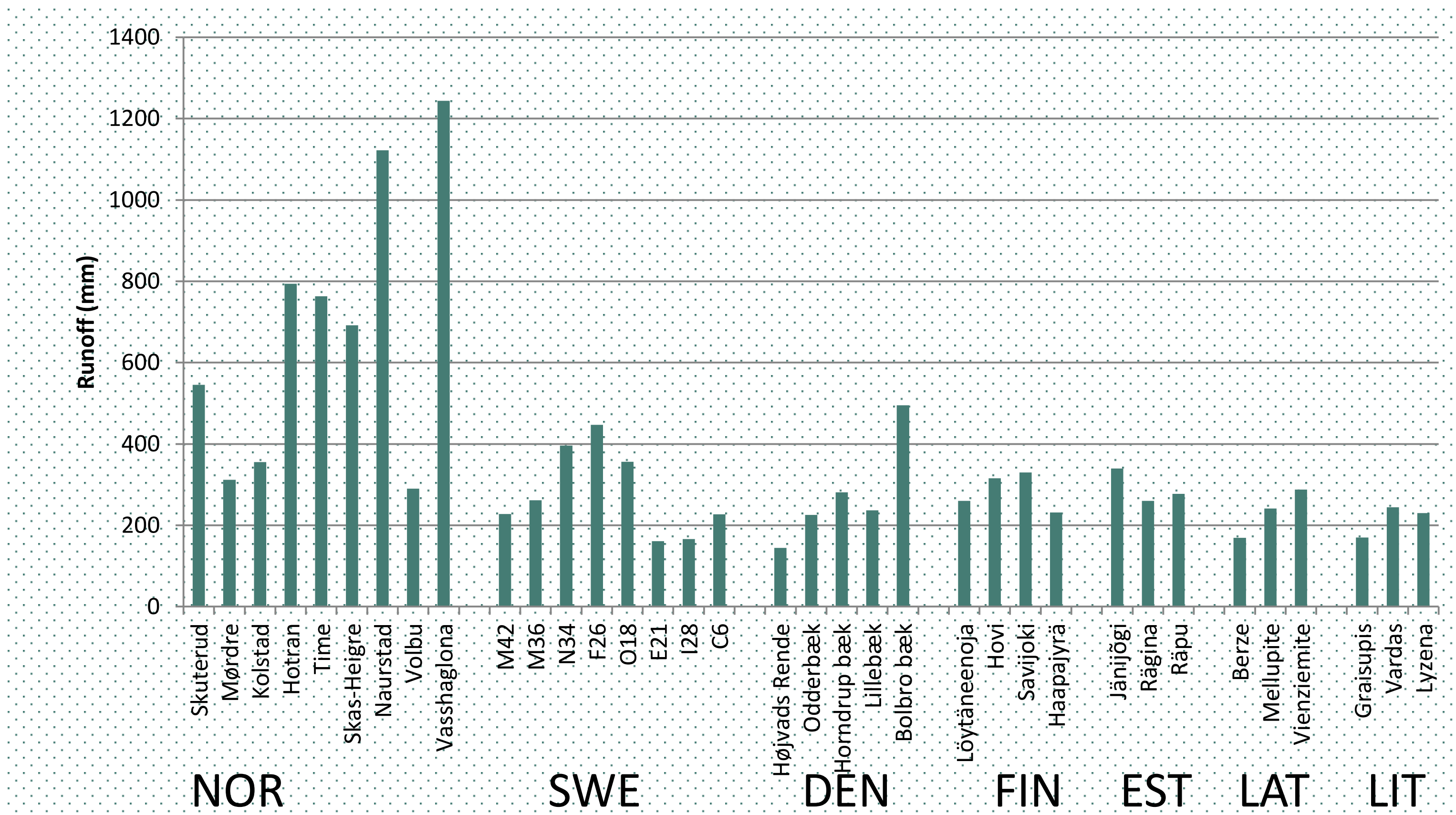
N-AGRICULTURAL LOSSES TO WATER (LONG-TERM ANNUAL MEAN) FROM 34 SMALL AGRICULTURAL CATCHMENTS



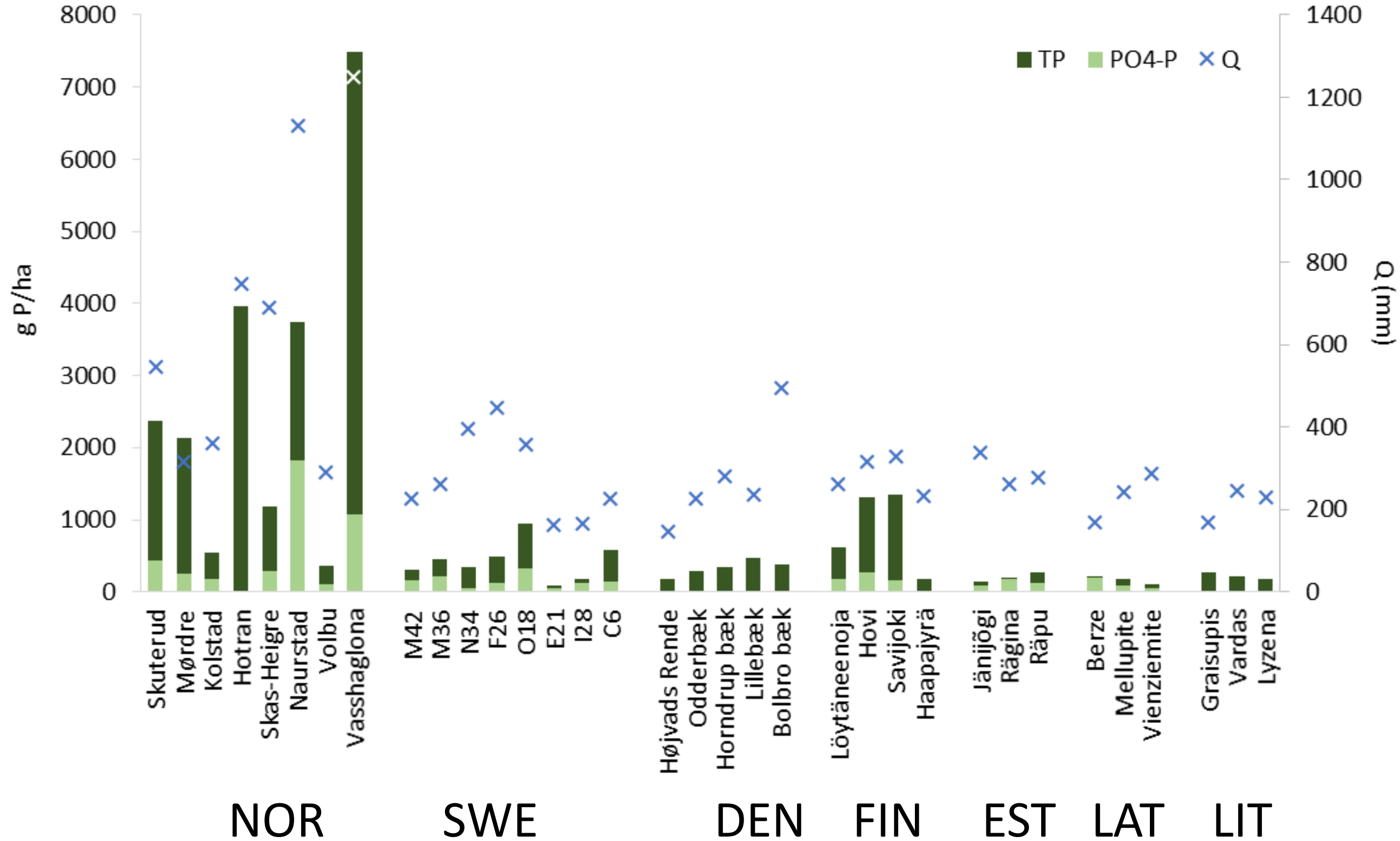
NOR SWE DEN FIN EST LAT LIT

WATER RUNOFF (LONG-TERM ANNUAL MEAN) FROM 35 SMALL AGRICULTURAL CATCHMENTS

(STÅLNACKE ET AL, 2014)

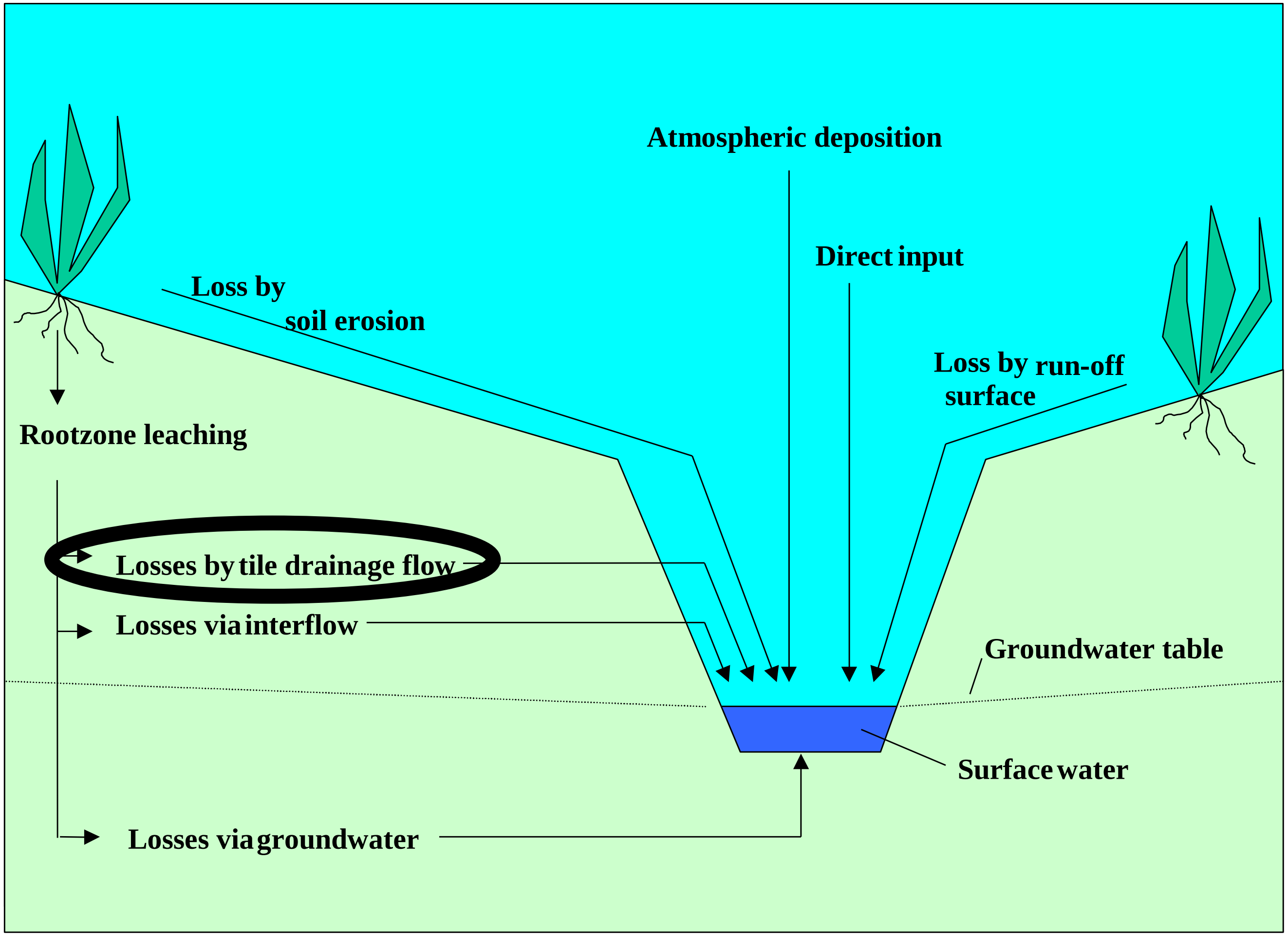


P-AGRICULTURAL LOSSES (LONG-TERM ANNUAL MEAN) FROM 34 SMALL AGRICULTURAL CATCHMENTS (PENGERUD ET AL, 2015)



Note: Data on PO_4-P losses not available for Danish and Lithuanian catchments

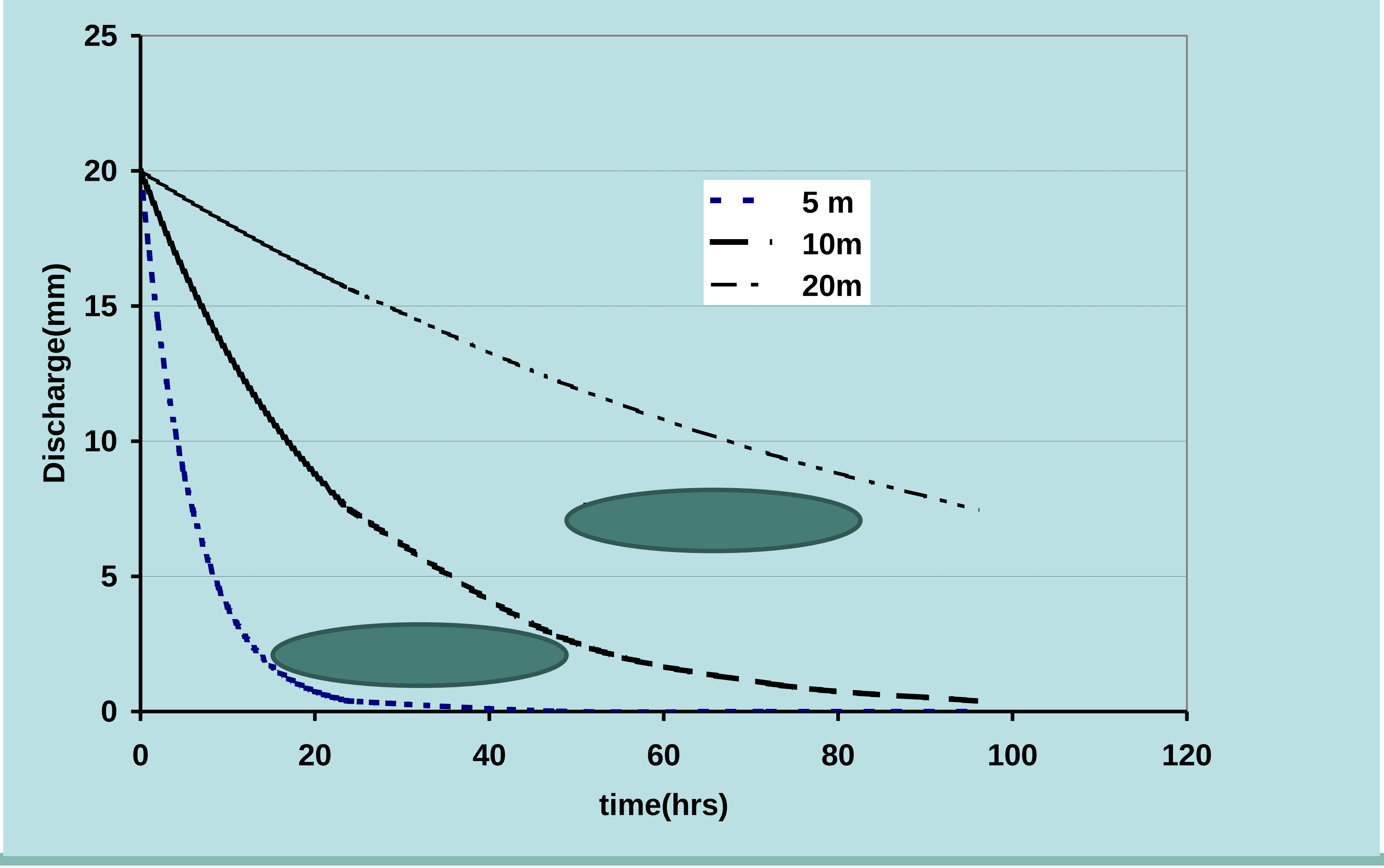
NUTRIENT LOSSES VIA THE VARIOUS HYDROLOGICAL PATHWAYS?



Source: Borgvang and Selvik (2000)

HYDROLOGICAL RESPONSE TO VARIOUS TILE DRAINAGE SPACINGS

(DEELSTRA ET AL., 1998)



TEMPORAL Within catchment N-loss variability

WINTER EPISODE (ØYGARDEN, 2000)

January 30

Runoff: 25 mm

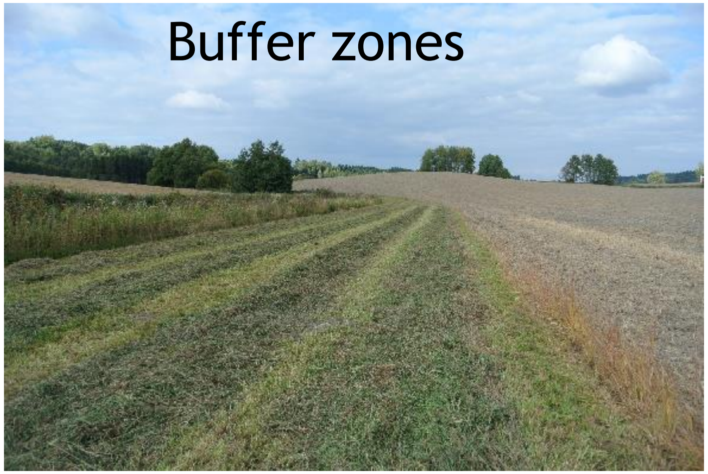
Soil loss: 2 kg ha^{-1}

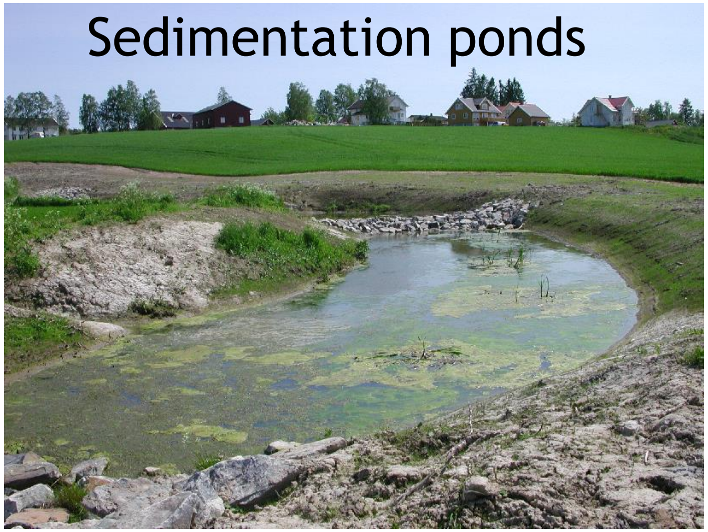
January 31

Runoff: 77 mm

Soil loss: 3 050 kg ha^{-1}

WHICH MITIGATION MEASURES?



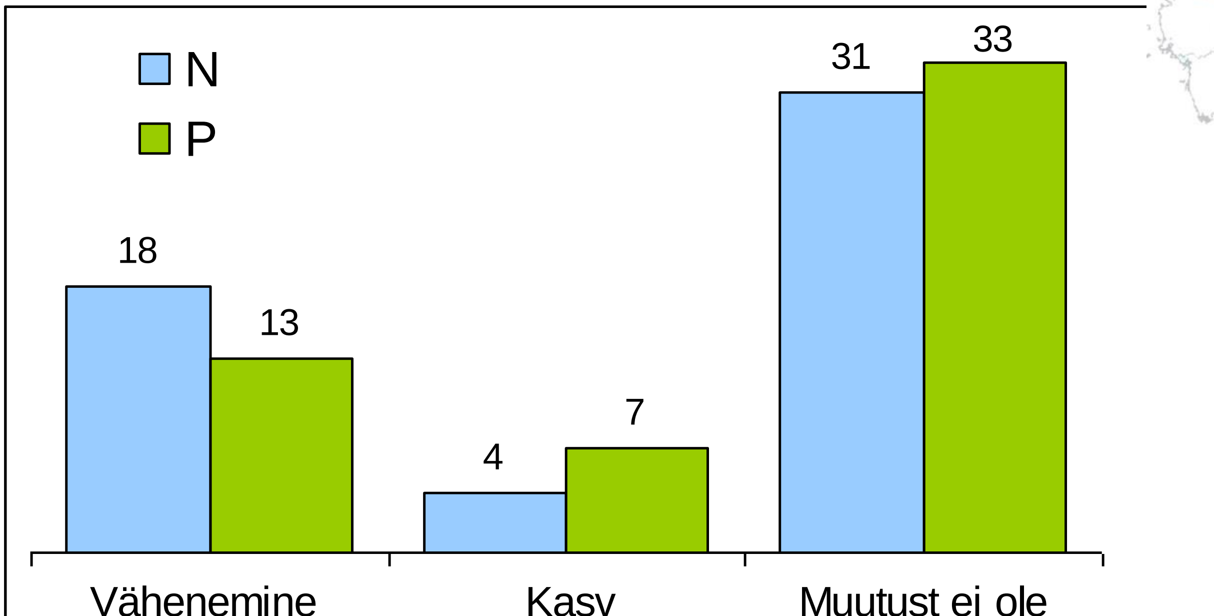


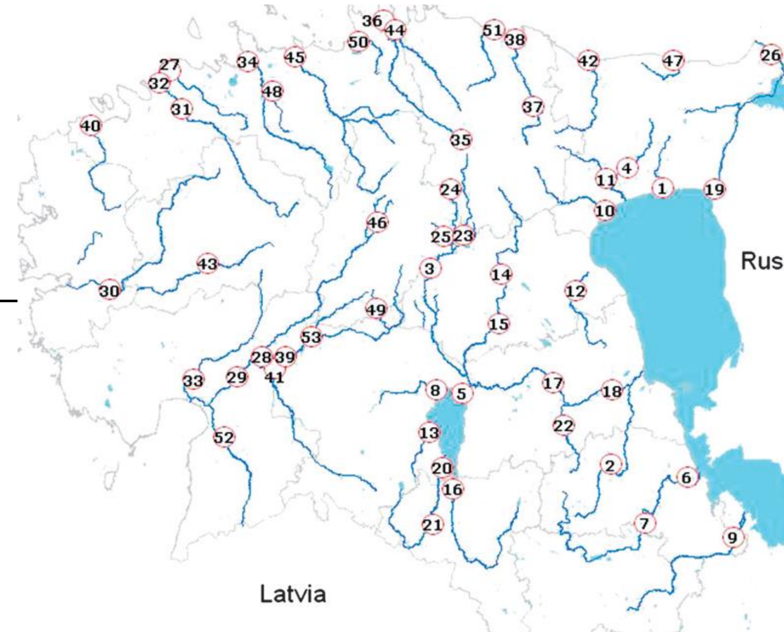
TIME TRENDS IN 35 AGRICULTURAL STREAMS IN THE NORDIC/BALRTIC REGION

(STÅLNACKE ET AL., 2014)

			Water discharge	TN	
Country	Catchment	Timeperiod		Concentrations	Losses
Norway	Skuterud	1993-2011	(+) 0.370	(-) 0.028	(+) 0.016
	Mørdre	1992-2011	(+) 0.192	(-) 0.014	(+) 0.011
	Kolstad	1991-2011	(+) 0.211	(+) 0.021	(+) 0.026
	Hotran	1992-2011	(-) 0.652	(-) 0.005	(-) 0.030
	Time	1995-1999 2004-2011	(+) 0.232	(+) 0.034	(+) 0.016
	Skas-Heigre	1995-2011	(-) 0.078	(-) 0.013	(-) 0.002
	Naurstad	1994-2011	(-) 0.197	(+) 0.039	(+) 0.002
	Volbu	1992-2011	(+) 0.023	(-) 0.072	(-) 0.003
	Vasshaglona	1998-2011	(-) 1.424	(-) 0.001	(-) 0.094
Sweden	M42	1992-2010	(+) 0.007	(-) 0.177*	(-) 0.003*
	M36	1990-2010	(+) 0.061	(-) 0.201***	(-) 0.005**
	N34	1996-2010	(+) 0.039	(-) 0.332***	(-) 0.060***
	F26	1994-2010	(+) 0.218	(-) 0.196***	(-) 0.018***
	O18	1988-2010	(+) 0.041	(-) 0.081*	(-) 0.002
	E21	1988-2010	(+) 0.127	(-) 0.047*	(+) 0.003
	I28	1989-2010	(-) 0.032	(-) 0.092	(-) 0.002
	C6	1994-2010	(-) 0.003	(-) 0.069*	(-) 0.001
Denmark	Højvads Rende	1990-2011	(-) 0.556	(-) 0.033	(-) 0.002
	Odderbæk	1990-2011	(+) 1.671	(-) 0.058***	(-) 0.002***
	Horndrup bæk	1990-2011	(+) 0.519	(-) 0.178***	(-) 0.016***
	Lillebæk	1990-2011	(+) 0.266	(-) 0.227***	(-) 0.013***
	Bolbro bæk	1990-2011	(+) 1.584	(-) 0.011	(-) 0.001*
Finland	Löytäneenoja	1998-2009	(-) 0.062	(-) 0.032	(-) 0.005
	Hovi	1998-2009	(-) 0.101	(-) 0.070	(-) 0.010*
	Savijoki	1998-2009	(-) 0.111	(-) 0.040	(-) 0.001
	Haapajyrä	1998-2009	0,000	(+) 0.038	(-) 0.000
Baltic states	Jänijõgi	2002-2011	(+) 1.390	(+) 1.138*	(+) 0.259
	Rägina	2000-2011	(+) 0.070	(-) 0.080	(+) 0.007
	Räpu	1995-2011	(+) 0.801*	(+) 0.457**	(+) 0.106*
	Berze	1993-2012	(-) 0.001	(+) 0.247**	(+) 0.002**
	Mellupite	1994-2012	(+) 0.017	(+) 0.042	(+) 0.001
	Vienziemite	1993-2012	(+) 0.079	(+) 0.021	(+) 0.002
	Graisupis	1996-2010	(+) 0.05	(+) 0.037	(+) 0.002
	Vardas	1996-2010	(+) 0.05	(-) 0.017	0,000
	Lyzena	1997-2010	0,000	(+) 0.030	0,000

NO. OF TN AND TP TRENDS IN 53 ESTONIAN RIVERS/STREAMS OVER THE PAST 15-20 YEARS (IITAL ET AL, 2009; 2010)



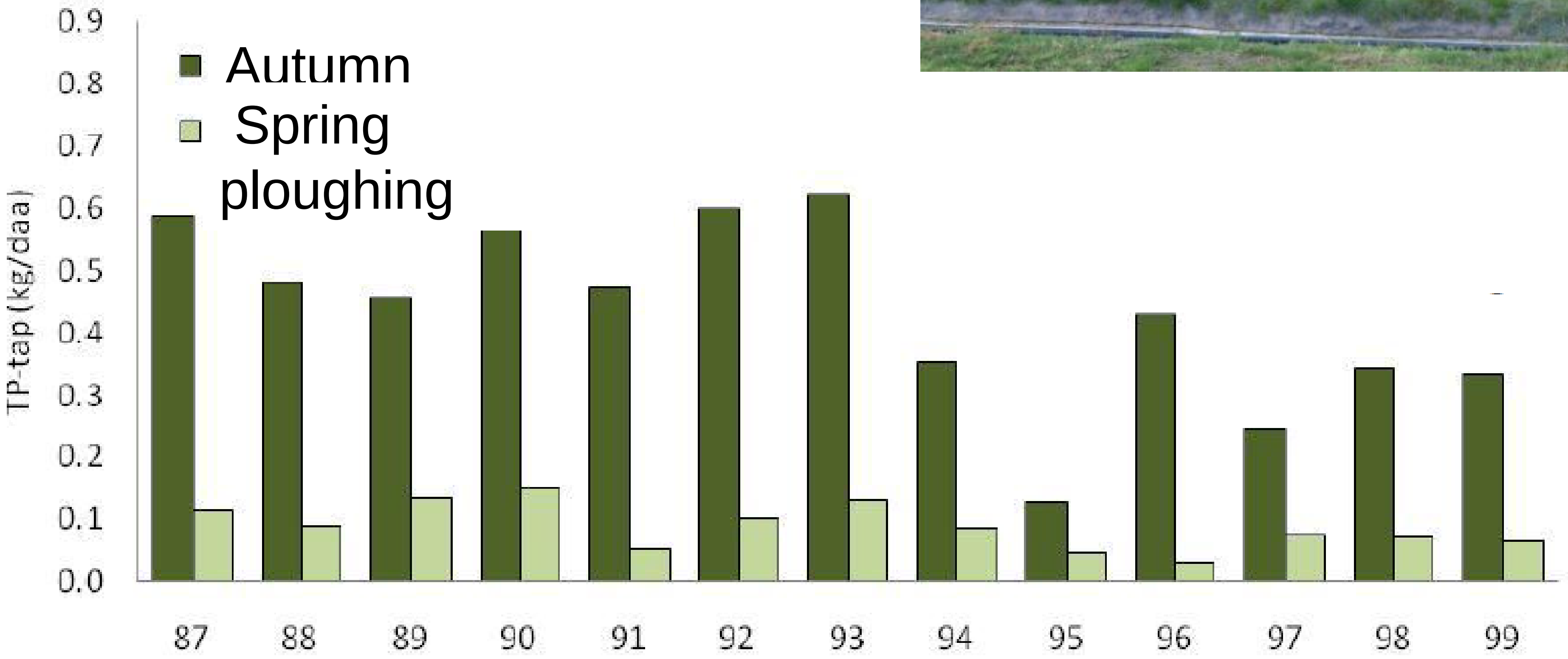


Decrease

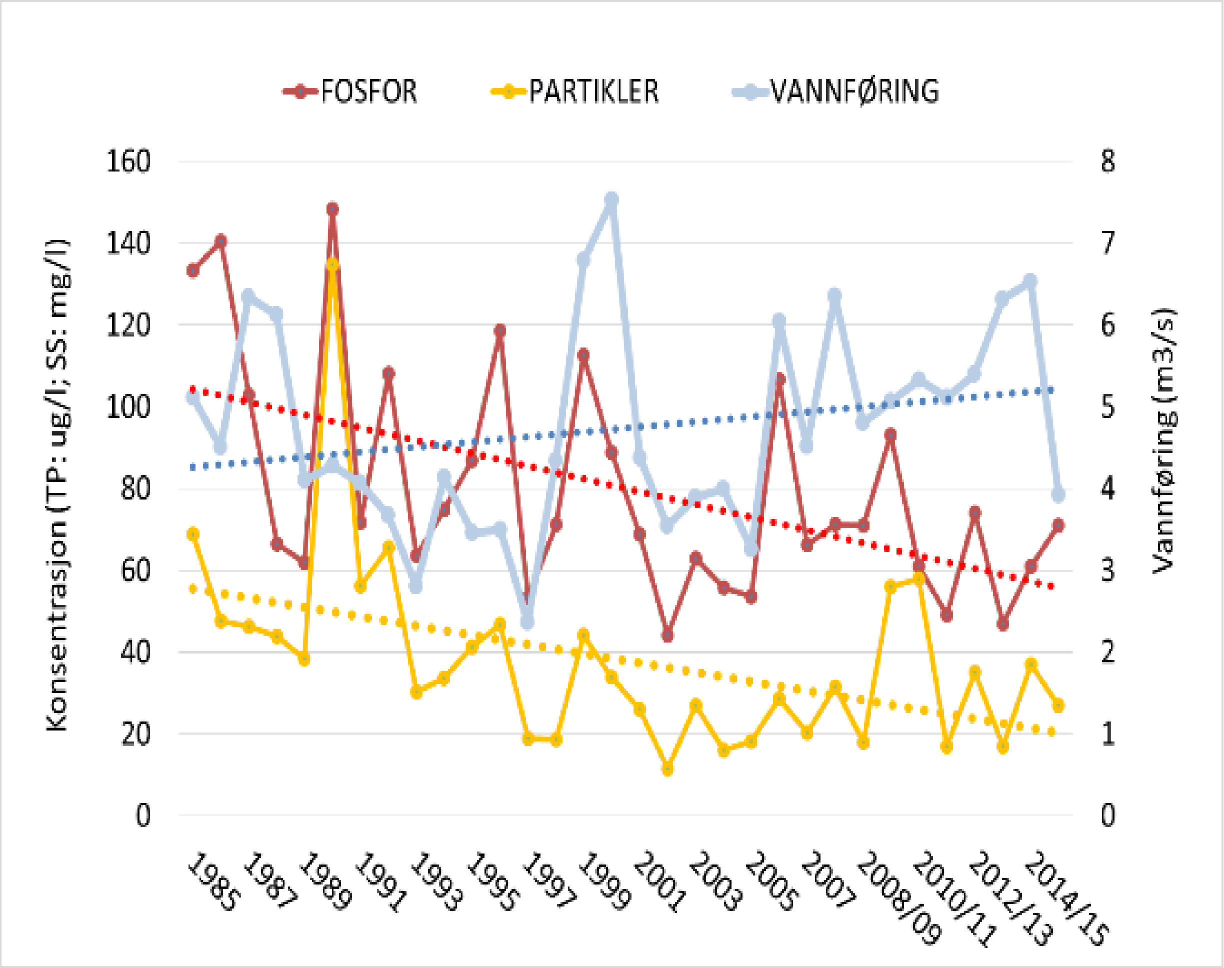
Increase

No-change

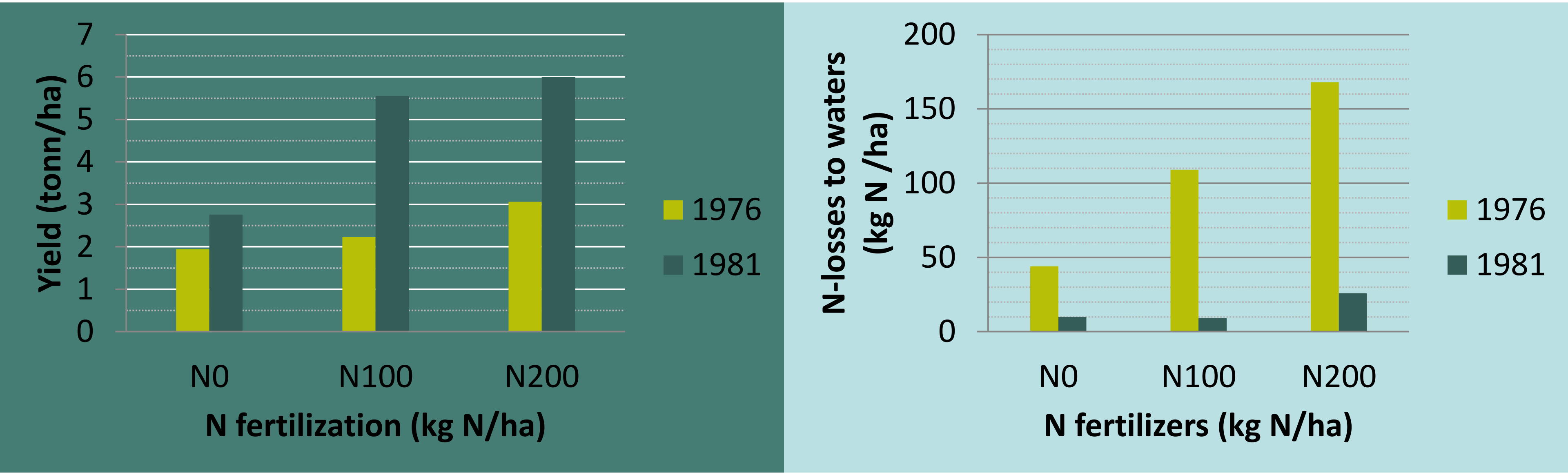
REDUCED TILLAGE



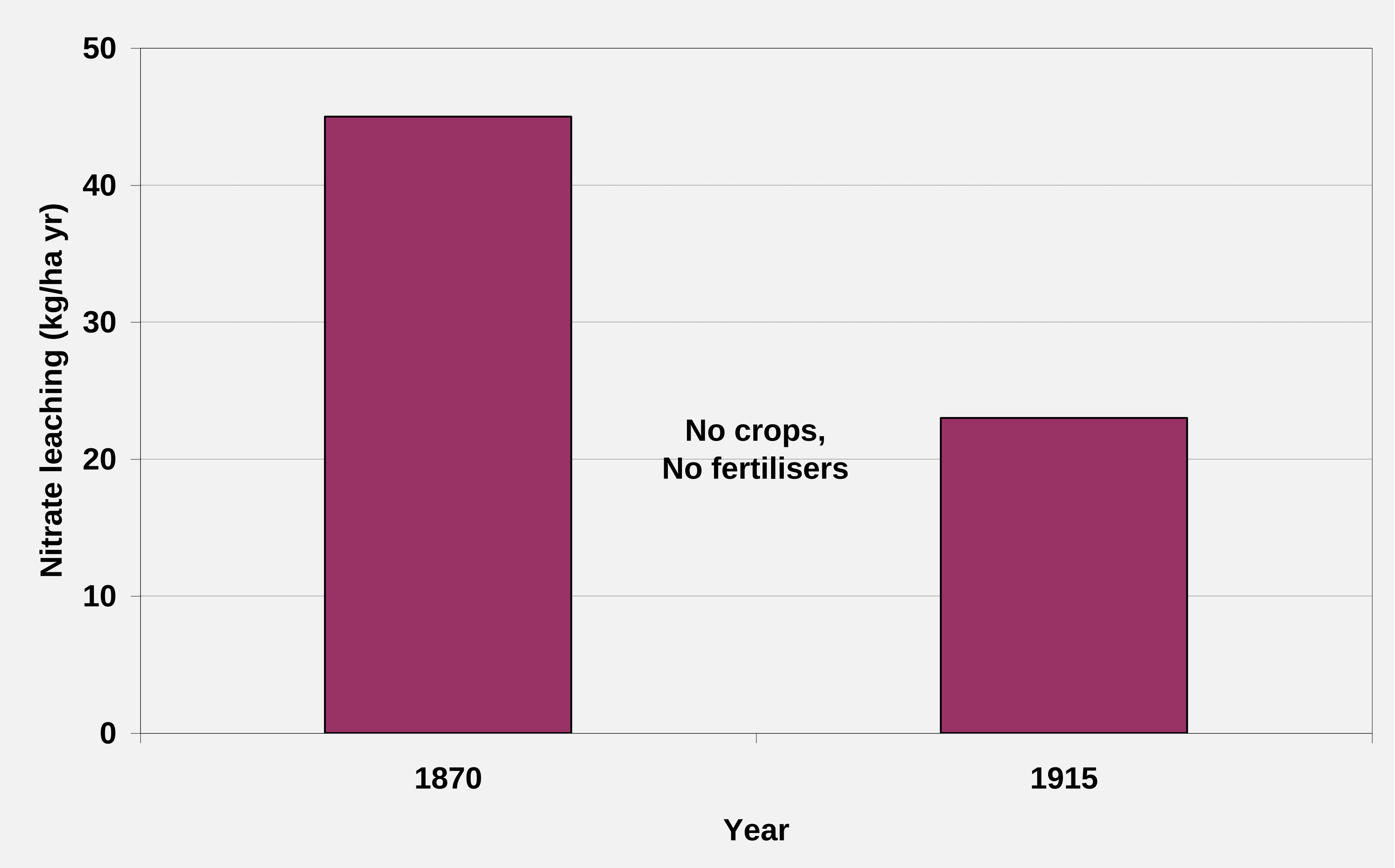
KONSENTRASJONER AV TOTALFOSFOR OG SUSPENDERT TØRRSTOFF I HOBØLELVA (SKARBØVIK, 2017)



N FERTILIZERS- YIELD RESPONSE – LOSSES TO WATERS (SOURCE: UHLEN, UMB)

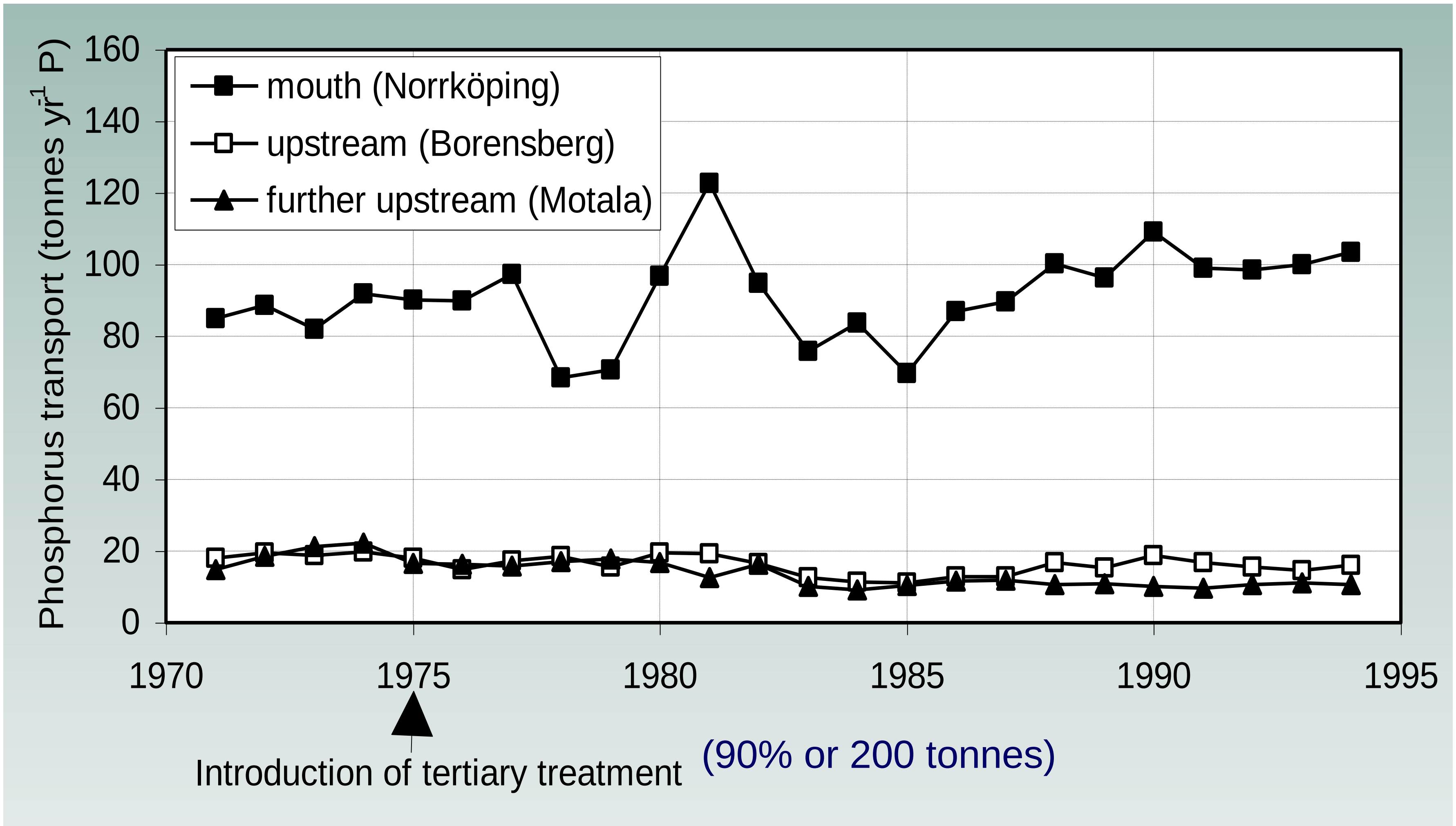


The Rothamsted experiment (UK)
(Addiscott, 1988)

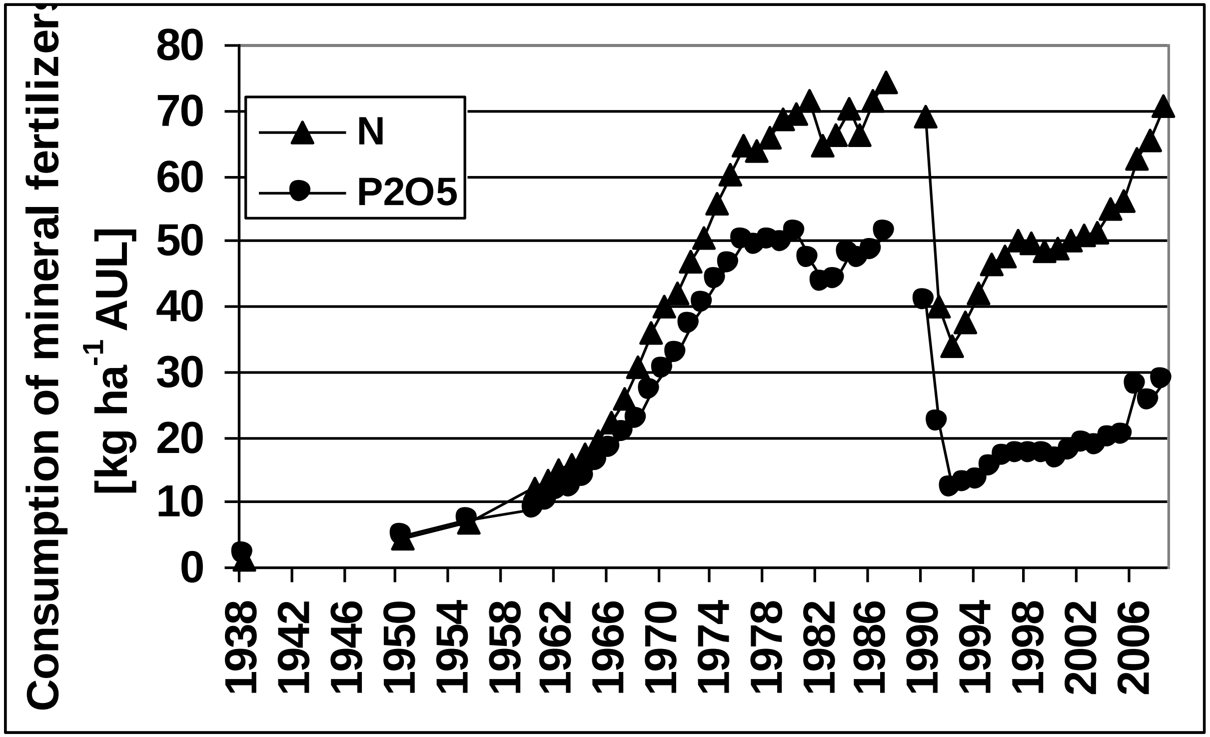


RIVERINE RESPONSE TO DECREASED POINT SOURCE P-EMISSIONS

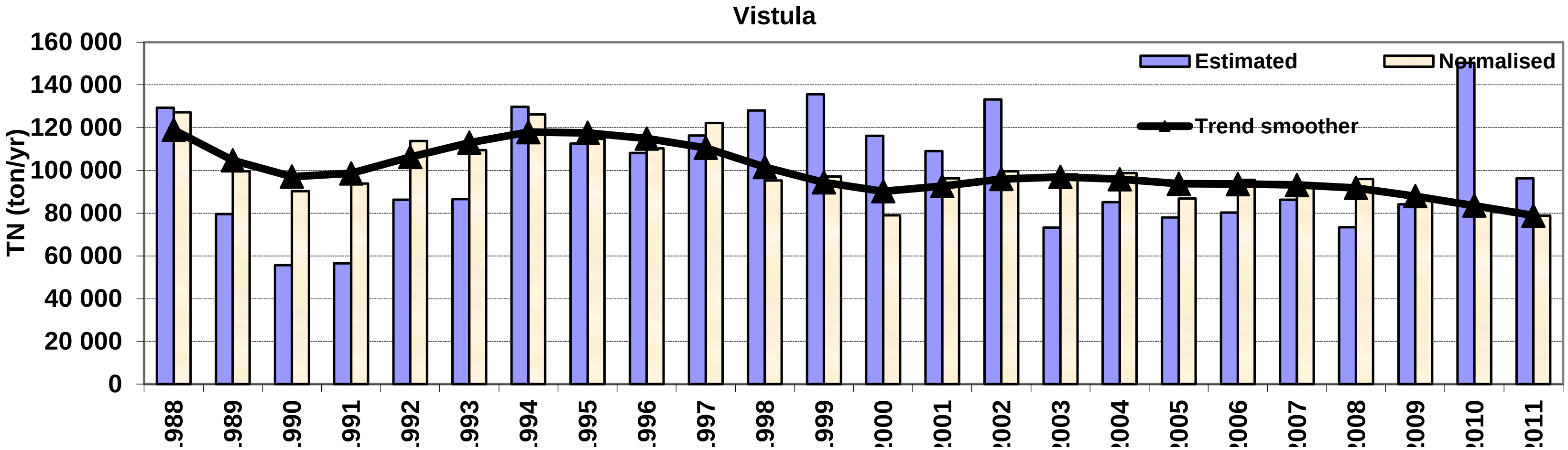
Motala Ström in Sweden (Grimvall & Stålnacke

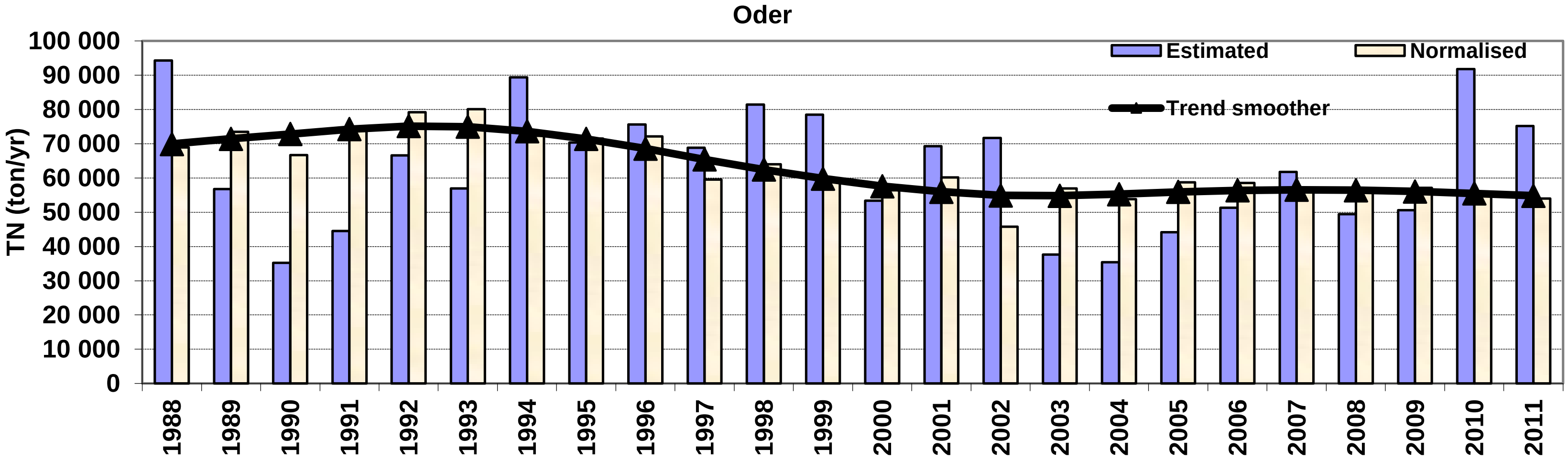


NUTRIENT APPLICATION IN THE 2 LARGE POLISH RIVERS (PASTUSZAK, STÅLNACKE, ET AL., 2012)

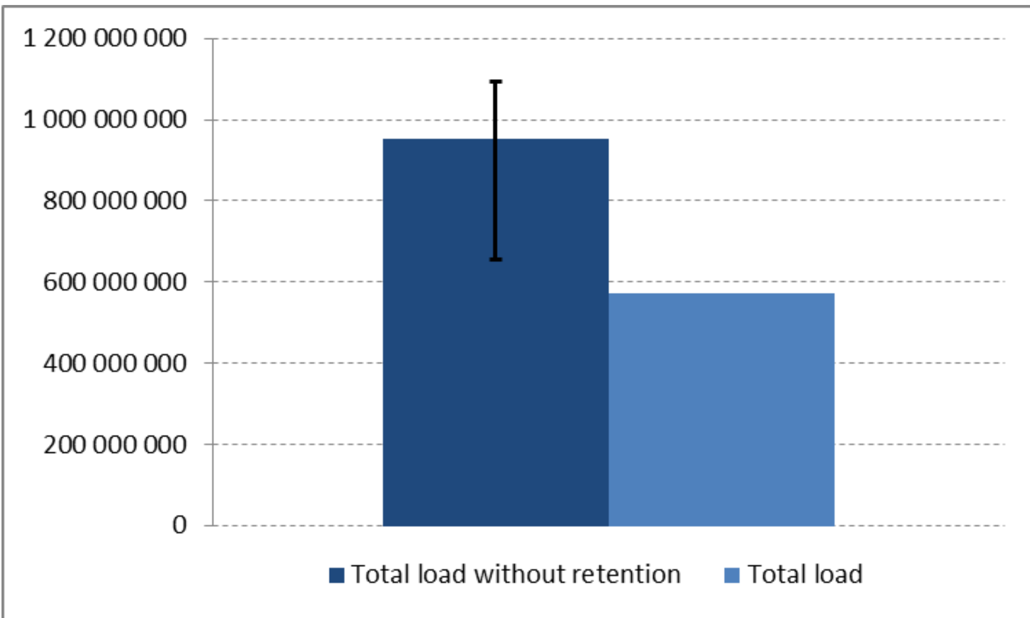


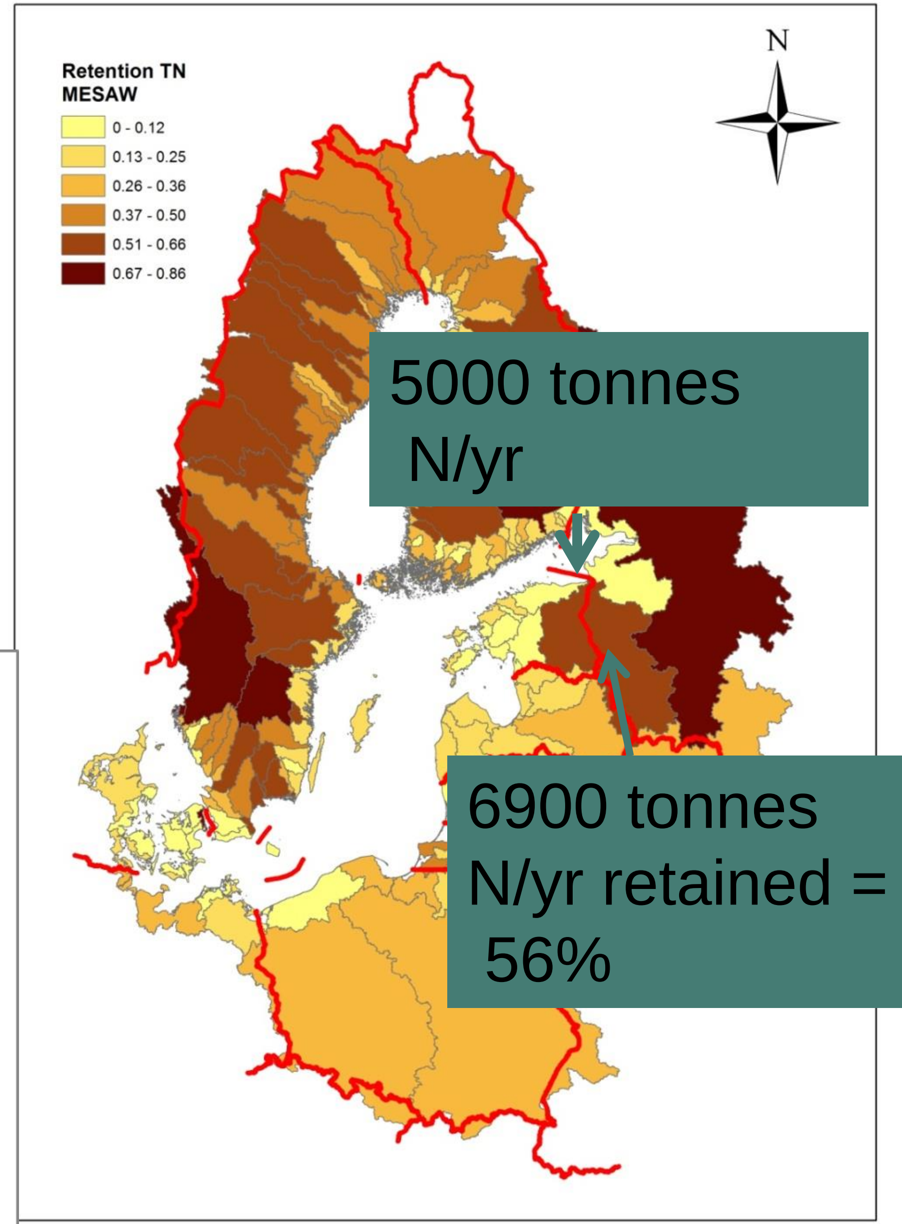
NITROGEN RIVER LOADS IN THE 2 LARGE POLISH RIVERS (PASTUSZAK, STÅLNACKE ET AL, 2012)



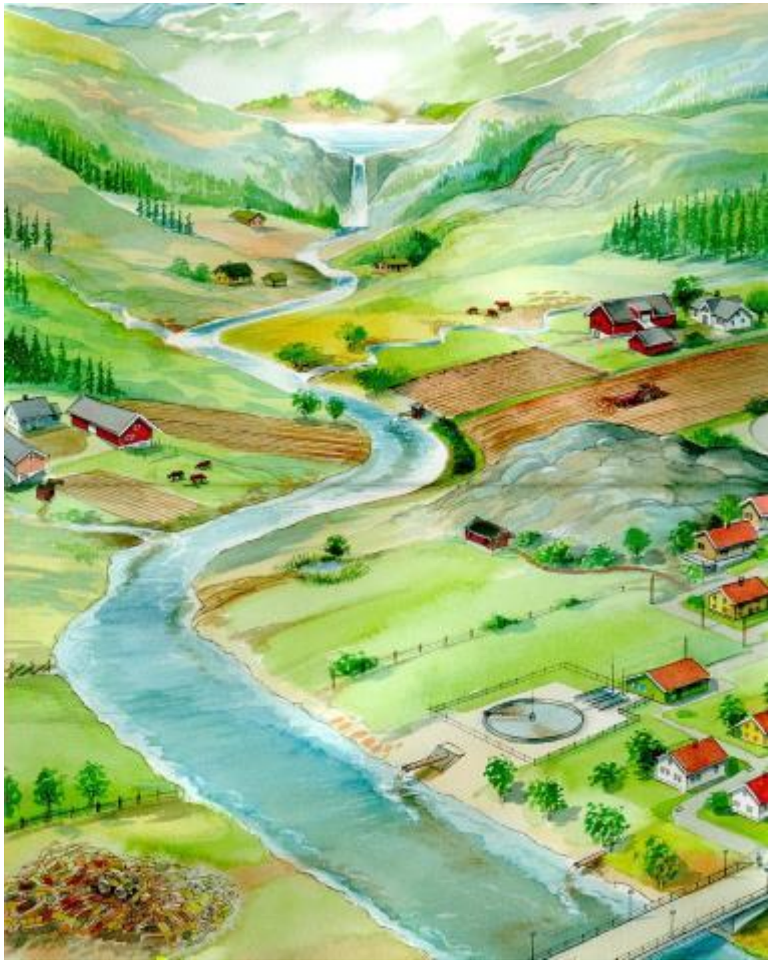


Nitrogen surface water retention in 117 Baltic Sea river basins with MESAW (Stålnacke et al. 2015)





Concluding remarks



- The case studies showed that the challenge of protecting water quality is intertwined with many other tasks of society – providing food, developing the economy, and providing safe sanitation.
- Data are essential for developing, monitoring and evaluating water resources management strategies
- A "one size fits all" mitigation measures will not work to solve the global water quality challenge

- Nutrient losess show high variability
- Pathways (e.g. hydrological) are important and site-specific
- Huge uncertainty in retention (from root-zone to stream)

-> Huge challenge to plan and model the optimal mitigations measures

->

THANKS FOR YOUR ATTENTION !