15 – 17 June 2021
SWS European Chapter Meeting

About smaller and bigger kidneys: riparian zones as nutrient buffers in Denmark

Dominik Zak[a,b], Carl C Hoffmann[a,b], Brian Kronvang[a,b], Mette V Carstensen[a], Sebastian P Zacho[c], Joachim Audet[a,b]

[a] Dep. of Bioscience, Aarhus University, Denmark
[b] Aarhus University, WATEC, Denmark
[c] SEGES, Crops and Environment Innovation, Denmark

INTRODUCTION

In Denmark, measures reducing nitrogen (N) and phosphorus (P) losses from fields are divided into two main categories "source mitigation measures", e.g. catch crops and fertiliser norms as well as set-a-side and afforestation, and "nutrient transport mitigation measures", e.g. restored wetlands and a number of drainage mitigation measures (Figure 1). This paper deals with nutrient transport mitigation measures to reduce diffuse pollution from agriculture. It treats already approved measures, such as restoration of riparian wetlands, larger lowlands areas including fens and swamps, re-establishment of shallow lakes, constructed wetlands (surface flow and subsurface flow), as well as drainage mitigation measures not yet approved and still under development such as integrated buffer zones, saturated buffer zones and controlled drainage.

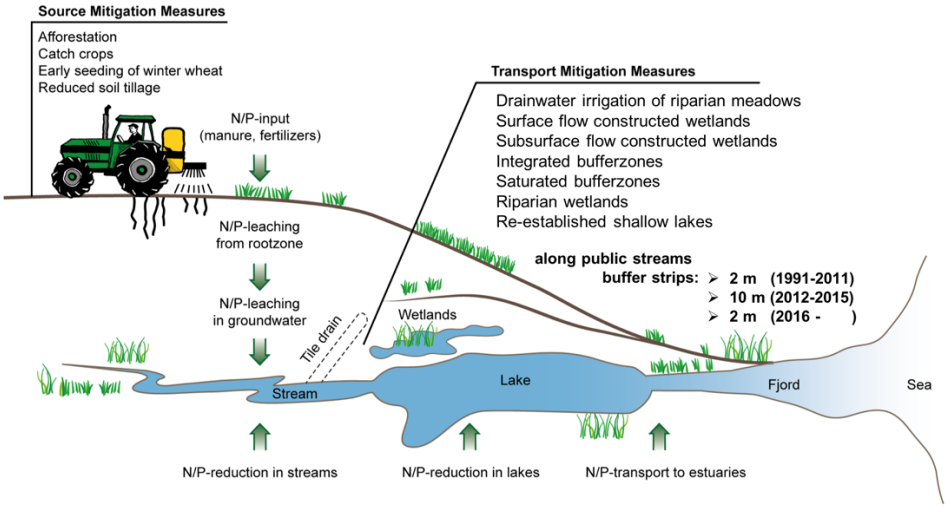

Fig. 1. Nutrient reduction efforts in Denmark since 1985.

METHODS

New nutrient transport mitigation measures cannot be implemented in Denmark until after completion of a series of steps. Whenever a new measure is proposed for use by Danish farmer advisors, it must be scientifically tested and thoroughly described. Thereafter, guidelines and national maps showing how and where to implement the measures must be made. A web-based support system for the funding of nutrient transport mitigation measures, including construction criteria, guidelines and maps, is run by the Danish Ministry of Environment and Food (lbst.dk/tilskudsguide).

RESULTS and DISCUSSION

Wetland restoration measures have proved to be efficient at removing N, whereas the results regarding P are more variable; in fact, some sites have been observed to act as P sources, especially in the first years following rewetting (Walton et al., 2020). Overall nutrient removal rates and efficiency vary strongly for all of the studied nutrient transport mitigation measures (Table 1). It is important to note that this variation not only reflect differences in efficiency of the mitigation measures but also differences in nutrient loading and local characteristics of the sites used for implementation (e.g. soil type, vegetation, climate) (Carstensen et al. 2020).

Table 1. Overview of absolute and relative nutrient removal efficiency (mean ± sd) of Danish nutrient transport mitigation measures (from Hoffmann et al. 2020)

	Sites (n)	Years	Removal rate (kg ha^{-1} y^{-1})		Removal efficiency (%)	
			TN	TP	TN	TP
Restored riparian wetlands	9	9	144±73	3±5	37±31	12±15
Restored shallow lakes	11	12	159±53	4±6	45±21	-2±83
Restored swamps and fens	5	5	209±77	2±3	44±12	11±26
Drain water irrigation	10	10	139±91	-0.3±0.3	45±22	-51±49
Surface flow constr.wetland	13	44	472±372	31±26	23±10	45±20
Subsurface flow constr. wetland	3	15	7771±241	34±6	50±13	12±4
Controlled drainage	4	8	8.8±6.5	2.2±2.4	33±13	5±29
Integrated buffer zones	3	6	1661±605	17±15	45±12	29±60

CONCLUSIONS

The Danish strategy to mitigate agricultural nutrient losses has resulted in a substantial decrease in the nutrient export to fresh waters.Yet, more efforts are still required to reach the “good ecological status” stipulated in the EU Water Framework Directive. Furthermore it is recognized that other aspects, for example, biodiversity or greenhouse gas emissions, needs to be included in montirong schemes to support the implementation of mitigation measures.

ACKNOWLEDGEMENTS

We are grateful for Nordic Centre of Excellence BIOWATER, funded by Nordforsk under Project no. 82263, by the Ministry of Environment and Food of Denmark (33010-NIFA-16-649) and by PAF drænfilterprojekt “SEGES innovationsplatform for drænvirkemidler”. SupremeTech Sustainable nutrient remediation technologies grant no. 09-067280, Danish Strategic Research Council; iDRAIN-Optimised Drainage Filter Technologies grant no 3405-10-0142, GUDP (Green development and demonstration programme) also supported the work.

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STØTTET AF

Promilleafgiftsfonden for landbrug