NABOTJEK AF KVÆLSTOF - OG FOSFORVIRKEMIDLER

MARTIN THORSØE, TOMMY DALGAARD OG MORTEN GRAVERSGAARD

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Videnskabelig rapport
Rapporterne indeholder hovedsageligt afrapportering fra forsknings-projekter, oversigtsrapporter over faglige emner, vidensynteser, rapporter og redegørelser til myndigheder, tekniske afprøvninger, vejledninger osv.

1. Sammenfatning

Nærværende rapport indeholder DCA's analyse af anvendelsen af forskellige kvælstof- og fosforvirkemidler i Danmark, Sverige, Holland, Polen, Schleswig-Holstein, Niedersachsen og Bretagne. Rapporten fokuserer på forskelle mellem landene i de tilgængelige virkemidler, godkendelsesprocedurer for nye virkemidler samt anbefalinger for en hurtigere godkendelsesprocedure af nye lovende virkemidler. Undersøgelsen er blevet gennemført gennem et desktopstudie af de virkemidler der anvendes i de syv landområder og en interviewundersøgelse blandt forskere, rådgivere og ansatte i den offentlige forvaltning. På baggrund af undersøgelsen kan det konkluderes at ingen af de undersøgte lande har en på forhånd fastlagt procedure for godkendelsen af virkemidler og undersøgelserne indikerer heller ikke, at der er en stor forskel på, hvilke virkemidler, der er tilgængelig for anvendelse i næringsstofforvaltningen. På baggrund af nærværende studie kan der ikke dokumenteres en generelt hurtigere og mere præcis godkendelsesprocedure i andre af de undersøgte lande i forhold til Danmark. På baggrund af studiet og DCA's erfaringer fra arbejdet med godkendelse af virkemidler anbefales det at arbejde for: 1) Integration af forskellige synergieffekter, 2) aktiv dialog med interessenter, 3) formaliseret tværnationalt samarbejde og 4) ikke en fast godkendelsesprocedure.

Indhold

2. Indledning

DCA er af Miljø- og Fødevareministeriet blevet bedt om at gennemføre et nabotjek, der indeholder:

1) En sammenlignende analyse af anvendelsen af forskellige kvælstof- og fosforvirkemidler i Danmark og i Sverige, Holland, Polen, Schleswig-Holstein, Niedersachsen og Bretagne.
2) En sammenlignende analyse af godkendelsesprocedurer for anvendelsen af kvælstof- og fosforvirkemidler i Danmark og de undersøgte nabolande – herunder dokumentationskrav til virkemidlernes effekt og økonomi samt risikovurdering af utilsigtede virkninger på miljø og klima.
3) Sammenfatning med vurdering af anvendelse og godkendelse af kvælstof- og fosforvirkemidler i Danmark sammenlignet med nabolande. Anbefalinger til udviklingen af en metode til hurtigere godkendelse og indfasning af lovende nye virkemidler på baggrund af erfaringer fra nabolande.

Denne rapport indeholder besvarelse af de tre spørgsmål, og er struktureret således, at sektionerne 3-5 overordnet set adresserer et af disse tre spørgsmål. Udover de nævnte forfattere har en række andre af DCA's forskere bidraget til processen, herunder særligt, Jørgen Eriksen, Gitte Holton Rubæk og Ingrid Kaag Thomsen.

2.1 Metode

Analysen er blevet gennemført i fire trin:

1. Indledningsvis er de virkemidler, der anvendes i de syv landområder blevet beskrevet gennem et desktop-studie på baggrund af materiale i form af lovgivning, forskningsrapporter og indberetninger, som er blevet fundet via søgninger og tilsendt fra udenlandske kontakter blandt forskere og myndigheder. En udfordring i denne forbindelse har været, at materialet er formuleret på relevante nationalsprog. Denne del af undersøgelsen er således blevet gennemført af forskere eller studentermedhjælpere ansat ved AU med de pågældende landes sprog som modersmål.
2. Der er blevet gennemført en interviewundersøgelse blandt forskere, rådgivere og ansatte i den offentlige forvaltning i de seks forskellige lande, med henblik på nærmere at indkredse den godkendelses- og dokumentationsmæssige procedure, samt den "reguleringsstil" og kontekst der har indflydelse på godkendelsen af nye virkemidler i de respektive lande. I valget af informanter har vi vægtet at identificere kilder, der dagligt arbejder med godkendelse eller implementeringen af virkemidlerne, og vi har bestræbt os på at gennemføre mindst tre interviews for hvert af de undersøgte lande. En oversigt over de informanter, der har ladet sig interviewe som en del af rapportens undersøgelser, findes som Bilag 1.
3. På baggrund af desktop studiet og interviewundersøgelsen er den indsamlede information for hvert af de syv forskellige områder, blevet samlet i en landerapport. Landerapporterne er blevet tilbagesendt til de interviewede med henblik på verifikation og eventuel opklaring af spørgsmål, der er opstået undervejs. Disse landerapporter findes som Bilag 2-8.

4. Med henblik på at identificere anbefalinger til at fremskynde indfasningen af nye virkemidler er der som et led i undersøgelsen den 11/5 2017 blevet afholdt en workshop session blandt en udvalgt gruppe på syv af de forskere, der dagligt er beskæftiget med DCAs myndighedsbetjening. På denne workshop blev undersøgelsens foreløbige konklusioner diskuteret, og på denne baggrund blev ideer til en hurtigere indfasning af nye virkemidler opsamlet. De anbefalinger og overvejelser, der præsenteres i sektion 5 er således resultatet af undersøgelserne af nabolandene kombineret med resultaterne af denne diskussion.

3. Sammenlignende analyse af kvælstof- og fosforvirkemidler i de syv områder

En række studier har tidligere sammenlignet anvendelsen af virkemidler til næringsstofforvaltning i forskellige europæiske lande. Nærværende rapport er således en opfølgning på en analyse foretaget af COWI, der sammenligner brugen af virkemidler i Danmark, Sverige, Holland, Polen, Schleswig-Holstein, Niedersachsen og Bretagne (Cowi 2015). Med udgangspunkt i Holland er der i 2009 foretaget et sammenlignende studie af Belgien, Schleswig-Holstein, Niedersachsen, Bretagne, Danmark og Holland, der fokuserer på standarder for anvendelsen og håndteringen af husdyrgødning (Van Dijk and ten Berge 2009). Derudover er der i regi af "North Western Policy-Science Working Group on Reducing Nutrient Emissions" publiceret et sammenlignende studie af effekten af udvalgte virkemidler i Danmark, Holland, England og Niedersachsen (van Boekel 2015). Endelig har Sarteel, Tostivint et al. (2016) undersøgt anvendelsen af virkemidler og mulighederne for minimering af næringsstoftabet i otte regioner i Europa og Gault, Guillet et al. (2015) har sammenlignet virkemidlerne til implementeringen af ND i 7 europæiske lande. Derudover har eksempelvis Dworak, Berglund et al. (2009) fokuseret mere specifikt på anvendelsen af randzoner i forskellige europæiske lande. Der er også foretaget en række sammenlignende studier af mere teknisk karakter, senest eksempelvis (Ibisch, Austnes et al. 2016).

I nærværende rapport har vi bygget videre på disse studier. Desktop-studiet giver derved et overblik over de virkemidler, der er bragt i anvendelse i de undersøgte lande. Tabel 1 viser en oversigt over de forskellige virkemidler, der findes i de undersøgte lande, men det er vigtigt at være opmærksom på, at de enkelte virkemidler ikke er defineret på samme vis i de forskellige lande og regioner. En fuld oversigt over hvordan de forskellige virkemidler er defineret for hvert land findes i landebeskrivelserne, se Bilag 2-8.

Tabel 1: Oversigt over hvilke virkemidler der anvendes i de seks undersøgte lande. X indikerer, at virkemidlet er i brug, - indikerer at det ikke er i brug, () indikere at virkemidlet de facto er i anvendelse, snart indføres eller bruges i begrænset omfang. Tomme felter indikerer, at vi ikke har været i stand til at fremskaffe præcis dokumentation for den præcise status for disse virkemidler.

	Danmark	Sverige	Schleswig-Holstein	Nieder-sachsen	Holland	Polen	Bretagne
Fosforlofter	(X)	X	X	X	X	-	(X[1])
Krav til opbevaring af husdyrgødning	X	X	X	X	X	X	X
Efterafgrøder	X	X	X	X	X	X	X
Flerårige energiafgrøder	X	X				-	(x)
Brak (ikke permanent udtagning)	X	X	X	X		-	-
Forbud mod jordbearbejdning i visse perioder	X	X	X	X	-	X	X
Permanent udtagning	X	X	?	?	-	X	-
Randzoner	X	X	X	X	(X[2])	X	X
Skovrejsning	X	-	X	X	-	-	-
Kontrolleret dræning	(X)[3]	X	-	-	(X[4])	-	-
Minivådområder med overfladisk afstrømning	(X)[3]	-	-	-	-	-	-
Minivådområder med filtermatrice	(X)[3]	X	-	-	-	-	-
Vådområder	X	X	X[5]	X[5]	X	-	X[6]
Dobbeltprofil/ Våde randzoner	-	X	Ét test sted	Ét test sted	(X)	-	X

3.1 Udbredelsen af forskellige virkemidler

Ved at sammenholde den række af virkemidler, der findes i de forskellige lande, er det værd at fremhæve:

[1] Loftet fungerer som et krav om et minimums areal for spredning af husdyrgødning, det er ikke et fuldt loft over alle typer af P input.
[2] Kun obligatorisk for opstrøms bækløb.
[3] Under godkendelse.
[4] Findes som praksis og muligt virkemiddel, men ikke som generelt indarbejdet politik.

[5] I praksis er der kun gennemført et par enkelte vådområdeprojekter I det nordlige Tyskland fordi der er forbud mod større landskabelige ændringer, hvilket gør det svært at få projekter godkendt.
[6] Primært I betydningen beskyttelse af eksisterende vådområder.

Der er stort set ikke identificeret andre virkemidler, end dem der allerede anvendes i Danmark, dog med følgende undtagelser: 1) Våde randzoner benyttes i begrænset udstrækning i Sverige og Holland primært mod oversvømmelser og erosionstab. I Holland bruges våde randzoner kun i enkelte deloplande, og i Sverige er det ikke blevet en stor succes på grund af brinkerosion. 2) Kontrolleret dræning. Virkemidlet er angiveligt ikke blevet en stor succes i Sverige på grund for meget relief, uegnede jordtyper, frygt for tilstopning og ødelæggelse af dræn. 3) Minivådområder med filtermatrice, der er blevet anvendt i Sverige i begrænset omfang og nu også er under godkendelse i Danmark. Der er således generelt ikke andre af de undersøgte lande og regioner hvor der arbejdes med flere virkemidler end dem, der anvendes i Danmark – de fleste har faktisk ikke samme adgang til virkemidler.

Der er ikke andre af de undersøgte lande og regioner, der i samme grad som i Danmark i øjeblikket arbejder med at udvikle og dokumentere nye virkemidler til reduktion af nærringsstoftabet, særligt uden for dyrkningsfladen. Helt generelt findes der for alle de undersøgte lande og regioner en grad af målretning i de virkemidler, der anvendes, hvor eksempelvis kvælstofnormer alle steder er tilpasset forskellige faktorer (jordtype, nedbør, afgrødetype, forfrugt ol.). Samtidig gør det sig gældende for alle de undersøgte lande, at der er en række virkemidler, der udelukkende kan implementeres på lokaliteter, hvor der er sket en sårbarhedsudpegning, eksempelvis reducerede gødningsnormer, økologisk drift, udbringningskrav for husdyrgødning, efterafgrøder og randzoner. Derudover er der en række virkemidler, der i kraft af deres virkemåde er geografisk differentieret, eksempelvis randzoner og vådområder, der naturligt kun kan placeres langs vandløb.

Randzoner er et virkemiddel, der er implementeret meget forskelligt i de undersøgte lande (Tabel 2). Eksemplerne med de forskellige krav til randzoner illustrerer, dels hvordan virkemidler tilpasses lokale omstændigheder dels vanskelighederne ved at lave en sammenligning af virkemidler på tværs af forskellige lande og regioner. I Bilag 2-8 findes en oversigt over, hvordan virkemidlerne forstås og defineres i de forskellige områder.

Tabel 2: Specifikationer for randzoner i de undersøgte lande og regioner.

Bretagne	Danmark	Holland	Schleswig-Holstein og Niedersachsen	Sverige	Polen
Randzoner skal være mindst 5 m men kan udvides til 10 m afhængig af diger, flora, etc.	2 m brædder er et generelt krav i forhold til Vandløbsloven, og frivillige randzoner er et frivilligt virkemiddel med varierende bredde på 9-20 m, i forhold til plantedækkebekendtgørelsen § 8	Der findes en lang række af forskellige kategorier og randzonebredden varierer mellem 25 cm og 2 m blandt andet afhængig af afgrøder og må ikke gødes.	Randzoner skal være mindst 3 m fra søer og vandløb (dog kun 1 m, hvis der bruges præcisionsudstyr som slæbeslange og gylle injektion) og op til 30 m i bredden. Kan variere på forskellige steder eksempelvis langs meandrerende vandløb. Landbrugsproduktion i randzonen er ikke tilladt, men det er tilladt at høste vegetationen og afgræsse.	Randzoner kan være 6-30 m brede og 1) græsbevoksede der høstes, 2) græsbevoksede der ikke høstes og 3) tilpassede zoner langs diger, erosionsflader inden for marken, langs brønde og vandområder. For at modtage støtte skal randzonerne placeres indenfor nitratfølsomme områder.	Randzoner skal være 2-5 m brede i intensivt dyrkede oplande. Der må plantes og høstes to gange årligt. Randzonen skal være mindst 50 m lang, for at der kan ansøges om støtte.

3.2 Drivkræfter for valg af virkemidler i næringsstofforvaltningen

De undersøgte lande har et ret forskelligt fokus i deres næringsstofindsats. Dette bunder dels i en forskellig landbrugsstruktur, landbrugs- og husdyrtæthed, samt jordbunds og klimatiske faktorer, dels i miljøtilstanden for de vandområder, der grænser op til de pågældende områder samt de naturgeografiske faktorer (afstanden fra mark til fjorde og kystvande). Derudover har hver enkelt land en forskellig administrativ historie og struktur, der giver en række forskelle i forhold til, hvordan virkemidler fastsættes, belyses og godkendes. De forskelle, der findes på tværs af de undersøgte lande, er derfor en blanding af forskellige administrative strukturer, forskellige indsatsbehov og forskellige tilgange til reduktion af næringsstoftab (Tabel 3). Dette medfører, at det er udfordrende at sammenligne reguleringen på tværs af de undersøgte lande, fordi det er forskellige miljøudfordringer og forskellige direktivforpligtelser, der driver forvaltningen i de forskellige områder.

Tabel 3: Centrale udfordringer i næringsstofforvaltningen (ND= Nitratdirektivet, VRD= Vandrammedirektivet, Helcom= Helsinki kommissionen, Baltic Marine Environment Protection Commission).

Bretagne	**Danmark**	**Holland**	**Schleswig-Holstein og Niedersachsen**	**Sverige**	**Polen**
Udfordringer primært I forhold til stor husdyrtæthed og stort næringsstof-overskud. Udfordringer i forhold til implementering af ND og VRD.	Primært fokus på implementeringen af VRD. Stor landbrugstæthed og nærhed til næringsstoffølsomme recipienter. N er den primære udfordring.	Primært fokus på implementeringen af VRD, men ND volder også problemer. Stor landbrugstæthed og nylig vækst i dyretætheden.	Minimering af et betydeligt næringsstof-overskud på husdyrbedrifter. Både ND og VRD. Kravene til grundvandsovervågningen er for nyligt genfortolket, og der er nu stort fokus på reducering af nitrat i grundvandet	Arbejder i dag primært i forhold til implementering af Helcom og VRD. P skønnes at være den største udfordring på grund af mange søer og afvanding til den Botniske bugt.	Håndtering af husdyrgødning og et stort antal små produktionsenheder. ND, VRD og HELCOM. Der er en del udfordringer i forhold til den polske implementering af direktiverne.

I medfør af ND og VRD er der udarbejdet fælles krav vedrørende overvågning, og tilskyndelsesprocedurer i forhold til involvering af interessenter i planlægningen. Dette har medført oprettelsen af en række nye institutioner, blandt andet vandråd, der således findes i alle de undersøgte lande, men som fungerer forskelligt (Tabel 4). Det varierer blandt andet, i hvor høj grad andre aktører end landbruget (som grundejere) er involverede i disse institutioner, i hvor høj grad vandrådenes arbejde er centralt koordineret og i hvor høj grad vandrådene i sig selv er i stand til at igangsætte og forhandle virkemidler.

Tabel 4: Institutionelle forskelle i vandrådene på tværs af de undersøgte lande og regioner

Bretagne	**Danmark**	**Holland**	**Schleswig-Holstein og Niedersachsen**	**Sverige**	**Polen**
Implementeret som CLE, er en lokal forankret institution, der på forskellig vis arbejder med forhandlingsplanlagte løsninger i oplande i medfør af VRD.	Vandråd er blevet nedsat som et tidsbegrænset konsultations-forum ifbm. arbejdet med første generation af vandområdeplaner. I første generation vandområdeplaner er vandrådenes arbejde fokuseret på samarbejde omkring forbedring af vandløbs fysiske tilstand og ikke direkte næringsstof forvaltning som i andre lande. Vandrådenes aktiviteter er centralt koordineret.	Vandforvaltning har en lang tradition i Holland, hvor vandråd er en folkevalgt og decentral myndighed, der har ansvaret for den lokale vandforvaltning. Traditionelt primært i forhold til mængden af vand, men nu udvidet til at omfatte vandkvaliteten. Vandrådene har blandt andet lovgivnings myndighed.	Schleswig-Holstein og Niedersachsen har en lang tradition for vandråd organiseret af grundejere mhp. afvanding. I forbindelse med regeringsskifte i 2012 blev der nedsat en central vandforvaltningsalliance bestående af de centrale aktører på national skala og en række mindre alliancer med udgangspunkt i del- oplandene til arbejdet med vandområdeplaner, som konsultations- og formidlingsforum.	Visse kommuner har i omkring 30 år arbejdet med at samle centrale aktører i vandråd, hvor det har været en succesfuld institution med stor lokal forankring. I dag er vandråd etableret ifm. udarbejdelsen af vandområdeplaner, men arbejdet er meget afhængig af det lokale engagement.	På national skala er der oprettet et nationalt og regionale vandråd (Prezes Krajowego Zarządu Gospodarki Wodnej) og Regionalny Zarząd Gospodarki Wodnej), der fungerer som rådgivende enhed og er ansvarlig for inddragelse af offentligheden i den nationale beslutningstagning. Disse er placeret i relation til myndigheden "Polsk Vand" (Panstwowe Gospodarstwo Wodne "Wody Polskie")

De enkelte lande har hver deres egen reguleringsstil, der er dybt rodfæstet i nationalt specifikke juridiske, politiske og administrative institutioner og kulturer (Van Waarden 1995). På trods af det fælles rammeværk, der på EU-niveau fastlægger ambitionerne i miljøplanlægningen i de enkelte lande, er der således stor forskel på, hvordan dette i praksis udmøntes, herunder både hvilke nationale målsætninger, der vedtages, hvilke virkemidler der bringes i anvendelse i forhold til at opnå målsætningerne, samt hvilke mekanismer der vælges i forhold til implementering af virkemidlerne.

Ud over Sverige, hvor landbrug ikke fylder så meget i arealanvendelsen (8%), er den primære udfordring for næringsstofforvaltningen i de andre undersøgte lande at håndtere husdyrgødning. Det er således også i forhold til håndtering af husdyrgødningen, at det største fokus i næringsstofplanlægningen findes (forbedring af udnyttelsesprocenter, sikring mod tab via overdækning af gyllebeholdere, nedfældning og udbringningstidspunkter), men også i forhold til etablering af institutioner til håndteringen af miljøreglerne (Polen) og bedre bedriftsovervågning (Schleswig-Holstein og Niedersachsen). Der er således i de senere år bl.a. på baggrund af EU's traktatkrænkelsessager sket store ændringer i særligt Holland, Schleswig-Holstein og Niedersachsen, i forhold til hvordan husdyrgødningen skal håndteres på landbrugsbedrifterne, indberettes og kontrolleres af myndighederne. Her ses der mod Danmark som et eksempel på "god praksis" hos myndighederne.

I flere af de undersøgte lande, hvor der tidligere har været problemer med efterlevelse af EU's direktiver, kan det konstateres, at der i øjeblikket sker øget kapacitetsopbygning i forhold til ambitionerne i EU's direktiver, blandt andet i Polen, Frankrig, Schleswig-Holstein og Niedersachsen. Dette kommer blandt andet til udtryk i en nylig udvidelse af nitratfølsomme områder i både Polen, Sverige og Frankrig. Det må samtidig understreges, at den forbedring, der er sket af miljøreguleringen, ikke nødvendigvis er tilstrækkelig til at opfylde de enkelte landes direktivforpligtelser. EU Kommissionen foretager således i øjeblikket vurderinger af traktatbrud for en række af de undersøgte lande. Det er særligt i relation til produktion, håndtering og dokumentation af anvendelsen af husdyrgødning, at der er udfordringer i de undersøgte nabolande.

Overordnet set er der i Danmark lagt stor vægt på afgrødekvælstofnormer og maksimering af udnyttelsesprocenten af husdyrgødning. Til sammenligning er der i eksempelvis Schleswig-Holstein og Niedersachsen et endnu ikke fuldt implementeret system bygget op omkring bedriftsbalancer. I Holland, hvor der generelt er høje udnyttelsesprocenter og et velfungerende normsystem for husdyrgødning, er der et system, hvor husdyrproduktionen er afkoblet produktionsarealet. Det betyder, at der i Holland i øjeblikket arbejdes med at indføre omsættelige produktionsrettigheder med henblik på at nedbringe dyretætheden med det der svarer til omkring 150.000 malkekøer; en udfordring der de senere år er øget blandt andet efter ophøret af mælkekvoten (Grinsven and Bleeker 2017).

4. Godkendelsesprocedure for virkemidler

Ingen af de undersøgte lande har en fastlagt procedure for godkendelse af virkemidler. Generelt set har godkendelsesproceduren for hvert enkelt virkemiddel været behandlet særskilt ved, at en uvildig videnskabelig rådgiver har udarbejdet et dokumentationsgrundlag, hvori virkemidlernes effekt og sikkerhed er vurderet for det specifikke virkemiddel i et givent område (Tabel 5).

Tabel 5: Rådgivning i forbindelse med myndighedsbetjeningen i de undersøgte lande og regioner.

Bretagne	**Danmark**	**Holland**	**Schleswig-Holstein og Niedersachsen**	**Sverige**	**Polen**
I Frankrig udføres myndighedsbetjeningen ofte af tekniske forskningsinstitutterne (eksempelvis de regionale afdelinger af INRA), der er finansieret via en landbrugsskat. Der er ikke nødvendigvis et direkte link til den aktive forskning, der foregår på universiteterne.	DCE og DCA, der er en del af Aarhus Universitet rådgiver regeringen om landbrugs- og fødevare relaterede problematikker og er ansvarlig for udførelse af eksperimentelt arbejde	Rådgivningen forestås dels af den uafhængige "Scientific Committee of the Manure Act (CDM)" der er sammensat af forskellige eksperter fra universiteterne og det uafhængige miljøpolitik vurderingsinstitut PBL.	På forbundsniveau sker der en rådgivning via to videnskabelige råd, der er nedsat under Landbrugs- og Fødevareministeriet 1) "The Scientific Advisory Board on Agricultural Policy", samt 2) "The Scientific Advisory Board on Fertilizer Issues", der begge består af universitetsansatte eksperter. På delstatsniveau foretages rådgivningen ad hoc efter aftale med lokale universiteter.	Forskningsaktiviteter i relation til virkemidler gennemføres primært af Sveriges Landbrugs Universtitet (SLU), samt en række andre offentlige vidensinstitutioner. Derudover forvalter SLU en national database over virkemidler (viss.se) og forestår forsøg på fire forskellige feltstationer, karakteristisk for forskellige klima og georegioner.	Landbrugsfaglig forskning usføres af "The Institute of Soil Science and Plant Cultivation (IUNG)" og "Institute of Technology and Life Sciences (ITP)" begge under Ministeriet for Landbrug og regional udvikling. Institutionerne er involverede i en lang række aktiviter i relation til landbrug og miljøbeskyttelse, herunder rådgivning, og uddannelse af landmænd. Derudover, vurderes omkostninger af policy af "The Institute of Agricultural and Food Economics (Instytut Ekonomiki Rolnej), baseret på register data.

På tværs af de undersøgte lande er der forskel på, hvilken kommandovej der gælder for myndighedsrådgivningen. I Holland er forskningsaktiviteter i relation til myndighedsopgaver ligesom i Danmark ofte bundet sammen med myndighedsbetjeningen. Samtidig er der i Holland i lighed med Tyskland (og Frankrig – ad hoc, men nu afsluttet) oprettet et nationalt råd, bestående af forskere, primært professorer fra de relevante universiteter, der stilles opgaver af parlamentet, og som i løsningen af opgaverne trækker på kompetencer i deres bagland. Rådene i både Holland og Tyskland fungerer i en vis udstrækning autonomt fra myndighederne og regeringen og kan blandt andet selv tage initiativ til igangsætning af undersøgelser. Der kan være både fordele og ulemper ved at anvende et råd af eksperter. Rådene sikrer på den ene side, at samfundsrelevante temaer kan blive belyst uafhængigt af den politiske kurs, der lægges af skiftende regeringer. På den anden side kan der også være en tendens til, at spørgsmål belyses uden om centrale forskere, der ellers arbejder med området. For at

et sådant råd skal være succesfuldt, indikerer erfaringer fra både Tyskland og Holland, at det er nødvendigt at sammensætte rådene med en lang række forskellige kompetenceprofiler, men at det derved kan være svært for rådet at besvare stillede spørgsmål entydigt.

Dokumentationskrav fastsættes ud fra en konkret vurdering af de miljømæssige- og økonomiske effekter, usikkerhederne for hvert enkelt virkemiddel, samt den i forvejen tilgængelige viden af virkemidlers effekt. Herunder inddragelse af repræsentativitet i forhold til landbrugssystemer, forsøgsgentagelser, dokumentationstid ol. Det betyder, at virkemidlerne til en vis udstrækning bliver tilpasset de lokale dyrkningssystemer, jordtyper og klimatiske faktorer, der gør sig gældende i de enkelte regioner. Et godt eksempel på dette er gødningsnormerne, der varierer meget fra område til område afhængig af afgrøde, jordtype, klima og forfrugt. Det rapporteres, at der anvendes en række forskellige metoder til afprøvning og dokumentation af virkemidlerne, herunder både forsøg, modellering og litteratur review til dokumentation af virkemidlernes effekt. Hvor stor en effekt bestemte virkemidler vurderes at have, afhænger således af de nationale data (der beregnes f.eks. en stor N-relateret eftervirkning af efterafgrøder i DK sammenlignet med andre lande, eksempelvis Sverige, hvor der er større fokus på P-virkemidler).

Afhængigt af hvilket virkemiddel der er tale om, vil der ske en afprøvning på forskellige forsøgsstationer, testgårde eller i *real life settings*, der er placerede repræsentativt i forhold til bestemte klima- og geo-regioner og dyrkningssystemer. Her er det imidlertid vigtigt at understrege, at der samtidig også bliver taget højde for allerede eksisterende viden på området og testresultater fra andre områder. Der rapporteres dog generelt om en nedgang i bevillingerne til gennemførsel af nye målrettede markforsøg, og der er for de fleste landes vedkommende sket en reduktion i antallet af forsøgsstationer.

Der er således på tværs af de undersøgte lande forskel på, hvad der er grundlaget for rådgivningen til myndighederne. Hvor nogle områder, eksempelvis Schleswig-Holstein, Niedersachsen og Sverige, anvender modelgårde og forsøgsstationer, anvendes der i Danmark og Holland i højere grad forskelligartede markforsøg spredt over hele landet kombineret med målinger på forsøgsanlæg. Det er svært at sige noget konkret om, hvilken indflydelse dette har på de forskningsresultater, der produceres, fordi der kun i beskedent omfang er gennemført sammenlignende studier, og disse er af ældre dato.

Nærværende rapport har ikke systematisk belyst, om der er forskelle i den konkrete vurdering af hver enkelt virkemiddel, der er blevet foretaget, eller om bestemte virkemidler er dokumenteret med et forskelligartet grundlag i de undersøgte lande. En sådan undersøgelse vil kræve et mere indgående fokus på bestemte virkemidler og vanskeliggøres også af, at der ikke i de andre undersøgte regioner er tradition for at samle den tilgængelige viden i hvidbøger, som man har gjort i Danmark med virkemiddelkatalogerne (Eriksen, Nordemann Jensen et al. 2014). Samtidig publiceres undersøgelser af forskellige virkemidler ikke nødvendigvis i den internationale forskningslitteratur, men publiceres i stedet som tekniske rapporter på nationalsprog. En samling og vurdering af dette materiale er således en meget omfattende opgave.

Den nuværende struktur for myndighedsbetjeningen i Danmark er centreret om en meget kort afstand mellem myndigheden og den videnskabelige rådgivning, hvilket sikrer en tæt kontakt og præcis rådgivning i forhold til de problematikker, der skal belyses og en hurtig overførsel af viden. Ud over Sverige er der ikke andre lande, hvor afstanden for kommunikation mellem viden-institutioner og myndigheder er så kort og direkte som i Danmark. Samtidig er der en forskel på, hvilken tidshorisont der opereres ud fra hos de forskellige myndigheder, og hvor grundigt virkemidler skal belyses videnskabeligt set for at blive politisk godkendt. I Danmark er der en tradition for først at implementere virkemidler efter en grundig afprøvning, hvorefter det udrulles på national skala. I Sverige er der eksempelvis en tilgang til reguleringen hvor, nye virkemidler implementeres, før deres effekt er fuldt dokumenteret med udgangspunkt i egentlige markforsøg og følge implementeringen op med et måle og dokumentationsprogram. På den ene side giver det den fordel, at nye virkemidler hurtigt introduceres og afprøves i praksis, men samtidig også den ulempe at virkemidler implementeres før det er videnskabeligt dokumenteret, at de fungerer efter hensigten, hvilket kan give et ressourcespild, hvis den forventede virkning ikke kan dokumenteres. Informanter således indikeret at eksempelvis kontrolleret dræning og våde randzoner i Sverige ikke har opfyldt forventningerne.

Det er imidlertid også vigtigt at understrege, at godkendelsen af virkemidler også er politisk. Med udgangspunkt i det videnskabelige grundlag sker der i alle lande efterfølgende en politisk behandling af virkemidlerne. Her besluttes, hvorvidt og hvordan det enkelte virkemiddel skal implementeres. Den konkrete effektvurdering foretages i alle tilfælde af forskere, men det er i sidste ende et politisk valg, hvordan videnskabelig usikkerhed skal håndteres, om der skal igangsættes nye undersøgelser, og i hvor høj grad der skal medregnes synergieffekter ud over de snævre næringsstofeffekter (fx afledte biodiversitetseffekter). Det sker således i enkelte situationer, at disse synergieffekter inkluderes kvalitativt. Interviewundersøgelsen indikerer, at virkemidler ofte også har en samfundsmæssig betydning, der rækker ud over fjernelsen og/eller udnyttelsen af næringsstoffer, både for landmanden, i form af indflydelse på interne arbejdsgange, produktion og økonomi og for samfundet som helhed i form af påvirkning af eksempelvis biodiversitet og klima. I Danmark har eksempelvis "randzoner" som alternativ til efterafgrøder en relativ fordelagtig omregningsfaktor, idet randzoner har flere synergieffekter end efterafgrøder (P, klima, pesticider). Denne vurdering er dog ikke ens i de undersøgte lande og denne undersøgelse indikerer, at disse synergieffekter, ud over N og P effekterne, ikke inkluderes systematisk i behandlingen og dokumentationen af virkemidlernes effekter.

4.1 Interessentinddragelse i arbejdet med virkemidler

På tværs af de undersøgte lande er der forskel på, hvordan interessenter bliver inddraget i udviklingen og implementeringen af virkemidler. En række af de undersøgte regioner, herunder Holland, Schleswig-Holstein, Niedersachsen og Bretagne, har i en årrække (også før indførelsen af vandrammedirektivet) anvendt "råd" som et generelt instrument i planlægningen. Samtidig er der andre lande, hvor vandrådsinstitutionen er en forholdsvis ny konstruktion. Der er imidlertid stor forskel på, hvordan medlemmer til vandråd udpeges. Hvor det i Holland eksempelvis sker via demokratiske valg, sker det andre steder i kraft af grundeje, organisationers eller frivilliges deltagelse (Danmark og Sverige). Der er derfor også stor forskel på, hvilke kompetencer og beføjelser

der er overdraget til vandrådene, og der er stor forskel på den borgerinddragelse, der finder sted i forbindelse med implementeringen (og i nogle tilfælde også i afprøvningen) af virkemidlerne.

Derudover indikerer undersøgelsen, at det er centralt, at der i implementeringen arbejdes med landmandens motivation i forhold til virkemidlerne. Der er stor forskel på, hvordan de enkelte lande har grebet denne indsats an (Tabel 6). Danmark og Holland har eksempelvis en høj grad af statslig koordinering af aktiviteterne (*top down*), hvorimod eksempelvis Bretagne, Sverige, Schleswig-Holstein og Niedersachsen har en mere forhandlingspræget tilgang, hvor fokus er rettet mod at skabe opbakning nedefra (*bottom up*).

Tabel 6: Reguleringsstilen i de undersøgte lande og regioner med udgangspunkt i Van Waarden (1995), for uddybning se Bilag 2-8.

Bretagne	**Danmark**	**Holland**	**Schleswig-Holstein og Niedersachsen**	**Sverige**	**Polen**
Legalistisk og helheds-orienteret tilgang, der lægger vægt på initiativer igangsat og kontrolleret af staten.	Proaktiv og kollaborativ tilgang til policy design, med interessent repræsentation. I valget af virkemidler traditionelt stor fokus på regulative indgreb, men med mulighed for ny tilgang ifm. målrettet regulering.	Inkrementielle forhandlingsplanlagte tiltag og lokalt tilpassede løsninger, men også, med aktive helhedsorienterede regulative indgreb.	Reaktiv og paternalistisk tilgang hvor løsninger udvikles i konsensus med udvalgte interessenter og med et fokus på at selvforvaltning blandt landmænd og deres interesseorganisationer.	Proaktiv bottom-up tilgang, med et stærkt fokus på lokalt tilpassede løsninger, selvforvaltning og implementeringen af frivillige tiltag. Stærke og selvstændige styrelser.	Reaktiv top-down tilgang, der er stærkt hierakisk i policy design og implementering (historisk set uden stor fokus på miljøproblematikker, men mere på produktivitetsforbedringer).

I forhold til at inddrage interessenter findes der forskellige erfaringer med, hvordan denne udfordring er løst i de forskellige undersøgte lande. I begge de undersøgte tyske delstater er der blevet oprettet en statslig alliance bestående af omkring 40 forskellige interessenter, herunder både landbrugsorganisationer, myndigheder, lokale vandråd og miljøorganisationer. Alliancen koordineres af det lokale landbrugs- og fødevareministerium og giver mulighed for, at myndighederne kan føre en aktiv men også uformel dialog med de interessenter der har en interesse i arealanvendelsen i det åbne land. I Bretagne, Holland og Sverige arbejdes der særligt med udgangspunkt i de enkelte deloplande, hvor interessenter inddrages i vandråd. På tværs af de undersøgte lande og regioner er der imidlertid stor forskel på hvad et vandråd er og hvor stor beslutningskompetence der er overdraget til vandrådene og her er det særligt Danmark der skiller sig ud i kraft af vandråd med en tidsbegrænset levetid, en central koordinering af aktiviteter og et fokus på vandløbsforvaltning (og altså ikke direkte nærringsstofforvaltning). I Sverige har der, særligt i den sydlige del, været tradition for anvendelsen af vandråd siden midten af 1990'erne, hvor disse har været en aktiv og vigtig spiller i den lokale vandforvaltning, der har været organiseret af kommunerne, hvor de har haft selvstændige budgetter og mulighed for at ansøge om projektbevillinger til forskellige tiltag. Derudover er der i medfør af VRD i Sverige indført nye vandråd, men der er stor forskel på, hvor aktive vandrådene er, afhængigt at oplandet, hvor nogle vandråd er

meget aktive er andre næsten ikke synlige. Derudover har de ikke nogen egentlig forvaltningsmæssig beslutningskraft, og det er således meget forskelligt, hvor succesfuldt det fungerer.

5. Sammenfattende vurdering og anbefalinger

Dette afsnit opsummerer indledningsvist rapportens konklusioner indtil videre og de ideer til en eventuel hurtigere indfasning af nye lovende virkemidler, som er blevet opsamlet gennem workshoppen med DCA's forskere, der arbejder med myndighedsbetjening.

5.1 Sammenfatning

Overordnet set kan det på baggrund af rapportens undersøgelser konkluderes, at ingen af de undersøgte lande har en på forhånd fastlagt procedure for godkendelsen af virkemidler. Undersøgelserne indikerer heller ikke, at der er en stor forskel på tværs af landene i forhold til, hvilke virkemidler der er tilgængelige i næringsstofforvaltningen. På baggrund af nærværende studie kan der ikke dokumenteres en generelt hurtigere og mere præcis godkendelsesprocedure i andre af de undersøgte lande i forhold til Danmark. Der kan imidlertid påpeges forskelle i forhold til, hvordan de enkelte lande arbejder med virkemidler. Der er eksempelvis ikke andre af de undersøgte regioner, der i samme grad arbejder med at målrette virkemidler uden for dyrkningsfladen for at nå målsætningen i VRD, som vi gør i Danmark.

Hvor der tidligere har været en forskel på de krav, der stilles til landmænd i forhold til næringsstofhåndtering i de forskellige lande, sker der i øjeblikket en opstramning af næringsstofforvaltningen i en række af de undersøgte lande. Der er dog stadig betydelige forskelle mellem landene. Hvorvidt den opstramning der er sket er tilstrækkelig til, at de undersøgte lande kan leve op til bestemmelserne i ND og VRD er dog endnu for tidligt at sige. Den indsats der i øjeblikket iværksættes i de undersøgte nabolande omhandler primært håndtering og produktion af husdyrgødning, hvilket anses som den primære udfordring. De virkemidler, der i øjeblikket implementeres i eksempelvis Schleswig-Holstein, Niedersachsen, Bretagne og Holland, er således centreret omkring at nedbringe produktionen af husdyrgødning og forbedre udnyttelsen heraf i marken, dokumenteret gennem gødningsregnskaber, indberetninger og bedre kontrol med udvekslingen af gødning mellem bedrifter (Bretagne, Schleswig-Holstein og Niedersachsen), og reduktion af husdyrtrykket (Holland).

5.2 Konklusioner og anbefalinger

Godkendelse af virkemidler en proces, der både inkluderer en forskningsmæssig dokumentation af virkemidlernes effekt og en politisk behandling af virkemidlet. Formålet med den forskningsmæssige dokumentation er grundlæggende at understøtte beslutningstagning vedrørende virkemidlerne på så veloplyst et grundlag som muligt for derved at maksimere udbyttet af virkemidlerne ved at sikre den mest hensigtsmæssige placering og implementering af disse, og en minimering af ressourceforbruget.

På baggrund af nærværende rapport kan der ikke dokumenteres en generel procedure til godkendelse af virkemidler i de undersøgte nabolande, eller en hurtigere og mere præcis dokumentationsproces i forhold til i Danmark. Det er her vigtigt at understrege, at den væsentligste del af tidsforbruget i forbindelse med godkendelsen af virkemidler stammer fra opnåelse af tilstrækkeligt datagrundlag for virkemidlernes effekt. Tidsforbruget er her en direkte funktion af dokumentationskravene. Det er væsentligt at understrege, at en hurtigere

godkendelsesprocedure ikke bør medføre, at der slækkes på dokumentationskravene. En mindre grundig godkendelsesprocedure vil kunne medføre, at der implementeres virkemidler, der ikke har en effekt, der lever op til forventningerne, at omkostningseffektivitetsberegninger bliver uprøcise, eller at virkemidler implementeres på lokaliteter, hvor de ikke har en tilstrækkelig effekt. Præmissen for vores anbefalinger har således været, at en hurtigere godkendelsesprocedure ikke må resultere i de nævnte uheldige virkninger af en dårligere godkendelsesprocedure.

Ud over ovennævnte kan der gives følgende anbefalinger for implementering af virkemidler. Anbefalingerne stammer primært fra en intern arbejdsworkshop i AGRO, AU, organiseret som et led i projektet om nabotjek:

1. **Integration af forskellige synergieffekter.** Virkemidler har ofte en række effekter ud over det næringsstofreducerende, på eksempelvis klima og biodiversitet, som i en vis udstrækning, men ikke nødvendigvis altid inddrages i dokumentationen og implementeringen af virkemidlet. Det vurderes, at en bedre dokumentation af forskellige synergieffekter i vurderingen af virkemidlerne dels vil lette arbejdet med at opfylde overordnede målsætninger på andre indsatsområder og samtidig gøre det attraktivt for landmænd at deltage. Det bør samtidig understreges, at der i både godkendelse og implementering af virkemidlerne bør fokuseres på synergien mellem forskellige virkemidler i relation til kvælstofudvaskningen. Virkemidlerne bør derfor indtænkes i en samlet strategi for et opland, således at de ikke hver i sær underminerer hinandens effekt og omkostningseffektivitet. *Synergier og trade-offs* bliver ofte behandlet overfladisk i den eksisterende godkendelsesprocedure. Det er væsentligt at samtænke virkemidlernes effekt så tidligt som muligt i udarbejdelses- og dokumentationsfasen, således at der tilvejebringes et tilstrækkeligt datagrundlag der også beskriver væsentlige sideeffekter, hvilket er svært, når antagelser er sat på forhånd inden inddragelse. Isoleret set vil det ikke føre til en hurtigere godkendelse af virkemidler, men i det lange løb vil det reducere ressourceforbruget og udfordringer i implementeringsfasen.

2. **Aktiv dialog med interessenter.** Den nye målrettede regulering kommer til at øge behovet for innovative og lokalt tilpassede løsninger. Nærværende rapport indikerer, at der findes en række gode erfaringer i arbejdet med forskellige former for vandråd på forskellige reguleringsskalaer blandt de undersøgte lande. I Schleswig-Holstein og Niedersachsen er der eksempelvis oprettet en national alliance for vandanvendelse på statsniveau bestående af en lang række af forskellige interessenter, til løbende dialog, koordinering af indsats og informationsudveksling (se bilag 2). I lyset af disse erfaringer vil det kunne være hensigtsmæssigt med en systematisk indsamling af ønsker (fx SEGES alternative virkemiddelkatalog), idet forskningsinstitutionerne ikke altid har fuldt overblik over de løsninger, der arbejdes med i erhvervets regi. Samtidig vil en løbende aktiv dialog med interessenterne sikre, at undersøgelsen af nye ideer til virkemidler hurtigt kan koordineres, afprøves og eventuelt bringes i anvendelse.

3. **Formaliseret tværnationalt samarbejde.** På nuværende tidspunkt sker der ikke nogen formel koordinering af arbejdet med virkemidler blandt EU lande i forhold til implementeringen af EU's direktiver, og herunder

ikke nogen systematisk samling af dokumentationen eller erfaringer, inspiration til nye virkemidler ol. på samme måde, som der eksempelvis findes i HELCOM regi. Dog er der gode erfaringer fra tværnationalt samarbejde i EU projekter og COST action programmer (se fx http://www.cost869.alterra.nl/Fs/List_of_options.htm#LS_production), og opfølgende uformelle fora, men der er er ikke etableret nogen formel systematiseret procedure for opsamling og inkludering af udenlandske erfaringer og forsøg med virkemidler. En mere formaliseret koordinering vil kunne sikre en mere ensartet tilgang til dokumentation af virkemidler på tværs af medlemslandene samt sikre, at eksisterende viden, der ikke altid er publiceret internationalt, inddrages i vurdering og godkendelse af nye virkemidler. Det skønnes, at et mere formaliseret samarbejde vil sikre en større grad af data- og erfaringsudveksling på tværs af de deltagende lande og dermed sikre, at udenlandske erfaringer hurtigere vil kunne bringes i anvendelse i dansk sammenhæng i det omfang, at resultaterne er relevante.

4. **Ikke fast godkendelsesprocedure.** Der er ikke nogen af de undersøgte lande, der anvender en fast procedure for godkendelse af virkemidler, men godkendelsesproceduren tilpasses på forskelligvis til den eksisterende viden, lokale institutionelle- miljø- og klimatiske forhold. Baseret på rapportens undersøgelser kan det ikke anbefales, at der generelt fastlægges en fast procedure for godkendelse af virkemidler, da virkemidlerne ofte er meget forskellige, og da der således også er et ret forskelligt dokumentationsbehov for at vurdere virkemidlernes effekt og usikkerhed.

6. Kilder

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Bilagsrapport til:
DCA rapport Nabotjek af kvælstof- og fosforvirkemidler

Annex 1
Informanter i undersøgelsen

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Annex 2
Country report - Denmark

Contents

1. Context

Historically farming in Denmark is an important industry and accounts for a significant share of the total landuse (approx. 2.6 million hectares in 2013, corresponding to 62 % of Denmark's total area. However, the area allocated for agricultural production has declined 8 % since 1982.

In the past 100 years a significant expansion of Danish agricultural production has taken place, which has led to a corresponding increase in agricultural Nitrogen (N) surpluses, and an increased N leaching (Hansen, Thorling et al. 2010, Dalgaard, Hansen et al. 2014). The nutrient leaching is not evenly distributed throughout the country, but particularly in the western and northern part has a significantly higher rate of nutrient leaching due to higher livestock density, prevalence of sandy soils and more precipitation, see figure 2. Furthermore, due to the prevalence of a short distance from fields to surface waters, a 7500 km long coastline with shallow estuaries and coastal waters, this has resulted in severe environmental problems, and according to the EU Nitrate Directive, Denmark has designated the whole territory as nitrate vulnerable (Hellsten, Dalgaard et al. 2017 (Forthcomming)).

In addition to the nitrate leaching, agriculture in Denmark is the largest source of ammonia emissions, contributing 96 % of the total Danish emissions. Most of these are related to the release of ammonia from livestock manure in animal housing, from the storage and spreading of manure and from grazing animals. The agricultural emissions of ammonia decreased from 124 Gg in 1990 to 73 Gg in 2012, primarily attributed to better utilization of nitrogen from manure and improved feed utilization in swine production. Furthermore, a ban on spreading manure on fields in winter and quick soil incorporation of manures was introduced in the 1980's, followed in 2004 by a ban on broad spreading of slurry, and special requirements in relation to nitrogen-fixing crops.

Agriculture was initially exempted from the environmental act of 1972, however, during the 1970ties and early 1980ties the general awareness of the environmental impact of agriculture gradually arose, and the regulatory response was a series of action plans to limit nutrient leaching (NPo, 1985; AP-I, 1987; AP-SUS, 1991; AP-II, 1998; Ammonia-AP, 2001; AP-III, 2004). From the mid-1980s these action plans consisted of general regulatory instruments such as, standardizing the timing and limits of fertilizer application, introduction of mandatory catch crops and introducing general norms, for instance, harmony regulation (Dalgaard, Hansen et al. 2014). In 2007 the WFD was implemented in Danish law with the "Ecological Status Act" (Miljømålsloven), which is the Danish implementation of the WFD. This introduced a fundamental change to the development of policy targets. Previously targets were based on a politically approved goal of nutrient reduction, but in the WFD policy targets are based on an assessment of the ecological conditions and the objective is that the ecological conditions should have a "good ecological status" by 2027 at the latest.

In 1985, the first Danish action plan to reduce losses of nutrient loss to the aquatic environment set the target to half the total N-leaching from the root zone of Danish agricultural soils, and at the same time reduce other types of losses significantly.

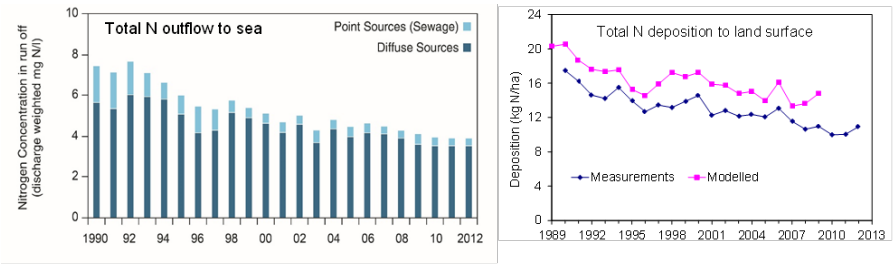

Figure 1: Annual N concentration in Danish surface water outflows to the sea and atmospheric N depositions to land surfaces (Hellsten, Dalgaard et al. 2017 (Forthcomming)).

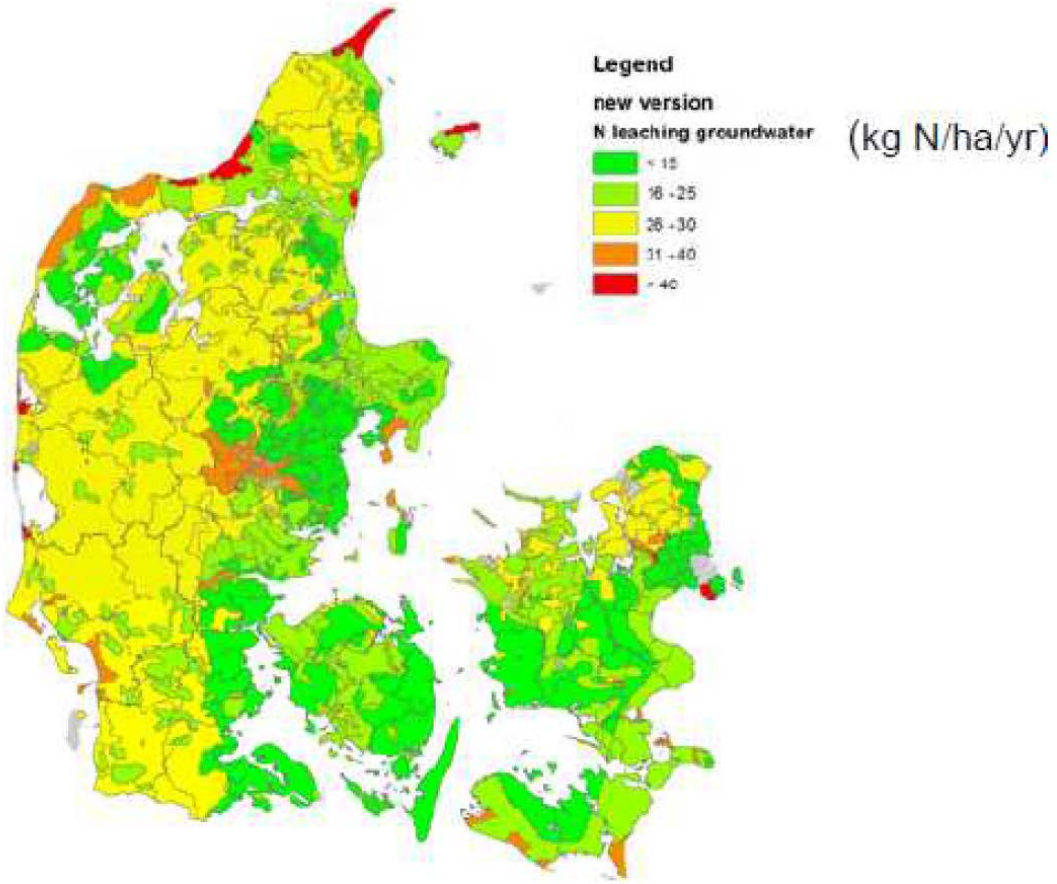

Figure 2: Geograhical distribution of N leaching in DK (Sarteel, Tostivint et al. 2016).

Today, the Danish nutrient management is structured around a system of mandatory fertilizer accounts and nutrient management plans, which has to be developed annually and submitted electronically to the Danish Agricultural Agency under the Ministry of Environment and Food of Denmark. These fertilizer accounts are

combined with detailed regulation on timing of fertilizer application, soil management and differentiated norms. The maximum nitrogen application are calculated as the financially optimal application rated based on all field trials with increasing N levels over the past 10 years, taking into account the soil type and the previous crop. Both mineral fertilizer and organic fertilizer are included in the fertilizer account, and manure production is calculated from a set of norms based on the farms livestock production. Prior to 2017 nitrogen quotas for crops were set 10-20% below the financially optimal level.

Over the past 30 years Denmark has managed to decrease the nitrogen load to marine waters by 50 %, as well as turning an overall trend of increasing nitrogen content in groundwater to a decreasing trend. This has been done mainly by improving the nutrient utilization efficiency in agriculture as well as setting restrictions on the use of nitrogen fertilizer in agriculture. P loads have also decreased significantly during the past 30 years, mainly due to better wastewater treatment.

Recently, the approach to nutrient management has been modified as the regulatory regime has previously been dominated by general policy instruments that are now replaced with a regulatory regime characterized by policy instruments that spatially differentiate the effort depending on local conditions, such as ecological status of recipients and nutrient leaching at field scale. This change in regulatory practice was decided in December 2015 when the Danish government in a political agreement among the governing parties agreed to "*the agricultural agreement*" (Aftale om Fødevare- og landbrugspakke, 2015) that relieved the agricultural industry of some of the restrictions on the use of fertilizer, but also introduced differentiated regulation as a new policy regime that begins in 2019. The agreement states that: "*It is the vision of the government and the agreement partners to conduct a paradigm shift in the agro-environmental regulation. For more than 25 years Danish farmers have been met with similar requirements, in spite of the proximity of their fields to a vulnerable fiord with a risk of oxygen depletion*". Hence, in this differentiated regulation, policy measures are implemented in the areas where they are most effective in reducing the environmental impact. However, this transition to a differentiated regulation however has been long underway in Danish environmental planning, and various attempts to implement differentiated measures have been carried out since the introduction of APII in 1998.

2. Drivers behind nutrient policy

Over the years, the national N action plans have been the central planning document for the nutrient policies especially focused on measures to reduce nitrate leaching to the aquatic environment; both groundwater and surface waters . Due to the high livestock density and proximity to sensitive recipients, currently the main policy concern is the implementation of the WFD. Primarily reducing the N load, as this is considered the limiting factor for eutrophication in the estuaries. Implementing the WFD is seen as a huge challenge for Danish agri-environmental regulation for a number of reasons. Despite more than 30 years of efforts to reduce the environmental impact of agriculture, the impact is still perceived as significant, a large share of streams are physically modified and the nutrient load is still too high (requires reduction from 60.000 ton N to about 48.000 tons N). Improvements using general policy instruments will be extremely costly, as the

cheapest policies have already been implemented. Furthermore, the implementation of the WFD needs to be integrated with a number of related policies, such as, reducing biodiversity loss, groundwater protection and mitigating climate change.

3. Organization of the scientific advice to policy makers

The two centers: Danish Centre for Food and Agriculture (DCA) and Danish Centre For Environment And Energy (DCE) are the framework for the collaboration between the research environments within the agricultural and food areas and are located at Aarhus University (AU). The centers are supported by a central unit which coordinates the university's agreement with the Ministry of Environment and Food of Denmark on research-based policy support. The policy support is managed in a framework contract that ensures that AU conducts research activities that can support the management tasks of the Ministry of Environment and Food. The agreement currently contains 6 focus areas: plant production, livestock production, food quality and consumer behavior, all coordinated by DCA, as well as nature and water, air, and arctic, coordinated by DCE. As a result of the policy support agreement DCE and DCA conducts a number of research activites both ad hoc and on a long term basis to support the Ministry of Environment and Food. The framework entails a holistic view on the advisory services involving as broad a range of expertise as required to produce the best possible input for societal decision-making. Hence a number of different methodologies are applied to assess the nutrient leaching and document the effect of measures, including, field trials at field stations and test fields, modelling and in situ measurements.

In addition, a branch of the Danish Agriculture and Food Council called SEGES functions as a bridging organization between farmers, research and extension service. Furthermore, the chamber of Agriculture conducts a number of field trials in which the nutrient leaching and economically optimal fertilizer application is documented. This data is used as input to deciding the norms for nutrient application, which are recommended by a committee consisting of the representatives from the chamber of agriculture, Aarhus University, Danish Environmental Protection Agency and the Danish Agrifish Agency.

As an example of this research support is the development of white books prior to the development of action plans or RBMP's. In these white books all available knowledge concerning policy measures is gathered to produce a comprehensive review of potential policy measures and their effect on environment and economy, see for instance (Schou, Kronvang et al. 2007, Eriksen, Nordemann Jensen et al. 2014).

4. Policy implementation and stakeholder involvement

Historically, the agro-environmental management in Denmark has been carried out by the county administration, based on legislation and action plans developed at national level. However, following a structural reform in 2007 the responsibility for the management was transferred to the municipalities. Hence, today the municipalities have the responsibility for granting permits to production increases and for

administering funding for mitigating measures under the RDP. Denmark is divided into four river basin districts, which are further subdivided into 23 sub-catchments.

To implement the WFD and ensure public participation in the development of RBMP's is was decided to develop a water council institution. In total 23 water councils were developed and active during the development of the first generation of RBMP's that ended in 2014. Compared to other European countries the Danish water councils are a different institution, as it is rather new, temporally defined and focused on particular tasks, primarily related to improving the physical conditions of the waterways and not directly involved in nutrient management as in other countries. Initially, the task that was given to the water councils was to propose measures to improve the physical conditions in the streams (Graversgaard, 2015). Initially the institution was temporally limited only to the first generation of the RBMP's, but they have been gathered again in 2017 to assist the municipalities in reducing the number of waterways that are a included in the RBMP's, based on a set of criteria developed by the Agrifish Agency and AU, DCE.

5. Recent changes

With the new 2016 agricultural agreement the Danish N action plan now emphasize targeted reduction in N leaching, in order to meet requirements of the WFD, whereas the general regulation with fertilizer norms has been loosened (from a level 15-20% below the economic optimal crop fertilizer norms, back to the production economical optimum). In the coming years this new policy will be further elaborated and implemented for instance using strategically placed wetlands, and targeted use of catch crops.

6. Mode of regulation

The mode of governance in the Danish agro environmental management is characterized by traditionally being rational comprehensive, with strong emphasis on centrally decided measures that have been implemented similarly across the country. The reductions in N losses from agriculture have been accomplished by various policy measures, ranging from Command and Control instruments, over Market Based Regulation and Governmental Expenditure to more Voluntary Action. These latter categories have particularly gained importance in recent years. However, most of the measures have, mainly for political reasons, been implemented uniformly for the whole country, with the same type of standards for all farmers across the country.

7. Overview of policy measures in Denmark

	Denmark
P-ceiling	(X)
Manure storage and use	X
Catch crops	X
Perennial energy crops	X
Set-aside (non permanent)	X
Ban against soil management in particular periods	X
Permanent land-use conversion	X
Buffer zones	X
Forestation	X
Controlled drainage	(X)[1]
Miniwetlands with surface flow	(X)[1]
Miniwetlands with filter matrix	(X)[1]
Wetlands	X
Wet buffer zones	-

Note: x indicate that the measures is in use, - indicate that the measure is not in use.

[1] In the process of approval

8. Detail of policy measures

Nutrient management			
Harmony regulation	Fertilizer standards	P-ceilings	Manure storage
Harmonie regler	Kvælstofnormer	Fosforlofter	Opbevaring af husdyrgødning
For all livestock types the max application of manure total N is 170 kg N/ha (230 kg N/ha if 70 % of the acreage is covered with grass, beets or catch crops).	Standards determining the allowed amount of fertilizer adjusted to soil and crop type are annually issued by LFST. Previously the fertilizer standards were lowered to 20% below the economic optimum, but following the new agricultural agreement in 2016 this has been increased to the economical optimum.	To merge parts of the animal husbandry related to fields into the field regulation and at the same time simplify regulations, while ensuring the same protection level as with former regulations directly or indirectly addressing P application to the fields P-ceilings will be implemented from August 1st 2017, which imply the following P-ceilings: Pig farms 39 kg P /ha, Cattle farms (mainly) 30 kg/ha; poultry and fur-bearing animal farms 43 kg P pr ha, mineral fertilizer and other products 30 kg P/ha. Farmers may get the ceiling enlarged if their fields have low soil P test levels (Olsen P). The general P-ceilings are gradually lowered until 2025. Catchments to P sensitive lakes will have stricter P ceilings than other areas from 2018 and onwards (30 kg P/ha), this stricter ceiling is expected to apply to an area corresponding to one quarter of the agricultural area.	Storage capacity should equal 9 months production, to enable dispersal when crops are in growth. Storage facilities should be covered by a floating layer or a cover, except solid manure stores with daily manure addition. In the period between November 15th until February 1st no manure can be applied in the field. Manure may not be distributed on frozen soil, snow-covered fields, and slopes >6 degrees. Manure dispersal in grass fields or on bare fields/stubble (before a new-sown crop) must be injected or acidified. Liquid manure including slurry can only be applied between February 1st and crop harvest, except on grass and winter rape where liquid manure can be applied until October 1st, and on grass for seed where slurry can be applied until October 15th.

Field and farm management							
Catch crops	Intermediate crops (Autumn)	Early sowing of winter crops	Perennial energy crops	Fallow (non permanent)	Ban against soil management in particular periods	Ban against converting fodder grass during autumn	Manure incineration
Efterafgrøder	Mellemafgrøder	Tidlig såning af vintersæd	Flerårige energiafgrøder	Brak (ikke permanent udtagning)	Forbud mod jordbearbejdning i visse perioder	Forbud mod omlægning af fodergræs om efteråret	Afbrænding af husdyrgødning
Catch crops cover a range of different schemes, that are both mandatory and voluntary. All farms above 10 ha are obligated to plant 10/14 % catch crops on their fields depending on Animal Units (AU). Additional requirements may apply to farms with an environmental approval requiring catch crops to limit nutrient loss by growing catch crops. In addition, catch crops is one of the ways that farmers can fulfil the requirements of Environmental Focus Area (EFA) (1 ha, corresponds to 0,3 ha of EFA). Catch crops must be established prior to August 1st , however, particular varieties before august 20th. The catch crops must be maintained until October 20th, however catch crops in maize should be maintained until March 1st the subsequent year. The mandatory catch crops may be replaced by other measures, such as crops, buffer zones, energy crops or fallow. Mandatory catch crops must be followed by a spring crop. Only specific varieties of crops may be used for mandatory catch crops, while others are allowed for EFA crops, they may be mixed and then the same area of catch crops may count as both a mandatory catch crop and EFA area. In selected areas catch crops may also be implemented voluntarily where they are substituted. Lack of mandatory catch crops imply an automatic reduction in fertilizer quota for the following year.	Intermediate crops, is a crop that is established prior to growing a winter crop. An intermediate crop is either, oil radish, yellow mustard or seed grass that remains on the field after the last harvest, intermediate crops must not be removed prior to September 20th and must be followed by a winter crop.	Early sowing of winter wheat, winter barley, winter rye (including hybrid rye) and triticale can be used as an alternative to catch crops if it is established prior to September 7th. One ha of catch crops can be substituted by 4 ha of early sowing of winter crops	To replace one ha of catch crop with perennial energy crops, the energy crops should be established at the earliest in the plan period 2009/2010 and at the latest July 31th 2016. 0,8 ha of perennial energy crops replace 1 ha of catch crops.	One ha of catch crops can be substituted by one ha of fallow, if fallow is planted with grass prior to January 1st. The vegetation must be maintained until at least October 20th. There are two types of Fallow, however only the mowing fallow is approved for substitution of mandatory catch crops 1) Mowing fallow (slåningsbrak) that requires mowing once a year from August 1st to September 15th, the plant material may not be removed from the field. 2) Flowery fallow (Blomsterbrak), in which the soil should be mechanically treated once in the period between January 1st and April 30th and subsequently planted with a selection of flowery plants. This type of fallow is exempted extend from mowing. in addition fallow used for EFS cannot simultaneously be used as mandatory catch crops.	If spring crops are planned on a field, then you must postpone plowing, harrowing and other mechanical treatment of the soil from harvest until later in the year or the subsequent year depending on soil type. On clay fields may be worked from October 1st, on loamy and organic soils from November 1st while it is February 1st on sandy soils. There are a wide range of exceptions to the rules, for instance organic farms, catch crops, sugar beets.	Fodder grass fields may not be converted from June 1st until February 1st, however fodder grass on clay soils may be converted from November 1st, if the field should be used for a spring crop. There are some exceptions to the rules.	The fiber fraction of the manure may be incinerated, manure corresponding to 25 animal units corresponds to one ha of catch crops

Measures adjacent to fields						
Permanent fallow	Buffer zones	Forestation	Controlled drainage	Construction of mini wetlands with surface runoff	construction of mini wetlands with filter matrix	Establishment of wetlands
Permanent udtagning	Randzoner	Skovrejsning	Kontrolleret drœning	Konstr. mini-vådområder med overfladisk afstrømning	Konstr. minivådområder med filtermatrice	Vådområder
About 4000 ha of low-lying fields are planned to be excluded from production with a combined effect of about 150 tons N	Buffer zones are no longer mandatory, but may be used to substitute the demand for mandatory catch crops or environmental focus areas (EFA). One ha of buffer zones corresponds to 4 ha of mandatory catch crops. Buffer zones must be established with grass prior to January 1st and the area must be maintained until at least October 20th. Buffer zones can be established as 9 meter wide strips along waterbodies (7 if 2 meter buffer zones are mandatory)	An important measure in the new agricultural agreement. The planned subsidy of 10 million DKK in 2016 was increased to 40 million DKK. Subsidies are 32.000 DKK pr. ha for areas with reduction targets in the RBMP's (deciduous) and 24.000 for areas without reduction targets. The forested area must be at least 2 ha.	Not yet fully developed as an instrument in DK, it is still being tested. Controlled drainage functions by differentiating the groundwater level throughout the year by establishing regulating wells in the drained area, thereby reducing N leaching due to increased denitrification during the winter months.	Mini wetlands with surface runoff are a technical unit that filters drain water for N (and P). The drain water is transported through basins that compose a natural water treatment plant. The exact size of the mini wetlands are adjusted after the size of the catchment area, Ideally one ha of mini wetland will be able to filter about 100 acres of catchment area. It is currently planned that the establishment of wetlands should contribute to a reduction of 900 ton N in the period 2018-21	Mini wetlands with filter matrix are a technical unit that filters drain water for N (and P). The drain water is transported through basins, that compose a natural water treatment plant. The exact size of the mini wetlands are adjusted after the size of the catchment area, one ha of mini wetland will be able to filter about 100 acres of catchment area.	A N-wetland can be made in different ways either by removing the drain, whereby the project area is flooded, establish a shallow lake, or by raising the bottom of the streams and reminder the stream, resulting in periodic flooding of the areas close to the streams. No matter how a wetland is established it contributes to nitrate reduction by conversion of nitrate to N2. In addition, the conversion of the arable land contributes to lowering the N leaching. A P-wetland is constructed to reduce the P load to selected lakes, where P is a particular problem for the water quality.

9. Literature

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Annex 3
Country report - The Netherlands

Contents

1. Context

The Netherlands is positioned in the confluent deltas of the Scald, Meuse, Rhine and Ems rivers. The landscape is flat, low lying with often wet soils and about 55 % of farmed agricultural land. Excess precipitation or seepage is drained by an intensive and sometimes historic network of trenches, tile drainage and ditches. Hence, water management has a long tradition.

The ND is in Dutch regulation implemented in the Manure and Fertilizers Act (Meststoffenwet) and in the Decree on the use of fertilisers (Besluit gebruik meststoffen) . These regulations contain clauses that determine the amounts and application procedure for manure and synthetic fertilizer. The current status of the water quality of Dutch waterbodies has recently been assessed in an evaluation of the act (Grinsven and Bleeker 2017). The evaluation concludes that the nitrate content in the upper groundwater has been much improved since 1990 but improvement due to the efforts since 2006 is modest. Apart from the southern sandy regions the average concentration is below the target value of 50 mg/l. However, eutrophication and exceedance of target concentration for N and P in the regional surface waters and small lakes is a persistent problem that would require further effort, see figure 1 and 2. Hence, additional effort is required to meet the requirement of the WFD, see figure 3. The ambitions in the Dutch implementation of the WFD are in many regions incompatible with intensive agriculture. For instance it is estimated that a substantial effort to meet the objectives in the WFD is needed, as the agricultural load of P must be reduced by 40% and N by 20% if the current targets of the WFD should be met by 2027 as agreed in the directive (Grinsven and Bleeker 2017).

The Netherlands have implemented different Nitrates Action Programs over the past 25 years. In these action programs, mandatory measures to reduce application standards for total input of N and phosphate from fertilizer and manure to soil and to cap manure production, have been established. The most important measures implemented are: system of N and P2O5 application standards, (2006), , increased mandatory manure storage capacity, strict regulations of manure transport (New controls have been introduced to prevent manure fraud (GPS and automatic sampling of transported manure), system of tradable manure production quota for pigs and poultry, mandatory manure processing for farmers with a manure surplus, low-emission housing for animals and low-emission application techniques (although not a part of the Nitrate Action Program for the implementation of the ND). This, however, is also quite complex as instruments were introduced and sometimes removed or replaced. Not all measures are fully implemented yet, such as low-emission housing for animals, as there is a gradual implementation process. Note that all these measures are implemented nationally. The area where still te groundwater quality needs to improve is the southern sand region and lössial region which is located in the provinces of North-Brabant and Limburg.

The main challenge for Dutch agriculture is reaching the 50 mg N per liter is in crops prone to leaching in these sandy and lössial areas. Hence, a number of issues are currently facing the Dutch fertilizer management including, more precise application of organic and inorganic fertilizers and a national manure surplus (Sarteel, Tostivint et al. 2016).

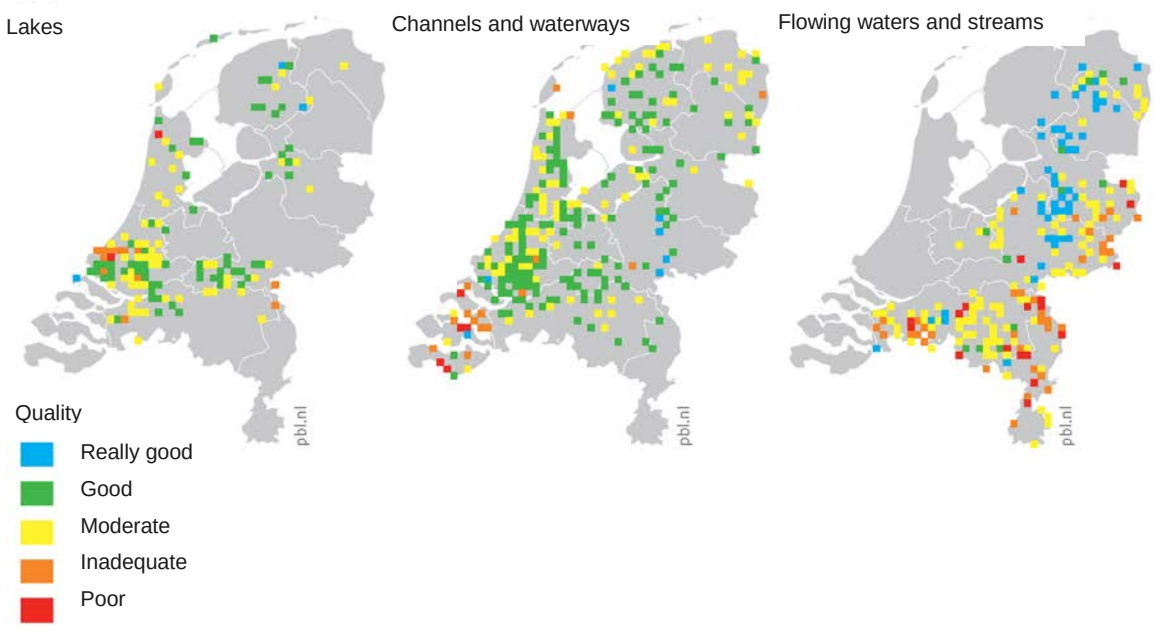

Figure 1: Water quality based on nitrogen concentration, 2010 – 2014 (Grinsven and Bleeker 2017)

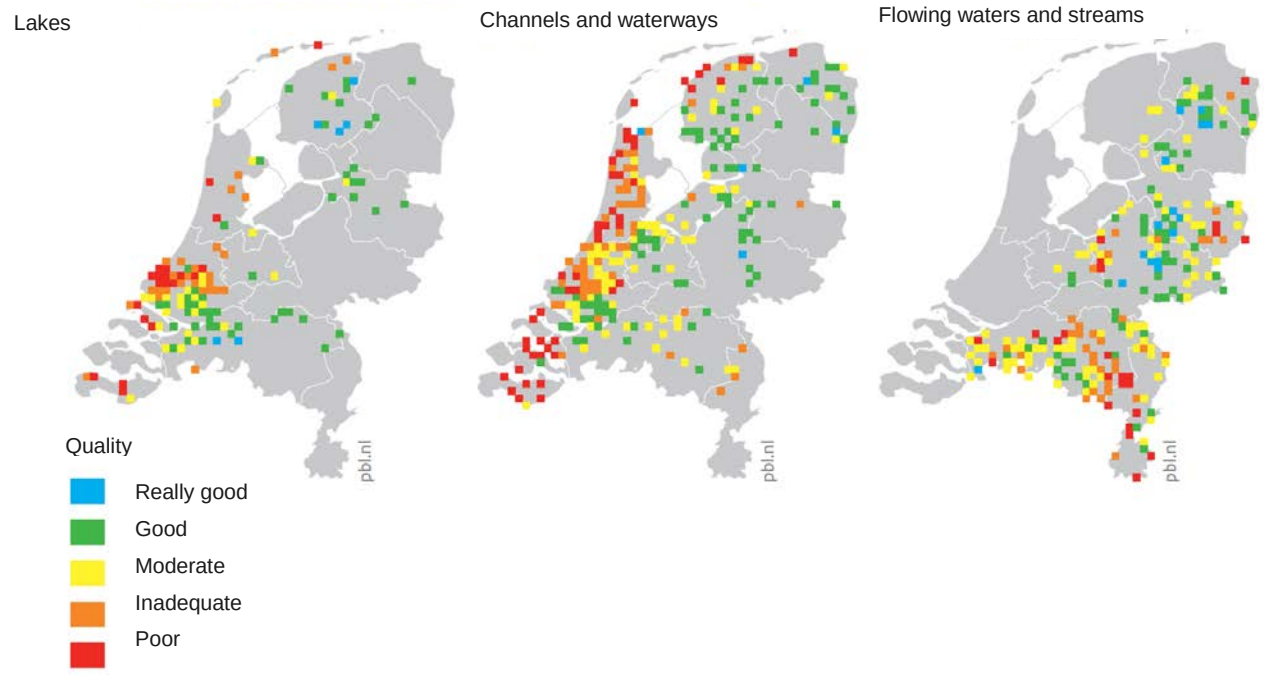

Figure 2: Water quality based on phosphorus concentration, 2010 – 2014 (Grinsven and Bleeker 2017)

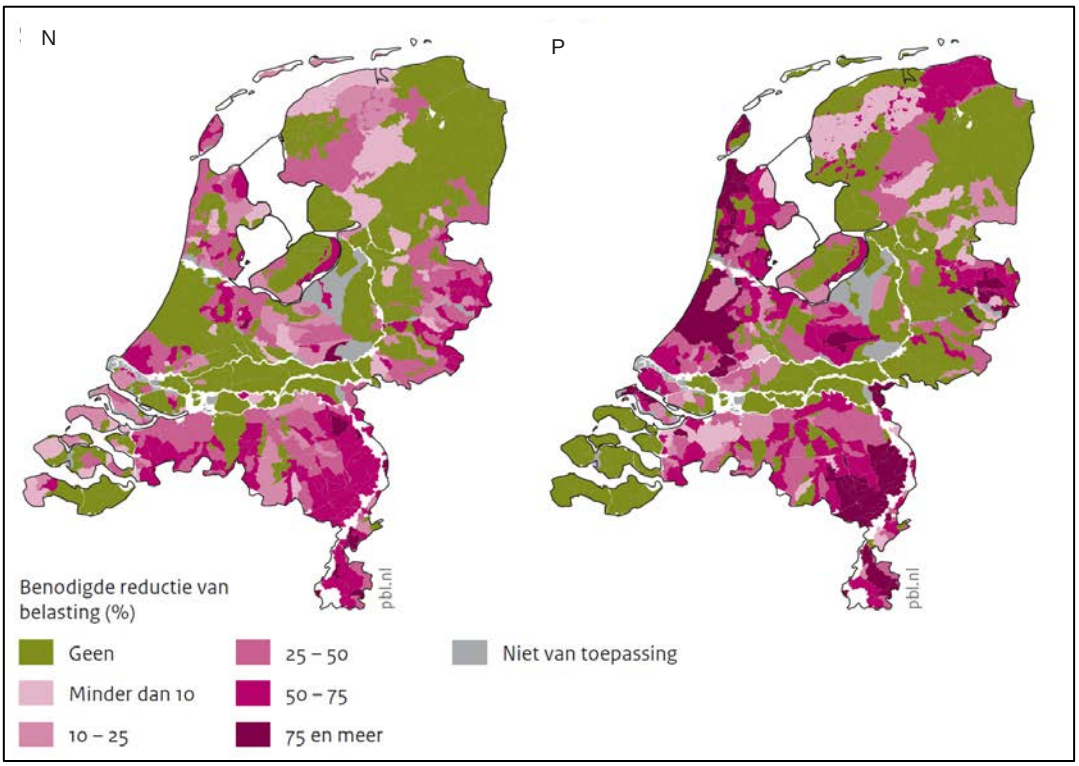

Figure 3: Geographical distribution of the reduction needs of N and P (Grinsven and Bleeker 2017)

2. Drivers behind nutrient policy

Until a few years ago the main driver of nutrient policies in the Netherlands was only driven by the need to implement action programs to fulfill requirements in the ND. This is still the case while the WFD-goals become increasingly important.

In the Netherlands there is no requirement for access to farmland to produce livestock (harmony regulation) and therefore a number of the livestock farmers do not own land to distribute manure. They however need to distribute their excess of manure to other farmers , which results in significant costs of operating the farm.

An important practice for about 25 years has been a large scale manure transfer to areas where there is a manure surplus to areas with legal room to apply manure, in fact about a quarter of the Dutch manure production is exported to other countries, particularly to Germany. It is estimated that the manure disposal for an average pig farm costs about 40,000 euros/year, representing about 5 percent of total production costs (Grinsven and Bleeker 2017). Furthermore, these cost are expected to increase for pig and dairy farms, when expanding the farm. The high reliance on manure export place, particularly, the pig industry in a vulnerable position as the main importer of Dutch manure, Germany, also has tightened its manure application regulation. Therefore there is a risk for a further increase of manure disposal costs.

In the Netherlands the manure production for pigs and poultry (1998-2001) is limited by a "production right" quota system, that is based on the production of P2O5. P is used as an indicator because P is a conservative element and therefore easy and accurate to measure, but the emission of P is not considered the only problem for the nutrient management. The system of norms for application of nitrogen and phosphate production was introduced for pigs and poultry in 2006, replacing the MINAS system (1998-2005). Further in 2005 farms with grazing animals and at least 70% of grassland were granted a derogation by the European Commission of the norm of 170 kg/a ha N manure, as required by the Nitrates Directive, to 250 kg/ha. A condition for this derogation was that the national livestock production of N and P2O5 should not exceed the production in 2002. Initially, it was considered unproblematic because the production had fallen from 2002-2006 and production was below the limit. However, it has again increased and today it exceeds the limit. From 2018 onwards a quite similar system is also implemented for dairy P-production, but prior to the introduction the phosphate production must be reduced to the level of 2002.This implies that the current stock of dairy cows must be reduced significantly (~150.000 heads).

3. Organization of the scientific advice to policy makers and central organizations in the nutrient management

In the Netherlands there is a division of responsibilities concerning the implementation of the ND, which is carried out by the national government (Ministry of Economic Affairs), and the WFD, which is under the Ministry of Infrastructure and the Environment and implemented by the provinces and water boards. With regard to manure policy, it is almost entirely the central government that makes decisions,, but they do so in consultation with farmers organizations, NGO's, water boards, ecologists etc. The Dutch national manure policy is organized in three pillars: 1) Prescriptions based on Annexes 2 and 3 in the ND regarding the timing of fertilizer application, application standards and regulation. 2) Limits on manure production, animal production quota and 3) Regulation regarding the surplus of P in the areas and how it should be processed.

In the decision-making concerning nutrient management the minister is assisted by "The Scientific Committee of the Manure Act (CDM)" that give advice and support to the Ministry in order to implement and modify the Manure Act. The committee is more or less responsible for the scientific underpinning of all the changes that are introduced to the Dutch nutrient management policy. The committee consist of members from different relevant university departments around the country, furthermore, policy makers and evaluators from a national level are observatory members. The work in the committee is entirely based on direct assignments from the ministries, who decide what the commission can and cannot do. This may be tasks on very detailed issues such as which compounds to use in a particular situation or broader problems such as how to address the Dutch manure problem.

The interviewees' stress that an important aspect in yielding good advice is diverse representation of knowledge and disciplines that not only include people with technical, but also social science, business science skills, because a variety of disciplines are needed to reach good solutions. The CDM is stressed as an

important institution, not only for policy advise, but also for communication with the stakeholders, as it is important that they also learn why policy issues are relevant. Furthermore, the CDM is responsible for completing various consultancy tasks for the government and it is assembled ad hoc with personnel from different universities depending on the nature of the inquiry.

The responsible ministry has an obligation to evaluate all policies, both ex-ante and ex-post. PBL – Netherlands Environmental Assessment Agency under the Ministry of Environment and Infrastructure, advise ministries on issues related to environment and assess the effects of policy decisions based on desktop studies and scenario analysis. It is important to stress that the PBL is an independent evaluator of public policies who are on the budget with a general allowance, and is able to answer questions that are given, but also able to formulate its own questions for analysis. The environmental status and the effectiveness of the manure act is evaluated in fixed 4 year cycles and based on this evaluation an action program is decided to target remaining problems. The evaluation contain a scientific assessment of the changes in agricultural production, the changes in soil nutrient content, the changes in ground- and surface water nutrient content at a rather detailed level, that is described in a report and then there is also a policy evaluation based on the scientific evaluation (For the most recent, see: Grinsven and Bleeker 2017). Currently a process is taking place to negotiate the 6th action program, which has been initiated with a public consultation to gather new ideas for the nutrient policy.

Statistics concerning the use of fertilizer, animal density and all transactions between farmers must be reported to a central database administered by the Netherland Enterprise Agency. The data is private but researchers are sometimes able to get summary files for scientific inquiries regarding surpluses. In addition, the ministry administers the farm structural survey, where each farmer shall indicate how much land they have, how many animals and each animal has to be registered. Hence, all farmers need to submit data on a yearly – or depending on the data concerned more frequent - basis to this system.

If a new policy measure is introduced it is always based on documentation which can be underpinned scientific publications indicating the costs, benefits and uncertainties. In the end it is politicians that make decisions whether or not to implement new or change their policies. Usually the documentation is based on a review of state of the art knowledge.

4. Policy implementation and stakeholder involvement

Generally, there is no fixed procedure for approving policy instruments, but to some extent the procedural requirements for approving new policy instruments is in place. If evaluations of policy instruments reveals that a particular measure is not effective enough, then a discussion starts to decide on a new measure to fill the gap, the decision is up to the ministry to organize specific assessments to analyze whether the proposed measures could work. Research is one of the aspects, which is used to decide on which measures to apply in combination with stakeholder consultancy.

The water boards are a central institution in the Dutch nutrient management, particularly in relation to implementing the WFD. When the WFD came into force the water boards in collaboration with the local provinces decided what should be achieved with regards to nutrients on their territory. There are 23 water boards in the Netherlands and members are democratically elected every 4 years, hence the boards function as a decentralized governmental body. Originally, the water boards were developed as a decentralized governmental body that make decisions concerning the water levels in the Poulders. Furthermore, the water boards are responsible for the maintenance of dikes and waterways. Following the increasing environmental awareness and the need to implement the WFD the water boards require a more central position as institutions that are identifying the need for actions to implement the WFD. In addition to decision-making the local provinces are responsible for the drinking water protections. However, if there is a need to implement measures on farmland, this has to be negotiated with the individual landowners and they have some budget for this. The benefit of this institution is that it creates a lot of local engagement and legitimacy in the local water management. Sometimes, however, it creates confusion regarding the distribution of responsibilities between the central government and the local water boards. This is particularly pronounced in areas with water quality issues. What currently is being done is to adopt voluntary measures funded by the Rural Development Program.

The waterboards are supported by the knowledge center STOWA (Foundation for Applied Water Research), which is jointly funded by the different waterboards. STOWA work towards: "Defining the knowledge needs in the field of water management and developing, collecting, making available, sharing, strengthening and implementing the required knowledge or arranging for this together with regional water managers." The center collects and organize knowledge from various fields such as: applied technical, scientific, administrative-legal or social science fields.

When the Government assesses the need for new measures there is a lot of discussion on all levels between the Government and all kinds of stakeholders. Earlier the farmers associations were very strongly organized, but nowadays they operates a little more fragmented because farmers are organized according to sectors, for instance in the dairy sector board, arable farmers board, pig sector board etc. In the end the politicians decide with agreement in the parliament.

5. Recent – temporary - changes

A number of policies have recently been implemented to reduce the manure production 1) subsidies are given to farmers who want to stop farming, 2) the dairy processing industry pay dairy farmers 10 cent/kg to producers that deliver less milk compared with last year and 3) there is an agreement between the animal feed processors that the P content in the feed concentrates shall be lowered, thereby limiting the P content in the manure.

6. Mode of regulation

The current governance system in the Netherlands has multiple aspects and detailed. However, in particular, policies relating to the manure and fertilizer act are centralized and the Netherlands has a focus on national regulation as a means for reducing nutrient loss. Hence, it is the central government, and related agencies that make all decisions concerning the use of agri-environmental measures, norms for nitrogen and phosphate application, at crop-soil level (synthetic fertilizer and manure). The fertilizer application is used to calculate the maximum legal space to apply manure N, total effective N and total P2O5 at farm level; but the farmer is free to decide how he will use it. Policies is market based regulatory system, for pigs and poultry currently based on a tradable excretion rights, fixed norms and compensated voluntary action, hence, manure production is decoupled from acreage. In collaboration with the government the local water boards are a central instrument in the policy-making and they constitute an important actor in deciding the focus of the regionally tailored approach to nutrient management. Hence, currently the environmental targets are planned to be primarily reached via source reductions rather than measures that filter water. Due to the development of a manure trading system there is no necessity to focus on the geographical location of the production facilities. The Netherlands will in the 6th action programme focuses on the areas where remaining problems with water quality have been identified.

7. Overview of policy measures in the Netherlands

	The Netherlands
P-ceiling	X
Manure storage and use	X
Catch crops	X
Perennial energy crops	
Set-aside (non permanent)	
Ban against soil management in particular periods	-
Permanent land-use conversion	-
Buffer zones	(X[1])
Forestation	-
Controlled drainage	(x[2])
Miniwetlands with surface flow	-
Miniwetlands with filter matrix	-
Wetlands	X
Wet buffer zones	(X)

Note: x indicate that the measures is in use, (x) indicate that the measure is in use in some areas or only of marginal importance, - indicate that the measure is not in use and.

[1] Only mandatory for upstream brooks
[2] This is practice and possible measure, but not a policy

8. Detail of policy measures

Nutrient management						
Application standards system N	Application standards system P	Manure processing	Manure, application timeframe	Inorganic fertiliser application	Manure storage (basin)	Manure storage capacity
Gebruiksnormenstelsel N	Gebruiksnormenstelsel P	Mestverwerkingsplicht	Mest, uitrijperiode		Mestopslag (bassin)	Mestopslagcapaciteit
Standards: depend on crop and soil type Crops: grass for grazing, grass for cutting, temporary grass; arable; flowers, fruit, trees, biomass. Soil type: clay; sand (north+west+central); sand (southern); loess; peat. N-standards valid for green manure (sand, loess, peat) if seeded 16 Sept (2016) at latest and ploughed after 1 Dec. On clay, seeded the latest 16 Sept (2016), ploughed after 8 weeks of development (proof). Exceptions when made use of 'succeeding crop' (not maize) **N-differentiation:** higher norms for selected crops if last 3 years yielded higher (on clay soil, set how high yield must be) If exceeded: €7/kg N (+€3,50). 170 kg N/ha (from livestock) Total N depends on specific field-characteristics: crop, expected yield, cropping system, ecological conditions of waterbody and soil. In case of derogation: 230 kg N on sand and loess in south/middle, or 250 kg N/ha on other sand and loess and all clay and peat.	**Standards**: depend on P-value and soil use (arable/grassland for roughage): phosphate differentiation. If no P-tests are done, the allowed P is based on the highest P-value. P-poor and P-fixating soils can use 120kg P/ha, if complied with conditions (grass <16; arable <25) 2017 requirements Grass: low (<27): 100; neutral (27-50): 90; high (>50): 80 kg P/ha Arable: low (<36): 75; neutral (36-55): 60; high (>55) 50 kg P/ha. If limits exceeded: apply (in year of exceedance) to settle in the following year, max 20kgP/ha (arable). If exceeded: €11/kg P (+€5,50)	**Manure expressed in P:** In case of farm-surplus (more produced than allowed to spread), part of manure has to be processed. % are set annually, and depend on the area. In 2017: south 59%; east 52%; other 10%. Exceptions: - minus P transferred to owned grounds abroad - if amount below threshold: 100kg P - if organic and manure transferred to other organic farm - if manure transferred who make mushroom-substrate - if total surplus transferred to other farms - since 2015 exemption for housing system with >2/3 straw Other restrictions for processor	**Grass, liquid manure:** 16 Feb - 1 Sep on all soil types Grass, solid manure: 1. Feb - 1 Sep on sand and loess, 1 Feb - 16 Sep on clay and peat Grass: should be applied emission-poor **Arable, liquid manure:** 1 Feb - 1 Aug all soil types, exceptions in case of sowing winter oilseed rape or green manure (15 Sept 2016) Green manure: leguminous and non-leguminous, mentioned in appendix A, table 1 Arable, solid manure: 1 Feb - 1 Sep on sand and loss, fruit trees and park trees on sand and loess all year, clay and peat all year **Inorganic fertilizer:** - on grass and arable from 1 Feb-15 Sept, equally spread over field (if winter rapeseed or some grasses also 16 Sept-15 Oct) - not if soil is: frozen (unless cereal on clay); covered in snow; water saturated; simultaneously irrigated; >7% steep + gulley-eroded; > 18% steep	Ban on use of inorganic fertilizer on arable or grassland from 16 Sept - 31 Jan, except if arable and evenly grown with 'outdoor vegetables?' (full-ground-vegetables); fruit; winter rapeseed; certain grasses; hyacinth and tulips	Manure storage in basins Liquid manure and digestate (§3.4.6): basins total max 750 m2 or 2500 m3. Contains distances to odour-sensitive objects and very sensitive areas. Coverage can be issued in case odour-limits are exceeded Article 3.67: manure basin is covered (no straw) - not applicable for basins from before 1 June 1978 until 1 January 2018	For production in period 1 August - 1 March by animals kept (7 months). Some exceptions If not enough capacity, manure produced has to be stored/processed elsewhere, without environmental impact. Contracts needed as proof.

Field and farm management	
Catch crops	Tearing and destroying grassland
	Scheuren en vernietigen van grasland
Farmers in the Netherlands are legally obliged to grow such a catch crop after cultivating maize on sandy and loess soils. In other cases, green manures are mainly grown to add organic matter to the soil to increase soil fertility. This type of green manure is mostly grown after cereals and is fertilized (unlike catch crops). On sand and loess Implement immediately after harvest of maize (undersown or sown after harvest) mandatory to keep until 1 Feb in the following year Crops: leaf cabbage (bladkool) Fodder radish (bladrammenas; Raphanus sativus) grass Lopsided oat Triticale Winter rye Winter barley Winter wheat	Clay: allowed if - 1 Feb - 15 Sept - 16 Sept - 30 Nov if followed by tulips, crocuses, irises and grape hyacinths (muscari) - 1 Nov - 31 Dec if following crop is not grass Sand and loess: allowed if - 1 Feb-10 May if followed by N-demanding crop (additional N-fertilizer only if proven that N is too low for crop) - 1 Feb-31May if followed by grass (fertilizer again if N is too low) - 1 June-15July if sown Lopsided oat, Tagetes erecta, Tagetes patula (nematode control) - 16 Nov-30Nov if followed by tulips, crocuses, irises and grape hyacinths (muscari) Peat: allowed if - 1Feb-15 Sept: no restrictions - 16 Sept-30 Nov: if followed by tulips, crocuses, irises and grape hyacinths (muscari)

Measures adjacent to fields		
Bufferzones	Controlled drainage	Two-stage dike/wet buffer strip
Teeltvrije zone (part of Activiteitenbesluit milieubeheer)		
Along surface-water-body a buffer zone (free of cropping). Rules for crop protection, but in article 3.80: - No use of fertilizer (exceptions in article 3.85) - grass, cereals generally >25cm - potatoes, unions, carrots, and other >50,>100,>150cm depending on management and location. - more categories with other restrictions - other: >50cm Buffer strips are advocated in the River Basin management plans of the Water Framework Directive. However, farmers can implement them voluntarily, there is a subsidy scheme for the implementation of buffer zones in place. Based on current practices, width requirements buffer strips range from 3 to 12 m.	Recently, controlled drainage was introduced to preserve water for dry periods as an adaptation to climate change and to reduce the emission of nutrients. The drainage level is regulated by raising or lowering the water levels in the ditches or in the tile drainage systems itself. The effects of controlled drainage is assessed ex-ante and still need to be quantified empirically. It appears to be very difficult to transfer the results of the few field experiments to other situations. Effects at regional and national scales are equal to the totaled or averaged local effects. Controlled drainage is applied as a measure on areas with peat soils as higher levels of ground water imply a better denitrification and less decomposition of the organic soils, thereby serving a double purpose.	Wet bufferzones are mostly installed for water storage purposes. (i.e. to prevent peak discharge). At low discharge levels, only the narrow deeper part of the surface water profile carries water, while at high discharge levels the wider shallower part is also involved. This wider shallower part is then designed and maintained like a constructed wetland to become a wet buffer zones, and may then also contribute to other goals (e.g. reducing nitrate loads from neighboring fields. Wet BS have been implemented by many water boards in parts of their management area (water storage and biodiversity). However they are rare or non-existent adjacent to the smallest channels and ditches where farmers are responsible.

9. References

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Annex 4
Country report - Lower Saxony

Contents

1. Context

Throughout Germany, agriculture is an important activity, but the structure of the agricultural sector is quite different across the regions. Germany is divided into 16 states and in relation to the nutrient management the states main function is to monitor the environmental state, compliancy and to offer agro-environmental schemes. In general, there is a regional difference in agricultural structure and natural conditions, furthermore the Northern states have less money, hence there is a variation in the schemes that are offered.

Germany has a complex governance system: The federal government develops the overall framework for the management of water and nutrients and the local governments are responsible for the implementation of the policy measures. In an assessment of the German nitrogen cycle, it is assessed that 4.2 million tons of reactive nitrogen enter the nitrogen cycle annually. Whereas considerable reductions have been made in other sectors, reductions in the agricultural sector have been much less successful (Geupel 2016). Within the European Union, Germany ranks among the six north-west European countries with the highest yields per hectare (ha) of agricultural production area, yet it is also one of the six countries with the highest national nitrogen surplus (Sarteel, Tostivint et al. 2016). Although the N surplus decreased after the 1950´s the decreasing trend has slowed down and shown stagnation at a level of about + 100 kg/ha since 2001. In effect, a number of regions face a challenge with high N-concentrations in the upper groundwater, see figure 1.

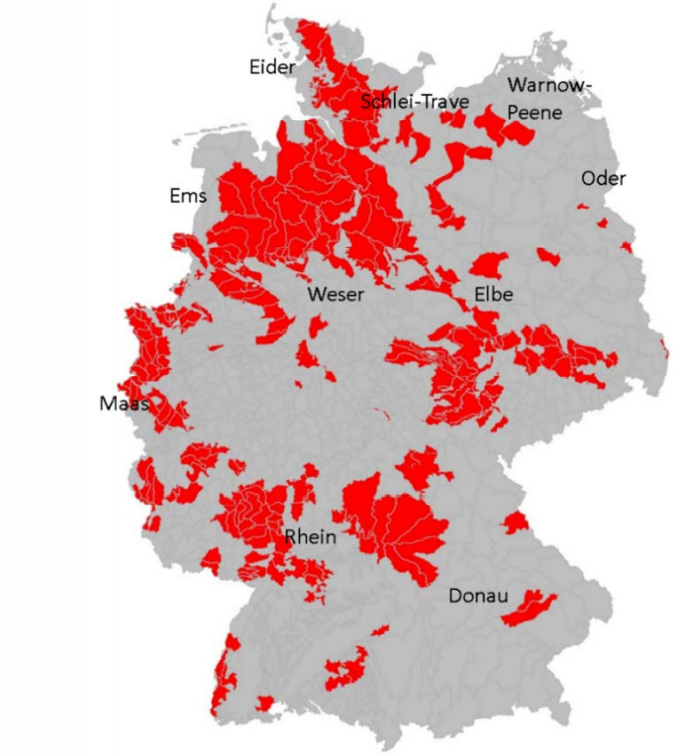

Figure 1. *The red zones depict areas of Germany where the nitrate concentration exceed 50 mg/l (Limit in the ND) (Taube, Henning et al. 2015).*

The national framework for the nutrient management is detailed in the "Düngegesetz" (fertilizer law) and "Düngeverordnung" (fertilizer application ordinance) (Taube, Balmann et al. 2013). Fertiliser Application Ordinance (DüV) is the central instrument for ensuring best management practice in fertiliser use and a reduction in nutrient surpluses originating from agriculture. The DüV contributes to the implementation of the EU Water Framework Directive (Directive 2000/60/EC) and to the EU Marine Strategy Framework Directive (Directive 2008/56/EC). Furthermore, DüV is the national implementation of the rules that are based on EU law within the framework of the EU Nitrates Directive of 1991 (Directive 91/676/EEC) and it is the central instrument in the German action program for implementing this directive. Hence, the ordinance govern the rules for implementing best management practice in relation to application of fertilizer and also for mitigating the environmental risks that arise from fertilizer application. Based on this national framework each individual state is responsible for implementing a fertilizer management program. In 2017, the DüV was renewed. In the new version, fertilizer planning are more emphasized and not following these regulations are handled stricter with reduction of payments and offences. According to paragraph 13 in the new fertilizer ordinance (DüV) the individual states have to implement stricter regulation in area where either the nitrate concentration is the main reason for reaching a not good chemical status in groundwater bodies or where phosphate concentrations are above environmental standards. Paragraph 13 further specifies a list of 14 measures that the individual states can choose between. However, currently it is unknown how the different states will deal with it, but it is very central as 60 % of Lower Saxony is vulnerable due to high nitrate concentration and high P concentration values. As the agricultural structure, density and environmental impact is quite different in the different states this is likely to differentiate the development, implementation and impact of the nutrient regulation. However, interviewees indicate that stricter nutrient regulation is underway in Lower Saxony.

In Lower-Saxony agriculture is an important sector as 2.6 million ha are cultivated, corresponding to about 55 % of the total land-use in 2014. 253 000 t of nitrogen from livestock manure is produced annually (Sarteel, Tostivint et al. 2016). Especially in western part of the state the allowable threshold level for N per ha is exceeded, due to a high livestock density with more than 2 LU/ha. In effect, a largescale manure export out of the western part of Lower Saxony takes place, see figure 2. The surface water bodies generally have high nitrate levels, in two-thirds of the surface near groundwater stations, the nitrate levels surpass the threshold of 50 mg NO3/l and are characterized as significantly polluted. The high nutrient levels also have an impact on the biological status of surface water bodies.

In lower-Saxony, 85 % of the drinking water is produced from groundwater and reaching the objective of the WFD of good chemical water quality is currently considered unlikely, particularly for many of the aquifers in the Weser-Ems region in the western part of the state, where the highest agricultural and animal density is located. Accorting to Sarteel, Tostivint et al. (2016) the main causes for nutrient loss to the environment is 1) Intensive livestock production locally leading to an excess of manure produced compared to crop needs. 2) High bioenergy production leading to increasing intensive energy crop production. 3) Overfertilisation due to

lack of accurate knowledge and fear to lose production 4) Lack of appropriate storage equipment 5) Cultivation of organic soils. 6) Ploughing of grassland and conversion to arable land.

Hence, between 1990 and 2009, 30 % of the grassland area in Lower Saxony was changed to another use, in particular arable land (Schramek, et al., 2012). One of the explanations for this conversion has been

subsidies for biogas production, which has made it more profitable for farmers to grow energy crops for biogas production than to manage grasslands. Furthermore, so far the biogas digestate has not yet been subject to a clear regulatory framework, hence it is used as an organic fertilizer beyond the limits set by the Nitrates Directive for processed manure.

One of the significant challenges for Lower Saxony is that manure production exceeds the amount that can be applied in a legal way, hence to maintain the current animal production manure need to be exported to other places. Hence, in total to fulfill the current policy objectives the state has to bring out 80.000 t/N. To manage the nutrient cycle in Lower Saxony, farmers are advised on voluntary actions like catch-crops, undersown grass, reduced tillage, reduced nitrogen fertilization, changing crop rotation and possibilities for obtaining targeted compensation. Contracts are established annually running for just one year, and these cooperation schemes were developed and implemented from 2005. To manage the nutrient production, measures related to feeding practices such as the adjustment of the quantity of feed and the composition of aminoacids have been implemented in the region, as the majority of animals are already fed with fodder with reduced P content. This measure is organised by the Chamber of Agriculture Lower Saxony, in collaboration with the administrative district and the farmers (Landwirtschaftskammer Niedersachsen, 2014).

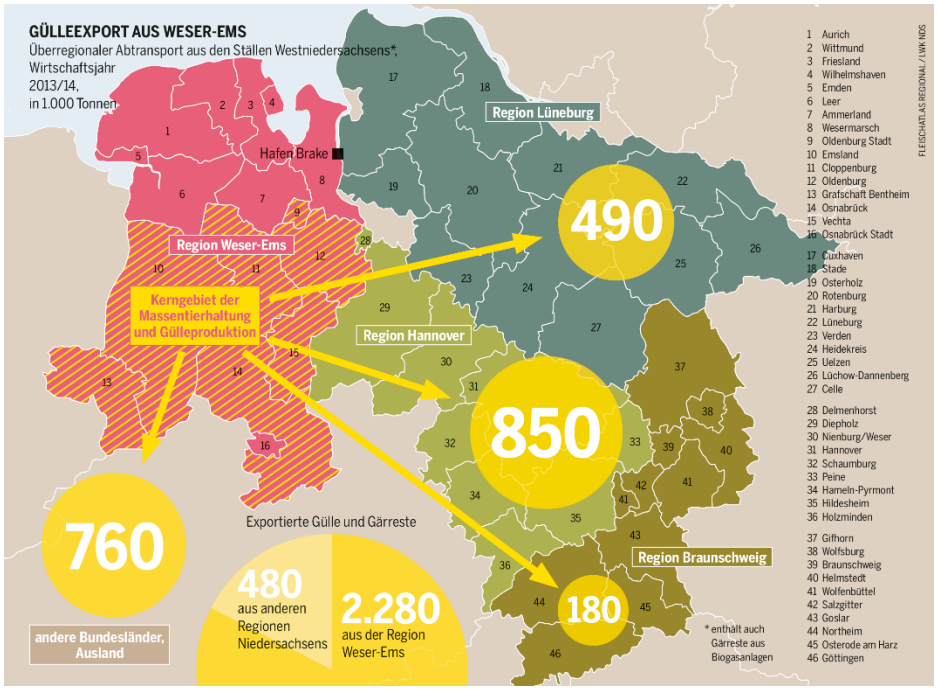

Figure 2: Manure export out of the Wesser-Ems region (Sarteel, Tostivint et al. 2016).

2. Drivers behind nutrient policy

The nutrient policies in Germany has been under increasing pressure both domestically and internationally. The German Fertiliser Application Ordinance was evaluated in 2012 by a Federal Government Laender Working Group, which concluded that additional measures have to be implemented in order to attain the targets and meet the objectives. Furthermore, the EU has encouraged the need for changes, a need that partially goes beyond the results of the national evaluation. At the moment there is a particular focus on meeting the requirements of the ND, as this is most pressing in relation to the transposition lawsuits. Which are primarily due to poor control with farms nutrient balances. Furthermore, due to a change in the interpretation of the requirements for groundwater monitoring suddenly there is a large N-surplus that will need to be reduced.

3. Organization of the scientific advice to policy makers

At federal level particularly two relevant advisory boards make advice for policy development, which are relevant to understand the scientific evaluation of proposed policy instruments. This includes 1) the Scientific Advisory Board on Agricultural Policy. This advisory board has up to 19 members working in various fields on issues of agricultural policy, food and consumer health protection. The board is appointed by the Federal Minister of Food and Agriculture for the duration of three years and the chair is elected by the Advisory Board. Members are chosen from university professors of relevant scientific disciplines. 2) The Scientific Advisory Board on Fertilizer Issues, which consists of ten members representing the special fields of plant nutrition, crop production, organic farming, fertilizer analysis, toxicology, ecotoxicology and environmental and animal hygiene.

Both advisory boards are based at Germany's Federal Ministry of Food and Agriculture – BMEL. The boards advise the Federal Ministry by providing expert opinions. The members of the Advisory Board serve on a voluntary basis and are not bound by instructions. Hence, in addition to developing opinions based on questions posed by the policymakers at federal level the advisory board also have the freedom to pose their own questions to explore new knowledge. Interviewees stress that this freedom is an important aspect of the ability of the boards to inform the policymakers and politicians of emerging and pressing issues. The Advisory Board is assisted by an office at the Federal Office for Agriculture and Food who are facilitating the advisory boards.

Furthermore, the agricultural chamber (Landwirtschaftskammer Lower Saxony) is an important institution as they manage field stations, which are ideal typical farming systems with optimal management where nutrient leaching is measured. In addition, the agricultural chamber offer extension service for farmers, including advise on nutrient management and environmental protection in the red areas. Lower Saxony got a permission to make a special nutrient regulation in 2012 and in effect an annual nutrient report regarding the flow of nutrients and progress is produced.

4. Policy implementation and stakeholder involvement

In Lower Saxony nutrient management is carried out by the Lower Saxony Ministry of Food, Agriculture, and Consumer Protection, which have both an agricultural divisions, responsible for managing agro-environmental schemes, controls and compliancy and a water division responsible for monitoring the environmental state of the waterbodies.

Traditionally in Germany the Chamber of Agriculture is normally one organization, but in Lower Saxony it consists of two parts, one part is working for the government, they are autonomous, and the other part is working for the farms. Hence in Lower-Saxony the fertilizer authority is the agricultural chamber, in other counties it is organized differently. The chamber is partly funded by the government, the part made by the farmers are conducting the advisory.

Lower Saxony have two authorities that in addition to the local agricultural chamber is important in the management of the water bodies 1) NLWKN (Der Niedersächsische Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz), that acts on county level and collect all data on ground and surface water bodies. Furthermore they are responsible for preparing the annual nutrient report for the federal government in Berlin who report this data to the European Commission. They are responsible for the countrol system containing more than 1000 control points and based on this they make a report for the state administration in Hanover and the local municipalities and they are also responsible for controlling the actions in the ground water protected areas. Furthermore they are an important participant in the regional conferences, and explain their data to the farmers. 2) Local groundwater authorities are part of the regional government (Landkreize, equals municipalities) they have local water authority and since last year they started to build more control points in the upper ground water to document the development. This has indiated more problems with surplusses of 40-50 mg NO3/L.

Currently there is an increasing requirement for solutions that are developed in collaboration with the farmers. In effect, an effort to build round tables consisting of a broad range of actors is currently taking place with the objective of discussing possibilities and demands for reducing nutrient leaching. The participants for these round tables include many actors such as waterboards, local authorities, fertilization authorities, farmers union and from the local water companies. This is a great challenge for all actors as there are significantly diverging interests, but it is considered crucial that all stakeholders participate in the policy implementation. Furthermore, the strong regional corporation is considered important because many farmers do not know about the fertilizer regulation and the water issues.

5. Recent changes

In February 2017, the fertilizer law was amended and in May 2017, the DüV was revised due to problems concerning German transposition of the EU WFD and ND. The basic idea is to achieve better nutrient management and control which will enable an improved nutrient utilization. The revision was carried out with an inspiration of the Danish nutrient management system. The change include various elements 1) New

and stricter requirements concerning manure application, manure storage, fertilizer norms and application, see current requirements in section 8. 2) Another important change is new reporting requirements detailed in a new ordinance under the fertilizer law called "Stoffstrombilanzverordnung". It will become effective in January 2018 and according to this ordinance, field gate balances have to be calculated. Up until today, farmers have developed field balances, which are accurate for some crop types, but not for forage and grasslands, hence, farmers have effectively been able to adapt their yield to the nutrient application when making accounts. This has meant that farmers would have a good balance on paper, but not in reality. Hence, one of the most important points in new regulation is that authorities have more possibilities to control the farms, hitherto the authorities have no access to data on fertilizer use electronically, it has to accessed from the farm, which is very complicated, this will change. Hence, until now authorities have been unable to make a risk control, in the future this will be possible. From 2018 onwards for all farms exceeding 30 ha and 2,5 AU/ha (~8-10 %) will be required to develop a field gate balance, and from 2023 onwards the use of the field gate balance will be evaluated and may apply to all farms. Nutrient demand for arable crops and grasslands are determined based on standard coefficients in the new ordinance. The value is not similar all over Germany, but it is specified according to climatic variation and soil conditions. Farmers can differ from this standard value if he/she can prove that his yields are above average, if more productive 10% more fertilizer is allowed, the opposite if the farmer is below. 3) Furthermore, data protection laws have made it impossible for the government to monitor farms properly. Hence, currently much work developing databases to administer these new documentation requirements.

A tangible outcome of the regulatory change is the development of an online nutrient exchange portal (Düngebörse), where farmers online can exchange manure between areas with a high animal density to areas with a low density. This institution will be established in all states with a high livestock density to achieve a better utilization of the local animal manure.

6. Mode of regulation

Generally, Germany has adopted a corporatist mode of governance, which imply a preference for self-regulation by actors in civil society or the delegation of powers to stakeholders. Hence, the nutrient management in Germany will be based on farm gate balances, developed at national level and diversified based on climatic variation and soil conditions. Furthermore, each state is responsible for implementing stricter measures in vulnerable areas, implying a decentralized structure for decision-making. Given the focus on self-governance extension is used as an important measure to ensure that the best practice and adoption of agro-environmental schemes, particularly in vulnerable areas. Adopting agro-environmental schemes is voluntary, some are available for the entire state, while others only are eligible in particular regions primarily defined by soil types, hence the implementation of policy measures is to some extent differentiated based on voluntarity.

7. Overview of policy measures in Lower Saxony

	Lower Saxony
P-ceiling	X
Manure storage and use	X
Catch crops	X
Perennial energy crops	
Set-aside (non permanent)	X
Ban against soil management in particular periods	X
Permanent land-use conversion	?
Buffer zones	X
Forestation	X
Controlled drainage	-
Miniwetlands with surface flow	-
Miniwetlands with filter matrix	-
Wetlands	X[1]
Wet buffer zones	One test site

Note: x indicate that the measures is in use, - indicate that the measure is not in use.

[1] In practice, only few wetlands are constructed in northern Germany because a set of rules prevents remolding of the landscape when more than 50 m3 of soil has to be moved, which makes it difficult to construct new wetlands or similar measures because it requires a special permit that is difficult to get.

8. Detail of policy measures

Nutrient management				
Harmony regulation	Fertilizer norms	P-ceiling	Utilization of N in manure	Manure storage and use
Stickstoff Regulierung	Düngeverordnung		Nutzung von Stickstoff in Gülle	Güllelagerung
Legal limit of 170 kg N/ha of organic fertilizer. (Until 2013 it was possible to file an application for 230 kg N from manure/ha. 8-10% of farmers use 230 kg N/ha. Since 2014 not possible anymore). Currently unknown if digestate from biogas plants and sewage sludge should also be included as manure in the future.	Based on 91/676/EWG (EU Nitrate directive 1991). German instrument for execution of the EU-directives: By the national law Düngeverordnung (DüV). Regulates amount, time, distance to surface water etc. Norms are adjusted after crop, yield, soil type, previous crop, decomposition of straw and N-min samples in early spring Within all drinking water protected areas norms are mandatory (37 areas of which 25 are appointed with agriculture).	Max 20 kg/ha phosphate in surplus in average over 6 years. High P level in the soil: no surplus	**After harvest:** N-Manure maximum of 60 kg N/ha. Ammonium-Nitrogen-Manure maximum of 30 kg NH4-N/ha. **Cow slurry:** 50 %, Below this maximum other percentages apply if below limit for animal manure 70% and 80% respectively depending on amount. **Pig slurry** 60 %, otherwise similar to cow, however the percentages are 60, 70 and 60 respectively. **Deep litter**. Pig and poultry manure 30 %. Cow, horse goat 25%. Other manure: poultry 60%, urine 90%. Calculations are based on clause 3 in "Düngeverordnung".	**Storage capacity:** Should equal 7 months production (Previously 6 months). Distributing manure banned after harvest of the main crop in late summer/autumn. **Distance requirements:** At least 50m distance to drinking water springs or wells. Not allowed in water protection Zone I and II (exceptions for zone II exist). Permanent impervious. **Manure disruption:** Manure may be distributed from November 1st until January 31st, however, for grass November 01th-january 31th. In addition, after last harvest distribution only on fields with a crop, total max 60 kg. N or 30 kg ammonia. **Special exceptions:** Ban on manure use on slopes exceeding 10 % and with a distance of 20 meter to recipients the rules are: • Slopes between 5-10 meters, manure must be ploughed down apart from manure from poultry where the 10-20 meter rule apply • Slopes between 10-20 meter manure must be injected • Fields without crops (after harvest, if sowing first in spring), if injected or ploughed down immediately (<4hrs) • On fields with row crops with a distance of 45 cm or more between the rows (primarily corn) only if also catch crop, the crop is developed or fertilizer is ploughed down within 4 hrs. • For other crops only if there is adequate plant cover or immediately after harvest or direct sowing. No manure on frozen land or snow cover . mandatory requirement

Field and farm management		
Catch crops	Fallow (non permanent)	Ban against soil management in particular periods
Zwischenfrucht	Brache (nicht permanent)	Verbot von Bodenbearbeitung in bestimmten Perioden
Establishment: 16. July - 1. October for areas announced as Environmental Focus Area. The use of pesticides, mineral fertilizer or sewage sludge is banned between previous crops and catch crops. Organic fertilizer is allowed. Catch crops have to remain on the field until the 15. February. In addition, catch crops is one of the ways that farmers can live up to the requirements of Environmental Focus Area (1 ha, corresponds to 0,3 ha of EFA). Catch crops are mandatory in drinking water areas: application of fertilizer can be expanded until September 15th if there is established catch crops or winter rape after the main crop. In addition, special rules may be implemented in each drinking water area.	Fallow land is only allowed on cropland. 1 ha fallow land is considered as 1 ha environmental focus area. Agricultural production is not allowed in the year of announcing. Nitrogen fertilizer and pesticides are not allowed. The mowing/cutting material from fallow land, designated as environmental focus area, is not to be used as fodder or for bio gas plants.	Plowing not allowed or limited during specific times on areas at risk of soil erosion (1. December - 15. February). Soils at erosion risk are classified into two classes. CCW1 (erosion risk): Ploughed areas after harvest, before 1. December, have to be sown. The farmer does not have to follow those regulations, if he works parallel to the slope (ploughing as well as seeding, etc.). Other preventive measures are not mandatory. CCW2 (high erosion risk): Ploughing forbidden 1. Dec - 15. Feb). German Bundes-Bodenschutzgesetz (BBodSchG) supposed to lower the risk of degrading soil quality. It is controlled by federal states. Law gives some amount of freedom for farmers ("site-specific usage").

Measures adjacent to fields		
Buffer zones	Forestation	Establishment of wetlands
Pufferzonen/Randstreifen/Gewässerrandstreifen	Aufforstung/Bewaldung	Errichtung von Feuchtgebieten
General rules: 3 meters from lakes and streams. 1 meter if precision equipment is utilized (defined on list form the state, for instance hose or injection). A 5m buffer zone at field-borders besides surface-water (Mandatory from 2022, so it doesn't interact with current period of sponsorship for buffer zones). **Voluntary buffer zones:** at least 1m broad with a maximum width of 20m. Parallel to the water body. Buffer zone can have different widths in different places (e.g. along meandered rivers). Buffer zones has to differ significantly from fallow land when it comes to vegetation. Agricultural production is not allowed on buffer zones. Pasturing and usage of cut material is allowed. If the area is not planned to be used as arable land the following year, the area has to be cut and the material distributed over the area. No pesticides, no fertilizer. Self greening or targeted sowing. Forbidden to mow buffer zones between 1. April and 30. June	Can also be used for EFA. Weighting factor of 1.	Recommendations are available and development is planned especially in areas prone to flooding.

9. Literature

Geupel, M. (2016). "Quantification of the German nitrogen cycle."

Landwirtschaftskammer Niedersachsen, 2014. Nährstoffreduzierte Fütterung in Niedersachsen.

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Annex 5
Country report - Schleswig-Holstein

Contents

1. Context

Throughout Germany, agriculture is an important activity, but the structure of the agricultural sector is quite different across the regions. Germany is divided into 16 states and in relation to the nutrient management the states main function is to monitor the environmental state, compliancy and to offer agro-environmental schemes. In general, there is a regional difference in agricultural structure and natural conditions, furthermore the Northern states have less money, hence there is a variation in the schemes that are offered.

Germany has a complex governance system: The federal government develops the overall framework for the management of water and nutrients and the local governments are responsible for the implementation of the policy measures. In an assessment of the German nitrogen cycle, it is assessed that 4.2 million tons of reactive nitrogen enter the nitrogen cycle annually. Whereas considerable reductions have been made in other sectors, reductions in the agricultural sector have been much less successful (Geupel 2016). Within the European Union, Germany ranks among the six north-west European countries with the highest yields per hectare (ha) of agricultural production area, yet it is also one of the six countries with the highest national nitrogen surplus . Although the N surplus decreased after the 1950´s the decreasing trend has slowed down and shown stagnation at a level of about + 100 kg/ha since 2001. In effect, a number of regions face a challenge with high N-concentrations in the upper groundwater, see figure 1.

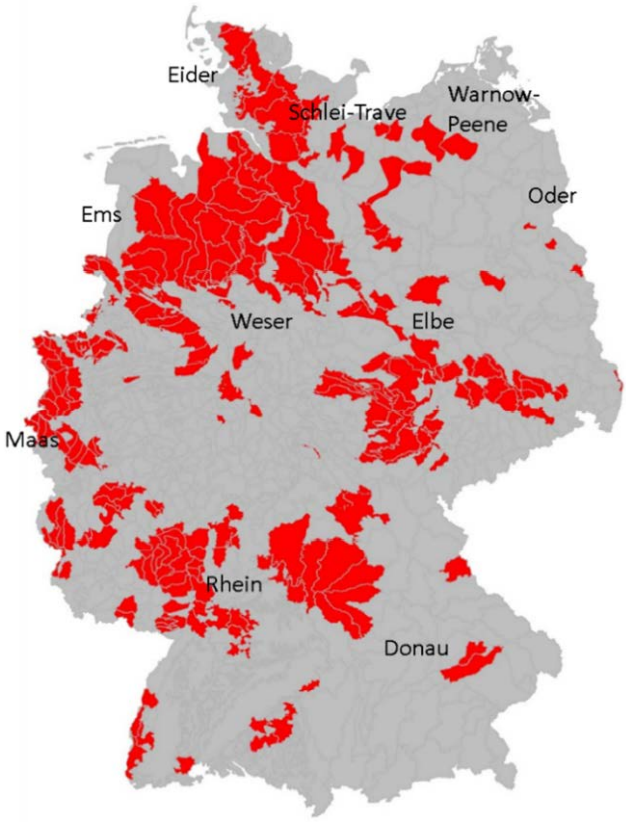

Figure 1. *The red zones depict areas of Germany where the nitrate concentration exceed 50 mg/l (Limit in the ND) (Taube, Henning et al. 2015).*

The national framework for the nutrient management is detailed in the "Düngegesetz" (fertilizer law) and "Düngeverordnung" (fertilizer application ordinance) (Taube, Balmann et al. 2013). Fertiliser Application Ordinance (DüV) is the central instrument for ensuring best management practice in fertiliser use and a reduction in nutrient surpluses originating from agriculture. The DüV contributes to the implementation of the EU Water Framework Directive (Directive 2000/60/EC) and to the EU Marine Strategy Framework Directive (Directive 2008/56/EC). Furthermore, DüV is the national implementation of the rules that are based on EU law within the framework of the EU Nitrates Directive of 1991 (Directive 91/676/EEC) and it is the central instrument in the German action program for implementing this directive. Hence, the ordinance govern the rules for implementing best management practice in relation to application of fertilizer and also for mitigating the environmental risks that arise from fertilizer application. Based on this national framework each individual state is responsible for implementing a fertilizer management program. In 2017, the DüV was renewed. In the new version, fertilizer planning is more emphasized and not adhering to these regulations are handled stricter with reduction of payments. According to paragraph 13 in the new fertilizer ordinance (DüV) the individual states may implement stricter regulation in area where either the nitrate concentration is the main reason for not reaching a good chemical status in groundwater bodies or where phosphate concentrations are above environmental standards. However, currently it is unknown how the different states will deal with it, but it is very central as two thirds of Schleswig-Holstein is vulnerable due to high nitrate concentration and high P concentration values. As the agricultural structure, density and environmental impact is quite different in the different states this is likely to differentiate the development, implementation and impact of the nutrient regulation.

In Schleswig-Holstein, the challenges of improved nutrient management is considerable, mainly because half of the area has too much nitrate in the upper ground water and at least 1/3 of surface water body streams fail the criteria for ortho-P. This is particularly pronounced in the northern and central part of the area, where the density of the animal production is highest and due to a high prevalence of bioenergy production, see figure 2 and 3. Since 2005 the situation has not improved, but monitoring show equally high or increasing values for nitrate in the upper groundwater.

Particularly in the northern part of the state there is a very high N surplus, see figure 3, however, Schleswig-Holstein is not in a situation where the animal density exceeds the manure application standards set in the nitrate directive, if each field are fertilized at the maximum level allowed.

2. Drivers behind nutrient policy

The nutrient policies in Germany has been under increasing pressure both domestically and internationally. The German Fertiliser Application Ordinance was evaluated in 2012 by a Federal Government Laender Working Group, which concluded that additional measures have to be implemented in order to attain the targets and meet the objectives. Furthermore, the EU has encouraged the need for changes, a need that

partially goes beyond the results of the national evaluation. At the moment there is a particular focus on meeting the requirements of the ND, as this is most pressing in relation to the transposition lawsuits. Which are primarily due to poor control with farms nutrient balances. Furthermore, due to a change in the interpretation of the requirements for groundwater monitoring suddenly there is a large N-surplus that will need to be reduced.

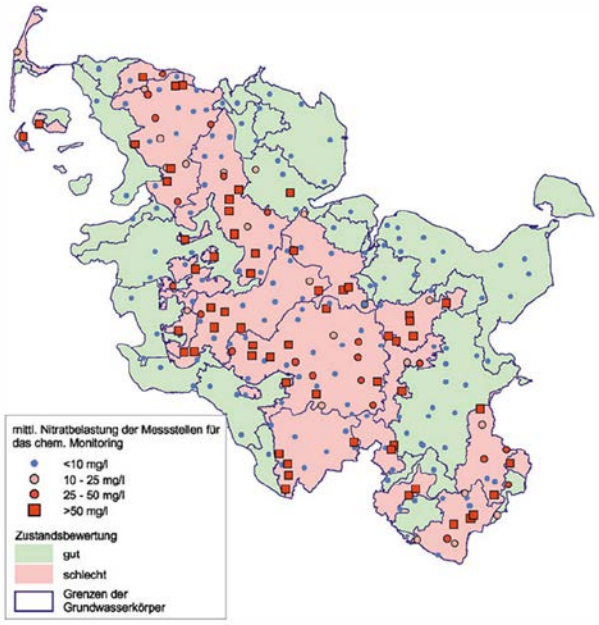

Figure 2. Status of the groundwater surveillance in SH, the red areas indicate a poor groundwater condition (Steinmann 2014).

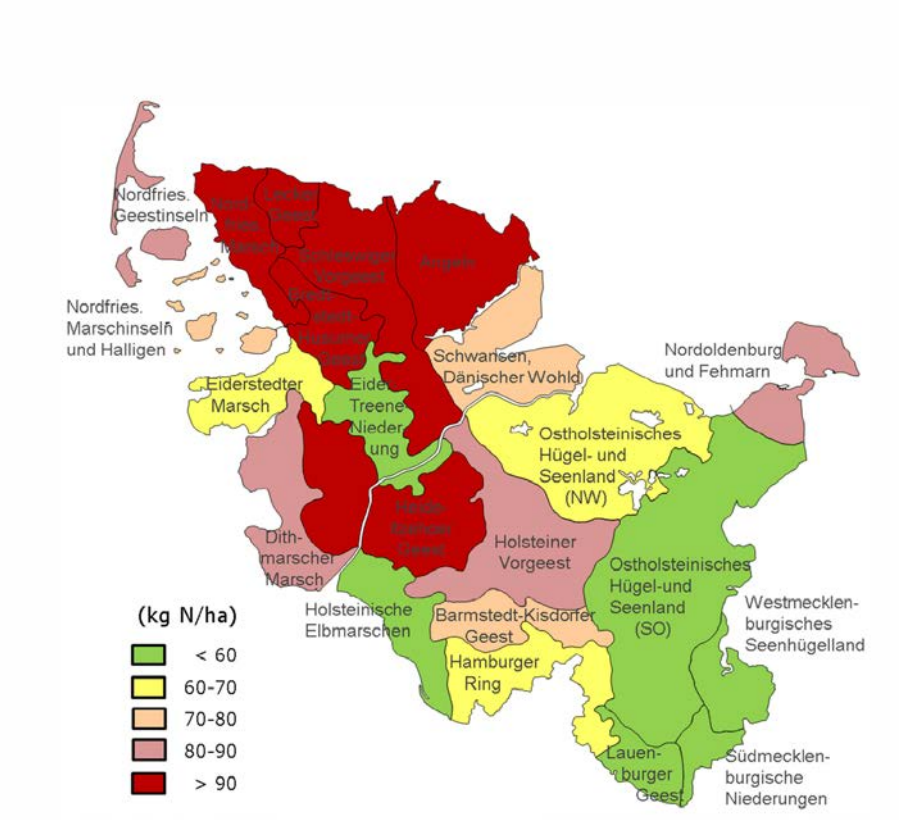

Figure 3. N-Balance of Schleswig-Holstein, 2010 data (Taube, Balmann et al. 2013)

3. Organization of the scientific advice to policy makers

At federal level particularly two relevant advisory boards make advice for policy development, which are relevant to understand the scientific evaluation of proposed policy instruments. This includes 1) the Scientific Advisory Board on Agricultural Policy. This advisory board has up to 19 members working in various fields on issues of agricultural policy, food and consumer health protection. The board is appointed by the Federal Minister of Food and Agriculture for the duration of three years and the chair is elected by the Advisory Board. Members are chosen from university professors of relevant scientific disciplines. 2) The Scientific Advisory Board on Fertilizer Issues, which consists of ten members representing the special fields of plant nutrition, crop production, organic farming, fertilizer analysis, toxicology, ecotoxicology and environmental and animal hygiene.

Both advisory boards are based at Germany's Federal Ministry of Food, Agriculture and Consumer Protection – BMELV. The boards advise the Federal Ministry by providing expert opinions. The members of the Advisory Board serve on a voluntary basis and are not bound by instructions. Hence, in addition to developing opinions based on questions posed by the policymakers at federal level the advisory board also have the freedom to pose their own questions to explore new knowledge. Interviewees stress that this freedom is an important aspect of the ability of the boards to inform the policymakers and politicians of emerging and

pressing issues. The Advisory Board is assisted by an office at the Federal Office for Agriculture and Food who are facilitating the advisory boards.

In addition to this federal level of advisors each state has their own ways of evaluating policies and conducting analysis. Schleswig-Holstein have an agreement with Kiel University, who advise the local government, which has resulted in a nutrient report documenting the nutrient management and challenges in the state.

Furthermore, the agricultural chamber (Landwirtschaftskammer Schleswig-Holstein) is an important institution as they manage field stations, which are ideal typical farming systems with optimal management where nutrient leaching is measured. In addition, the agricultural chamber offer extension service for farmers, including advise on nutrient management and environmental protection in the red areas.

Kiel University manages three test farms representing different farming systems, they are owned by the university and get their funding from the state and from the federal government through a scientific committee, based on research project applications.

4. Policy implementation and stakeholder involvement

In Schleswig-Holstein nutrient management is carried out by the Ministry of Energy, Agriculture, Environment and Rural Areas which have both an agricultural divisions, responsible for managing agro-environmental schemes, controls and compliancy and a water division responsible for monitoring the environmental state of the waterbodies.

The ministry further organizes the alliance for water protection (Allianz für den Gewässerschutz), which is an important forum for public participation and for the dissemination of new research results. Background of the alliance was the election in 2012 which resulted in a green majority, who wanted to change farmers nutrient management strategies via dialogue and advice. The participants include the farmers' association, the local agricultural chamber, the MELUR, the employment association, local waterboards, the biogas association, the UNI Kiel, the FH Rendsburg, the Rendsburg agricultural school and various consulting organizations. The alliance meet 3-4 times pr. year and is organized into 6 working groups with different thematic focus (feeding optimization, economic fertilizer use, spring manure application, manure application methods, manure storage, buffer strips). The work in the alliance has been a bit difficult in the beginning as it was a completely new forum, but particularly in the last years especially the farmers association have acknowledged that they have a nutrient problem and must adapt to the rules. For instance, the farmers association recently published a report documenting that they will have to change their thinking about nutrient management, so the alliance has led to a change in the public perception of the nutrient management.

In addition, Schleswig-Holstein has around 450 water boards, who manage the surface waters, lakes and small streams, in relation to maintenance work, and to keep the water running. Furthermore the water boards

are responsible for measures, often they are the body applying for funding of the implementation of measures as a collective entity. The local waterboards are self-administered and it is a semi-democratic institution, which is 100-150 years old. Every landowner must pay a fee to the water board and waterboards are mainly organized in rural areas where farmers are the only members. In addition to the funding obtained via fees the water boards also get subsidies for river maintenance. Since 2003 30 waterboard groups re representing different subcatchment areas, have been used for consultation in relation to the development of the River Basin Management Plans. These sub groups have many tasks in the process, they can decide about the designation of the water bodies, whether it is natural or heavily modified and they can also implement some of the measures.

5. Recent changes

In February 2017, the fertilizer law was amended and in May 2017, the DüV was revised due to problems concerning German transposition of the EU WFD and ND. The basic idea is to achieve better nutrient management and control which will enable an improved nutrient utilization. The revision was carried out with an inspiration of the Danish nutrient management system. The change include various elements 1) New and stricter requirements concerning manure application, manure storage, fertilizer norms and application, see current requirements in section 8. 2) Another important change is new reporting requirements detailed in a new ordinance under the fertilizer law called "Stoffstrombilanzverordnung". It will become effective in January 2018 and according to this ordinance, field gate balances have to be calculated. Up until today, farmers have developed field balances, which are accurate for some crop types, but not for forage and grasslands, hence, farmers have effectively been able to adapt their yield to the nutrient application when making accounts. This has meant that farmers would have a good balance on paper, but not in reality. Hence, one of the most important points in new regulation is that authorities have more possibilities to control the farms, hitherto the authorities have no access to data on fertilizer use electronically, it has to accessed from the farm, which is very complicated, this will change. Hence, until now authorities have been unable to make a risk control, in the future this will be possible. From 2018 onwards for all farms exceeding 30 ha and 2,5 AU/ha (~8-10 %) will be required to develop a field gate balance, and from 2023 onwards the use of the field gate balance will be evaluated and may apply to all farms. Nutrient demand for arable crops and grasslands are determined based on standard coefficients in the new ordinance. The value is not similar all over Germany, but it is specified according to climatic variation and soil conditions. Farmers can differ from this standard value if he/she can prove that his yields are above average, if more productive 10% more fertilizer is allowed, the opposite if the farmer is below. 3) Furthermore, data protection laws have made it impossible for the government to monitor farms properly. Hence, currently much work developing databases to administer these new documentation requirements.

A tangible outcome of the regulatory change is the development of an online nutrient exchange portal (Düngebörse), where farmers online can exchange manure between areas with a high animal density to

areas with a low density. This institution will be established in all states with a high livestock density to achieve a better utilization of the local animal manure.

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7. Overview of policy measures in Schleswig-Holstein

	Schleswig-Holstein
P-ceiling	X
Manure storage and use	X
Catch crops	X
Perennial energy crops	
Set-aside (non permanent)	X
Ban against soil management in particular periods	X
Permanent land-use conversion	
Buffer zones	X
Forestation	X
Controlled drainage	-
Miniwetlands with surface flow	-
Miniwetlands with filter matrix	-
Wetlands	X
Wet buffer zones	One test site

Note: x indicate that the measures is in use, - indicate that the measure is not in use and, blank indicate that we are uncertain.

8. Detail of policy measures

Nutrient management				
Harmonie regulation	Fertilizer norms	P-seiling	Utilization of N in manure	Manure storage and use
Stickstoff Regulierung	Düngeverordnung		Nutzung von Stickstoff in Gülle	Güllelagerung
Legal limit of 170 kg N/ha of organic fertilizer. (Until 2013 it was possible to file an application for 230 kg N from manure/ha. 8-10% of farmers use 230 kg N/ha. Since 2014 not possible anymore). Currently unknown if digestate from biogas plants and sewage sludge should also be included as manure in the future.	Based on 91/676/EWG (EU Nitrate directive 1991). German instrument for execution of the EU-directives: By the national law Düngeverordnung (DüV). Regulates amount, time, distance to surface water etc. Norms are adjusted after crop, yield, soiltype, previous crop, decomposition of straw and N-min samples in early spring Within all drinking water protected areas norms are mandatory (37 areas of which 25 are appointed with agriculture).	Max 20 kg/ha phosphate in surplus in average over 6 years. High P level in the soil: no surplus	**After harvest:** N-Manure maximum of 60 kg N/ha. Ammonium-Nitrogen-Manure maximum of 30 kg NH4-N/ha. **Cow slurry:** 50 %, Below this maximum other percentages apply if below limit for animal manure 70% and 80% respectively depending on amount. **Pig slurry** 60 %, otherwise similar to cow, however the percentages are 60, 70 and 60 respectively. **Deep litter**. Pig and poultry manure 30 %. Cow, horse goat 25%. Other manure: poultry 60%, urine 90%. Calculations are based on clause 3 in "Düngeverordnung".	**Storage capacity:** Should equal 7 months production (Previously 6 months). Distributing manure banned after harvest of the main crop in late summer/autumn. **Distance requirements:** At least 50m distance to drinking water springs or wells. Not allowed in water protection Zone I and II (exceptions for zone II exist). Permanent impervious. **Manure disruption:** Manure may be distributed from November 1st until January 31st, however, for grass November 01th-january 31th. In addition, after last harvest distribution only on fields with a crop, total max 60 kg. N or 30 kg ammonia. **Special exceptions:** Ban on manure use on slopes exceeding 10 % and with a distance of 20 meter to recipients the rules are: • Slopes between 5-10 meters, manure must be ploughed down apart from manure from poultry where the 10-20 meter rule apply • Slopes between 10-20 meter manure must be injected • Fields without crops (after harvest, if sowing first in spring), if injected or ploughed down immediately (<4hrs) • On fields with row crops with a distance of 45 cm or more between the rows (primarily corn) only if also catch crop, the crop is developed or fertilizer is ploughed down within 4 hrs. • For other crops only if there is adequate plant cover or immediately after harvest or direct sowing. No manure on frozen land or snow cover . mandatory requirement

Field and farm management		
Catch crops	Fallow (non permanent)	Ban against soil management in particular periods
Zwischenfrucht	Brache (nicht permanent)	Verbot von Bodenbearbeitung in bestimmten Perioden
Establishment: 16. July - 1. October for areas announced as Environmental Focus Area. The use of pesticides, mineral fertilizer or sewage sludge is banned between previous crops and catch crops. Organic fertilizer is allowed. Catch crops have to remain on the field until the 15. February. In addition, catch crops is one of the ways that farmers can live up to the requirements of Environmental Focus Area (1 ha, corresponds to 0,3 ha of EFA). Catch crops are mandatory in drinking water areas: application of fertilizer can be expanded until September 15th if there is established catch crops or winter rape after the main crop. In addition, special rules may be implemented in each drinking water area.	Fallow land is only allowed on cropland. 1 ha fallow land is considered as 1 ha environmental focus area. Agricultural production is not allowed in the year of announcing. Nitrogen fertilizer and pesticides are not allowed. The mowing/cutting material from fallow land, designated as environmental focus area, is not to be used as fodder or for bio gas plants.	Plowing not allowed or limited during specific times on areas at risk of soil erosion (1. December - 15. February). Soils at erosion risk are classified into two classes. CCW1 (erosion risk): Ploughed areas after harvest, before 1. december, have to be sown. The farmer does not have to follow those regulations, if he works parallel to the slope (ploughing as well as seeding, etc). Other preventive measures are not mandatory. CCW2 (high erosion risk): Ploughing forbidden 1. Dec - 15. Feb). German Bundes-Bodenschutzgesetz (BBodSchG) supposed to lower the risk of degrading soil quality. It is controlled by federal states. Law gives some amount of freedom for farmers ("site-specific usage").

Measures adjacent to fields		
Bufferzones	Forestation	Establishment of wetlands
Pufferzonen/Randstreifen/Gewässerrandstreifen	Aufforstung/Bewaldung	Errichtung von Feuchtgebieten
General rules: 3 meters from lakes and streams. 1 meter if precision equipment is utilized (defined on list form the state, for instance hose or injection). A 5m bufferzone at field-borders besides surface-water (Mandatory from 2022, so it doesn't interact with current period of sponsorship for bufferzones). **Voluntary buffer zones:** at least 1m broad with a maximum width of 20m. Parallel to the water body. Bufferzone can have different widths in different places (e.g. along meandered rivers). Bufferzones has to differ significantly from fallow land when it comes to vegetation. Agricultural production is not allowed on bufferzones. Pasturing and usage of cut material is allowed. If the area is not planned to be used as arable land the following year, the area has to be cut and the material distribted over the area. No pesticides, no fertilizer. Self greening or targeted sowing. Forbidden to mow bufferzones between 1. April and 30. June	Can also be used for EFA. Weighting factor of 1.	Recommendations are available and development is planned especially in areas prone to flooding.

9. Literature

Geupel, M. (2016). "Quantification of the German nitrogen cycle."

Steinmann (2014). Gewässerschutzberatung in Schleswig-Holstein. Hochwertiges Trinkwasser. Bauernblatt. 6.

Taube, F., et al. (2013). "Amendment of the fertiliser application ordinance: Limiting nutrient surpluses effectively." Berichte über Landwirtschaft-Zeitschrift für Agrarpolitik und Landwirtschaft(219).

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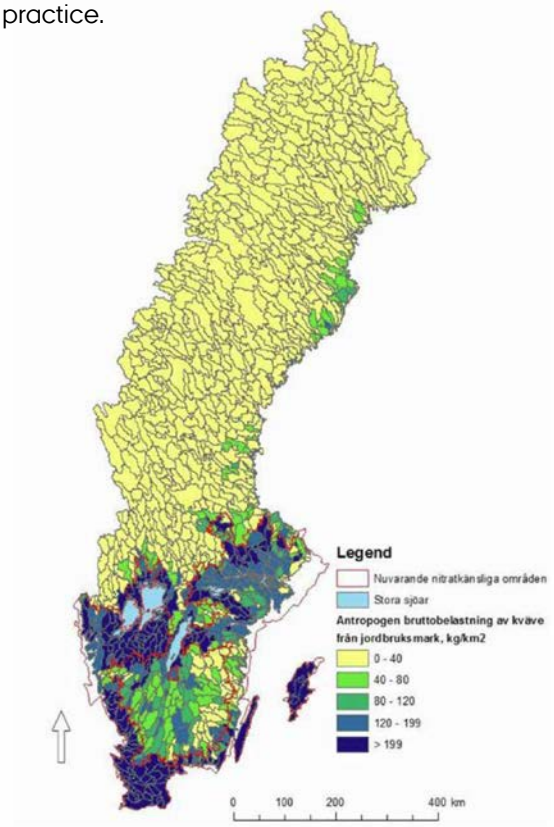
Annex 6
Country report - Sweden

Contents

1. Context

The use of the Swedish landscape is very varied, most of the country is covered with forest or other semi-natural areas and agriculture only accounts for about 8 % of the Swedish land use. The agricultural areas are concentrated in certain regions particularly in the center and along the southern coastal regions, where agriculture has a more prominent place in the regional land use, see figure 1.

Due to the low density of agriculture, agriculture is only a minor part of the water management. ND requirements are mostly fulfilled. Today, the focus in Sweden is primarily on the implementation of the WFD and Baltic sea action plan (HELCOM). The main focus is on P due to the presence of many P sensitive lakes and because many rivers discharge to the Baltic sea where P is the limiting factor on the water quality. In many lakes and coastal waters eutrophication is a common problem, hence 75 % of the agricultural area in southern Sweden is designated as a Nitrate Vulnerable Zone. Particularly the Baltic Sea is highly impacted due to the leaching of nutrients from agricultural areas. Around half of the Swedish leaching of N and P and about 85 % of the ammonia emissions derive from agriculture. To reduce the environmental impact, Sweden is committed to a 15 % ammonia emissions reduction by 2020 and by 17 % in 2030 compared with 2005. In the period 2005-2014 ammonia emissions have been reduced by about 6 %. Hence, ammonia emissions need to be further reduced (by more than 6 ktonnes until 2030). The local counties are an important actor in implementing these policies in practice.



Figur 1: Anthropogenic grass nitrogen load (nitrogen leaching) from agricultural land per total land area (Johansson and Bång 2014).

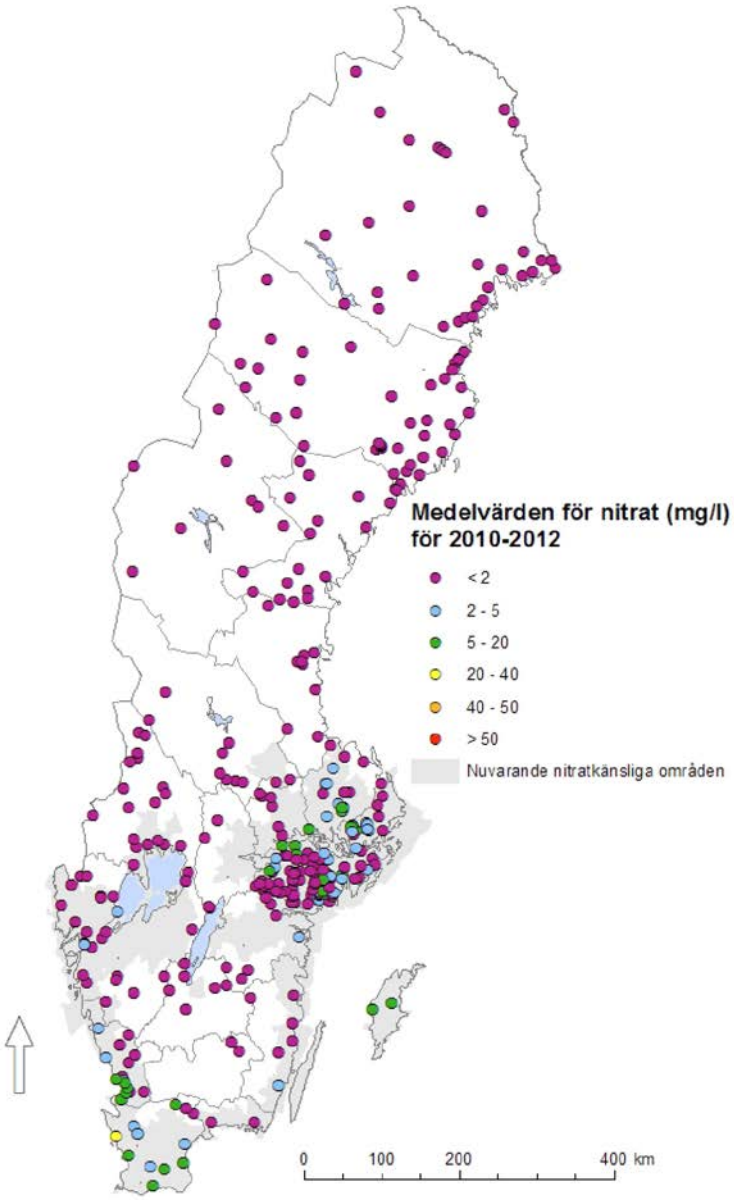


Figure 1: Groundwater nitrate concentration and designated NVZ (Johansson and Bång 2014).

2. Drivers behind nutrient policy

Sweden has worked with nutrient reduction from agricultural land since the end of the 1980s. Today, the ambitions are based on EU directives, international commitments and national environmental objectives (Aronsson and Johnsson 2017).

Important national drivers of the Swedish nutrient management is a national adaptation of 16 "Environmental Quality Objectives, the objectives have been politically approved by the Swedish parliament (Jordbruksverket 2013). However, they are goals for the whole society and not only for the development in the agricultural industry. This include an objective of "Zero Eutrophication" that addresses nutrient loss and its environmental impact. The environmental objective has been defined by the Swedish Parliament as:

"Nutrient levels in soil and water must not be such that they adversely affect human health, the conditions for biological diversity or the possibility of varied use of land and water." This includes an ambition of lowering the impact on 1) the pressures on the marine environment 2) pressures on the terrestrial environment, 3) good ecological status of lakes, watercourses, coastal waters and groundwater and 4) good environmental status of the marine environment. Other relevant environmental objectives of relevance include "Thriving Wetlands", "Reduced Climate Impact" and "Good-Quality Groundwater". Based on these objectives particular targets for the nutrient management are set.

Measures to reduce nutrient losses particularly address three aspects: 1) legislation concerning nutrient management and application procedures, 2) financial instruments such as agri-environmental payments and 3) facilitating extension services and providing information on good practice (for instance the initiative Focus on Nutrients (Greppa Näringen)) (Jordbruksverket 2013). Environmental legislation is gathered in the Environmental Code (Miljöbalk (1998:808)), and in its ordinances and regulations. Detailed rules about the handling of nutrients are available in the Ordinance (Förordning (1998:915) om miljöhänsyn i jordbruket), which specifies environmental concern in agriculture including rules on manure storage capacity and minimum shares of land under vegetative cover during autumn or winter (which is called green land). The Swedish Board of Agriculture (Jordbruksverket) administers rules and general guidance on environmental concern in agriculture that include rules regarding manure storing facilities, spreading area and techniques, quantity restrictions and detailed rules on green land. Furthermore, Swedish framework for water management is found in the water management act (Vattenförvaltningsförordningen).

3. Organization of the scientific advice to policy makers and central organizations in the nutrient management

The Swedish Board of Agriculture (Jordbruksverket) is an agency under the Ministry of Food (Näringsdepartementet) that deals with the impact of agriculture on water and air and work with the implementation of measures to reduce the impact, furthermore the agency is responsible for the implementation of the ND and the implementation of the rural development program. The Board of Agriculture is the Government's expert authority in the agro-food sector, and is responsible for all matters related to agriculture and horticulture. This means for instance that they monitor and analyze the development within the sector and keep the Government informed, but also implement political decisions within their field of activity. For instance, the agency allocates funds to research and development for reduced nutrient losses, including both cropping and technical development in agriculture and horticulture. The Board of Agriculture employs various advisors in Alnarp, Skara, Linköping and Uppsala. Each regional office coordinate the practical conduct of the nutrient management advice in the region.

In addition, the Swedish Agency for Marine and Water Management (Havs- och Vattenmyndigheten) under the Ministry of Environment and Energy (Miljö- och energidepartementet) deals with environmental matters, including monitoring the state of the environment and implementation of the WFD. The agency has regional

offices and work in close collaboration with the counties and municipalities that have the responsibility for implementing the environmental policies in practice.

Research activities in relation to policy measures are primarily carried out by Sveriges Landbruksuniversitet (SLU) (and a number of other public knowledge institutions), that also contribute to manages a national database of policy measures(viss.se) managed by the Water Authorities (vattenmyndigheterna). The database gather all information concerning policy instruments and environmental monitoring in Sweden related to the Water Framework Directive. Agricultural field research is carried out at 4 different research facilities that carry out about 100 trials per year. The research activities at SLU are coordinated by, FältForsk, which is a cooperation between SLU and other organizations within the agricultural sector. In addition, SLU monitors the environmental state in 2000 points in the arable land under the national environmental surveillance program for the nature protection agency (Naturvårdsverket). The objective of the program is to monitor the environmental quality targets quantitatively and describe the state of Swedish farmland as well as the quality of the crop in relation to the state of the land, crops and modes of operation. There are special aspects of the program, which monitors agriculture's effect on water quality, based on the surveillance of "typical areas" and "observation fields". The "typical areas" consist of small catchment areas dominated by agriculture, in these areas samples are taken from runoff water and in surface near groundwater. "Observation fields" are areas of arable land in ordinary crop rotation with individual farmers, where samples of drainage water and surface near groundwater is collected. SLU is responsible for coordinating and presenting the results of these programs.

4. Policy implementation and stakeholder involvement

There is no fixed protocol for approving new policy instruments, but generally, the task is commissioned by various agencies in the Swedish Government where an analysis documenting the costs and efficiency normally is initiated, which can be done using different methods such as tests and trials, modelling or spatial analysis. Hence, how the analysis is carried out differs from time to time but generally if there is a decision on a new measure or a new rule there should be an analysis of the consequences. Sometimes the Government also enclose instructions on particular aspects of the inquiry that they want to emphasize and detail how detailed they need their descriptions. In general, a description contains a detail of the scientific measure, where it will be effective, how much it will cost and contribute to reducing the nutrient load from agriculture or something else. Cost calculations are either completed by employees within the agencies or commissioned to researchers at the universities, depending on the requested speed and accuracy and whether there are researchers with specific competences. The different agencies do not conduct their own research activities, but commission research from partners.

Generally Swedish farmers are little involved in the policy development, where involvement is primarily intended for NGO's, however, great focus on involvement and voluntary action in the "Greppa Näringen" program, which emphasize voluntary action through consultancy and capacity building in the implementation phase. Extension service plays a crucial role in the Swedish nutrient management, which is

carried out by The Board of Agriculture. The emphasis of the advisors is to ensure that actions to reduce nutrient losses are implemented efficiently, disseminate information about new research results, trials, and new legislation. Generally the Swedish nutrient management emphasizes voluntarity as the preferred means for implementing policy measures and they greatly emphasize the use of voluntary measures and dissemination as the preferred policy instrument to motivate the landowners and tailoring solutions for the individual farms.

Local advisors are organized in the Focus on Nutrients program (Greppa Näringen), as a joint venture between The Swedish Board of Agriculture, The Federation of Swedish Farmers and The County Administration Boards. About 8000 farmers accounting for an acreage of 1 million hectares (40 % of Sweden´s most intensively cultivated arable land) utilize the service. Farmers are offered a range of different themed advisory sessions organized at the farm. At the visits an advisory plan is developed along with a nutrient balance and the visit may be followed up by several future visits. The issues that are addressed include strategies for fertilizing, manure handling, animal feeding, precision farming and wetland construction, always taking into account the farm influence on the farms' economic performance. One of the corner stones of the program is the emphasis on putting the farmer in focus. According to Hellsten, Dalgaard et al. (2017 (Forthcomming)), there are four factors that explain the success of the program, 1) Repeated visits are key to change behavior, 2) The advisor always has to relate to how measures are taken and how it will influence the farm economy, 3) It is important to inform farmers about the progress and make them proud of their achievements – preferably through the media/press and 4) To inspire change, the visits need to be voluntary for the farmer.

The establishment of wetlands is mentioned by several interviewees as an example of the success of this approach, as no other country has created so many wetlands in such a short time. In particular Sweden has prioritized the construction of many small scale wetland projects, that in practice does not require the participation of multiple landowners. The task of (re)establishing wetlands is not easy even though it is often a financially good decision for the farmer, hence they are often reluctant to flood their farmlands, as it goes against the whole identity of the farmers. Therefore, it requires an enduring and active dialogue to enable locally acceptable solutions and making sure that all actors realize the multiple benefits of the policy instrument. In the implementation of the policy measures, the effect is maximized by differentiating the support granted via the rural development program, if the measure is located in an area with a high nutrient loss as much as 90 % of the costs are covered. It is important that such a task is carried out with patience and involves actors that are in close contact with the farmers in an active dialogue and are able to develop locally tailored solutions.

Counties and Municipalities also have an important function in relation to the implementation the national environmental objectives and also contribute to the implementation of nature reconstruction via their own funds. Particularly some of the southern counties and municipalities in Skåne have been quite active in the water management. The counties are grouped into five county boards that are appointed by the

government to be water authority in each of its water districts. There are county boards in Norrbotten, Västernorrland, Västmanland, Kalmar and Västra Götaland. The county administration is responsible for giving permits and administration of the rural development program, but there is also a differences between the different counties not big differences need to ask others about this legal implementation. The five county administrations collaborate on developing the water management nationally through information and collaboration with stakeholders. The municipalities are responsible for auditing companies that influence the aquatic environment based on the Environmental Code.

Another important local institutions is the water boards that have been established to implement the WFD, there are about 100 of these in Sweden. Informants note that these waterboards are driven by the local engagnement, hence some of the waterbords are very active, whereas other are less active. Initially the water boards had their own money to cover administrative costs and they could also apply for for funding of activities. However, the success has waded off a bit as the waterboards have no legal function as such, as all these matters are decided in the county administration. But they function as some kind of consultancy forum for the county administration. In addition to these new water boards the municipalities in Southern Sweden have used another form of waterboards for more than 30 years, which are using their regional and own money for installment of measures.

In addition to these initiatives the Swedish Agency for Marine and Water Management arrange an annual workshop that gathers all stakeholders and practitioners who are engaged in water management to different sessions concerning the possibilities for policy development.

5. Recent changes

At the moment no upcoming changes are expected, but there is a lot of work taking place in embedding the national environmental ambitions in the strategic plans of counties and municipalities. The new rural development program has nearly started, because there was a delay in the implementation. Furthermore the River Basin Management Plans and resulting actions have just been updated and should now be implemented and have time to work. When these programs ends they will be evaluated and may be changed accordingly.

6. Mode of regulation

On a national scale the 16 strategic environmental goals provide a comprehensive strategic framework for nutrient use and management. On a local level there is also much focus on voluntary action and capacity building as a means of achieving policy goals. Number of different instruments are used and tested in negotiation between farmers, advisors and authorities. The administration and farmers are relatively open towards trying out new things, hence a number of policy measures have been implemented without much previous testing. The advantage is that it is relatively easy to introduce new things and things get tested in practice immediately, but the disadvantage is that a lot of mistakes are also made (see description of controlled drainage, wet buffer zones below). Many of these solutions are locally adapted to the specific

environmental conditions that apply. A benefit of the approach is that Sweden has been quite good at implementing complicated measures such as constructed wetlands. However, it is also important to stress that Sweden due to a relative low density of agriculture has not faced a challenge that is comparable to some of the other countries in Northwestern Europe.

7. Overview of policy measures in Sweden

	Sweden
P-ceiling	X
Manure storage and use	X
Catch crops	X
Perennial energy crops	X
Set-aside (non permanent)	X
Ban against soil management in particular periods	X
Permanent land-use conversion	-
Buffer zones	X
Forestation	-
Controlled drainage	X
Miniwetlands with surface flow	X
Miniwetlands with filter matrix	X
Wetlands	X
Wet buffer zones	X

Note: x indicate that the measures is in use, - indicate that the measure is not in use-

8. Detailed description of policy measures

Nutrient management				
Harmonie regulation	Fertilizer norms	P-ceiling	Manure storage and use	Limitations on nutrient management periods
Spridningsareal	Begränsning av mängden tillfört kväve med organiska gödselmedel	Begränsning av mängden tillförd fosfor med organiska gödselmedel och krav på fördelning över hela arealen	Lagring av stallgödsel	Stängda tidsperioder och perioder med begränsning för spridning av gödselmedel
Are there no mandatory regulation on required acreage for animal farming based on N-norms, but this this is implicitly regulated via the P-ceilings.	170 kg N/ha in sensitive areas. In addition, winter cereals may not be fertilized with more than 40 kg NH4-N / ha and winter oilseeds maximum of 60 kg / ha. In sensitive areas under the Nitrates Directive, to protect from overuse of nitrogen, farmers must make a qualified assessment of the nitrogen demand and adjusts the application rate for it. The rule is a Swedish solution to what in many countries would otherwise expressed as fertilizer norms for different crops. The calculation should be documented in the field plan. The calculation should built on expected yields, long-term effects of manure, preceding crop, the supply of organic fertilizers and soil (loam). As a basis for calculating the crops nitrogen requirements the guidance of the extension service for fertilization and liming must be used.	A farm must not produce more manure than what corresponds to 22 kg P/ha, and within a five year period each field must not receive more than what corresponds to 22 kg P/ha. This only applies to manure and not mineral fertilizer.	No requirements for farms less than two animal units. Farms larger than 10 animal units 10 months storage is required except for sheep, goat and horse, where 6-8 months are required. In sensitive areas also farms less than 10 animal units must have storage facilities for 6 months (see detailed table in publication cited). In some areas also regulation about cover of liquid manure.	No nutrients may be distributed from November 1st until Febuary 28th in sensitive areas appointed under the Nitrate directive. In addition, no manure distribution from August 1st until October 31th unless it is applied to planted fields or before autumn sowing s in 3 regions (Skåne, Halland and Blekinge). Furthermore, application of manure in growing crops in Skåne, Halland and Blekinge must be distributed with either, hose, injected or subsequently watered with at least 10 mm water. Ploughing of manure (and mineral fertilizer containing urea) on bare field within 4 hours (. No distribution of frozen, snow covered or water saturated field.

Field and farm management		
Catch crops	Fallow (non permanent)	Ban against soil management in particular periods
Höst- eller vinterbevuxen mark	Träda	Försiktighetsmått vid spridning av gödselmedel
Requirement for 60 % green cover during autumn and winter in Skåne, Halland and Blekinge, 50% in the rest of Sweden. Not necessarily 50 or 60% catch crops but catch crops can be one way to fullfill the requirements. It can be ordinary crops that are harvested late, sown durring harvest or perrenial crops. The full list of approved crops: grass, autumn oil crops, winter cereals, sugar beet, root vegetables, fruits and berries (perennial), energy crops, cover crops and unprocessed stubble after cereal or oilseed crops	To obtain support the land should be out of production until July 15th. There are some rules on how to manage the arable land when lays fallow depending on the support scheme. To obtain "the greening support" (förgröningsstödet), the soil may need to be out of production until 31 July in northern Sweden. For compensation support (kompensationsstöd) the fields may not be used for pasture or harvesting of feed before 1 August. This is where compensation is given for Type 1, 2 or 3 farming (coarse crops in combination with cattle, goats or goats). If compensation is given to Type 4 farms (agriculture with crop cultivation crops) and 5 (extensive agriculture with forage, forage crops, cattle, goats or goats), production is permitted after July 15.	Caution has to be given regarding the spreading of fertilizer on sloping land, close to watercourses and on water saturated, frozen or snowy land.

Measures adjacent to fields						
Bufferzones	Forestation	Controled drainage	Construction of miniwetlands with filter matrix	N wetlands	P wetlands	Two-stage dike/wet buffer strip
Skyddszon på åkermark		Reglerbar dränering	Infiltrationsbäddar för rening av dräneringsvatten	Våtmark för näringsretention	Våtmark - fosfordamm - sedimentationsdamm	Tvåstegsdiken
Buffer zone on arable land can be divided into a number of sub-measures. 1) Grass buffers along waterways which is not harvested. 2) Grass buffers along watercourses which are harvested. 3) Custom zones - located where the greatest effect can be achieved for example by dikes, erosion paths inside the field around the wells with surface water intakes, etc. Detailed information on the costs and effects available under the respective measures in the VISS database. In order to receive environmental payment, the protection zones should lie on farmland in the nitrate vulnerable zone. A buffer zone along waterways should be at least 6 meters wide and up to 20 meters wide. To receive environmental support harvest is not allowed before the 1st of July.	This is not a high priority in Sweden due to the high proportion of forested areas and it is expensive	The aim is to reduce the leaching of nitrogen transported by drains. The support is a fixed payment of 8000 SEK per well, for a maximum of 1.5 wells per hectare. According to a study by SLU based on digital terrain model, land use and soil types 100 000 hectares of arable land in the south of Sweden's coastal agricultural areas suitable for controlled drainage. Projects are planned in in collaboration with local counties who administer support under the rural development program. Not widespread in use, due to problems with clogging, the landscape relief and soil types that make it an unsuitable measure and problems with unintended destruction of the upper drain pipes	A number of different types of draining systems are used and tested including various filter types in relation to conventional draining systems containing LECA or lime to chemically solidify dissolved P. Furthermore, since at least 2012 a number of projects with biological filters of dainwater has been carried out.	Wetland construction and restoration is a measure that has been used for a number of years in Sweden (since 1980ties), initially the aim has primarily been to preserve and enhance biodiversity of the landscape or to improve water quality in lakes, rivers and seas by filtering the water. Wetlands are supported under the rural development program, administered by the counties. full support for wetlands require establishment in nitrate sensitive areas. Initially the local municipalities have played a very active part in establishing wetlands. The "wetland research center" at Halmstad Universitet is an important knowledge institution in relation to the construction of wetlands. Wetlands are graded by based on list criteria by the county administration including: Size, location, shaped to best catch nutrients and the surrounding area of arable land and water through flow. Up to 100 % support is given within NVZ, while up to 90 % to areas outside. In addition to these wetlands for nutrient retention support is also given to the construction of wetlands for biodiversity protection.	Dams collecting phosphorus are often smaller than traditional N wetlands and can be built in or along an existing dikes. They should be placed in the upper parts of the catchment area, close to the field where there are problems with high phosphorus losses. The dams are designed for watercourse flow, the greater the flow, the greater the dam to be constructed. Dams are developed and planed and constructed in close collaboration with local advisors. Depending on locality various degrees of support can be obtained.	The past decade two-step ditches have been studied in the United States. The two-step ditches consists of a centerpiece trench, surrounded by terraces on a higher level. At normal flows the water goes down in the furrow and at higher flows, the water rises up on the terraces. The idea is that the design should mimic natural waterways with a centerpiece surrounded by terraces. Two-step ditches is a more stable structure than the conventional trapezoidal ditch because the vegetated area protects the terrace slope, which lowers the speed of the water at high flows. The lower speed decreases the erosion of the trench which is favorable both from an environmental and stability point of view. Currently (2013) ongoing planning to build out a couple ditches in Sweden. It is important that these facilities are monitored to provide a better basis for future investments. Important questions to evaluate the costs and methods of maintenance and down-laying at the cost compared to alternative measures, such as constructed wetlands. Some of these have been implemented, but is at present not considered successful due to problems with erosion

9. References

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Annex 7
Country report - Poland

Contents

1 Context

Poland has about 16.3 million hectares of arable land, which equals about half the Polish territory. In Poland, there are about 1.4 million farms and more than 1 million farms have area of less than 10 ha. These small farms are exempted from the nutrient regulations.

The agricultural policies and their implementation vary across Poland, as the agricultural sector in some regions is highly modernized, whereas other areas are much less developed and do not have that much focus on environmental protection. There is high variation of agricultural intensification in different voivodeships (provinces) in Poland therefore soil nutrient status and pollution differs. The highest density of the livestock production is in Wielkopolskie (81,5), Podlaskie (78,6), Kujawsko-Pomorskie (56,7) and Mazowieckie (56,3) voivodeships (Statistical Yearbook of Agriculture, 2016).

Nitrogen Vulnerable Zones (NVZs) are designated in some of these voivodeships, where stricter regulations and more frequent controls take place. However, outside the NVZs still high amount of fertilizers is used. The amount of organic animal fertilizers produced in Poland was estimated at 80 million ton farm yard manure, about 13 million m^3 liquid manure and 7,5 million m^3 slurry (Agro- News, 2017)

Data about the amount of applied chemical and mineral fertilizers for the whole country is shown in table 1, and for voivodships in table 2. Bigger farms above 20 ha, often do not have enough acreage to apply the animal manure in recommended doses and surplus is applied on fields or disposed in nature. There is also lack of biogas plants to manage the organic waste. In most areas, there are no formal requirements to conduct nitrogen and phosphorus balances and to perform soil analysis to determine nitrogen and phosphorus content. Soil analysis can be also expensive for many farmers.

WYSZCZEGÓLNIENIE *SPECIFICATION*	2009/10	2012/13	2013/14	2014/15
NA 1 ha UŻYTKÓW ROLNYCH w kg *PER 1 ha OF AGRICULTURAL LAND in kg*				
Nawozy mineralne lub chemiczne[a] *Mineral or chemical fertilizers[a]*				
OGÓŁEM *TOTAL*	**119,2**	**133,0**	**132,9**	**123,2**
W tym gospodarstwa indywidualne *Of which private farms*	112,7	126,6	127,8	117,3
Nawozy azotowe *Nitrogenous fertilizers*				
RAZEM *TOTAL*	**68,9**	**80,7**	**75,5**	**69,0**
W tym gospodarstwa indywidualne *Of which private farms*	65,2	76,6	71,9	65,0
Nawozy fosforowe *Phosphatic fertilizers*				
RAZEM *TOTAL*	**23,7**	**25,6**	**23,4**	**20,9**
W tym gospodarstwa indywidualne *Of which private farms*	22,7	24,6	23,0	20,2
Nawozy potasowe *Potassic fertilizers*				
RAZEM *TOTAL*	**26,6**	**26,7**	**34,1**	**33,3**
W tym gospodarstwa indywidualne *Of which private farms*	24,7	25,4	32,9	32,1
Nawozy wapniowe *Lime fertilizers*				
OGÓŁEM *TOTAL*	**39,8**	**43,4**	**47,9**	**39,0**
W tym gospodarstwa indywidualne *Of which private farms*	33,7	38,9	40,3	34,5

Figure 1: The use of mineral and chemical and lime fertilizers in terms of pure ingredient in Poland, per 1 ha of agricultural land in kg (Statistical Yearbook of Agriculture, 2016).

In Polish groundwaters only a few percent of monitoring points register concentration above 50 mg NO_3/l (GIOS, 2016: National Inspectorate of Environmental Protection Report). Most of the monitoring points registered concentration < 25 mg/L (GIOS, 2016).

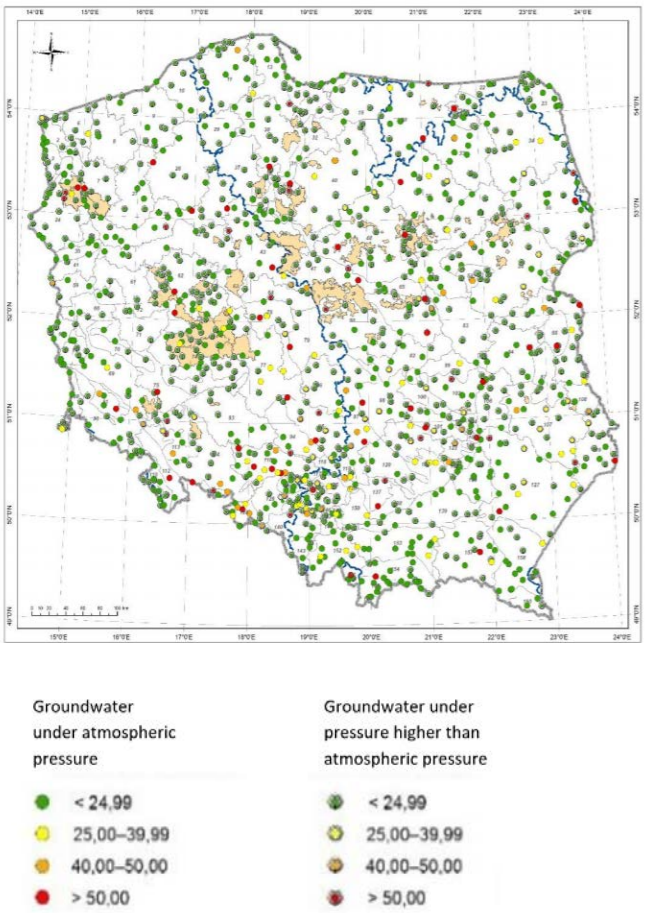

Figure 2: Average NO_3 concentrations in groundwaters in Poland, data collected from 1200 monitoring stations in years 2012-2015 (GIOS, 2016).

Only a quarter of monitored surface waters in Poland has good ecological status (Figure 2). Biogenic compounds such as nitrogen and phosphorus from agricultural and municipal waste water treatment plants caused eutrophication and resulted in low rating (GIOS, 2016).

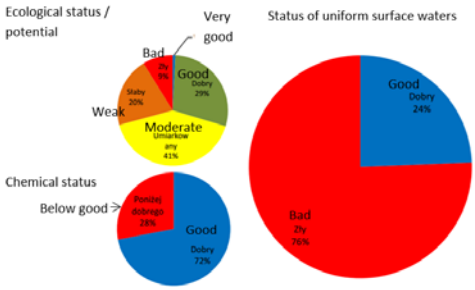

Figure 3: Ecological and chemical status of uniform bodies of surface waters- rivers in Poland assessed in 2015 (GIOS, 2016).

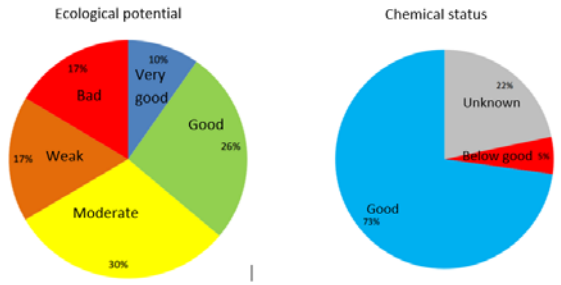

Figure 4: Ecological potential and chemical status of uniform surface waters- lakes in Poland (GIOS, 2016).

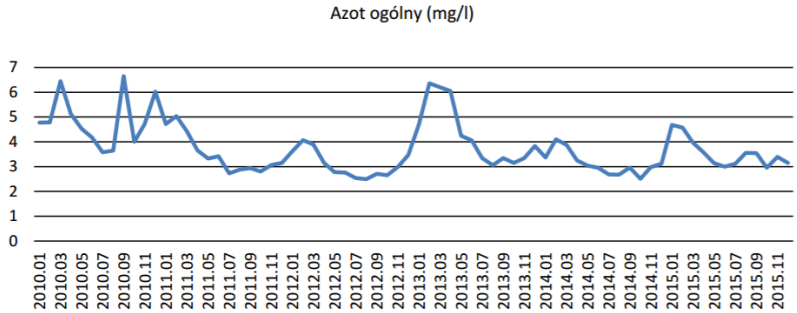

Figure 5: Average monthly concentration of total nitrogen in surface waters from all monitoring stations in Poland in years 2010- 2015 (GIOS, 2016).

In the Polish Baltic Sea Zone the Ecological status was assessed as bad. Problems are caused by excessive nutrient leaching due to insufficient number of sewage treatment plants and excessive fertilization of fields and not sufficient measures to prevent nutrient losses from animal- origin fertilizers (GIOS, 2016). Actions have been taken to reduce the nutrient load. In the period 2011-2014 the share of urban population connected to the sewage network increased from 85% to 87.9% and the rural population increased from 21.3% to 37.4%. The principle of Good Agricultural Practice has been introduced and more farms have implemented measures to prevent nutrient losses e.g. installed manure slabs (GIOS, 2016). Despite of that after more than ten years of downward trend of phosphate concentration in the Polish Baltic Sea, in 2015 the concentration was at an elevated level again (GIOS, 2016). However, for mineral nitrogen forms (NO_2^+, NO_3^+, NH_4^+) downward trend from the preceding decade has been observed (GIOS, 2016).

2 Drivers behind nutrient policy

The water management in Poland currently undergoes a process of major organizational and structural reform driven by external pressure from the European Union for Poland to comply with Water Frame Directive and Nitrate Directive. Problems relate primarily to the absence of Annexes, gaps in monitoring of water status, lacking designation of nitrate vulnerable zones and gaps in the

water monitoring programs. These transposition cases are an important driver for the changes that take place to avoid further procedures.

3 Organizations of the scientific advice to policy makers

The Institute of Soil Science and Plant Cultivation (IUNG) in Puławy is the largest and the oldest research institution in Poland conducting agricultural studies under the supervision of the Ministry of Agriculture and Rural Development (IUNG, 2017). Other important institution is the Institute of Technology and Life Sciences (ITP) established under the ordinance of Minister' of Agriculture and Rural Development.

These institutes are involved in a wide scope of research for agriculture and environment protection and conduct field trials. The institutes cooperate internationally with research institutions. For, example, Polish Institute of Technology and Life Sciences cooperates with The Swedish University of Agricultural Sciences, SLU work on Baltic Compass project that look for least costly solutions such as constructed wetlands on farms. The aim is to reduce nutrient load into Baltic.

The Institute of Agricultural and Food Economics (Instytut Economiki Rolnej) is a research institution that is responsible for accountancy and estimating costs of policy instruments in agriculture. The institute also runs Polish Farm Accountancy Data Network. It has empirical data gathered from farms and from field studies for many years. The main objective is to deliver accountancy data from representative sample of farms to the European Farm Accountancy Data Network.

Institute of Agricultural Economics (Instytut Gospodarki Rolnej, IGR) is another non-governmental organisation that actively participates in the creation of legal acts. Cooperates in preparing strategies for Polish agricultural economy. The institute conducts its own research.

The Agency of Reconstructing and Modernisation of Agriculture (ARMA) (in polish: ARIMR (Agencja Rekrutyryzacji i Modernizacji Rolnictwa) was established with aim to support agriculture and rural development in Poland. It has been designated by the government to perform the role of accredited paying agency. The role of ARMA is to implement instruments co-financed from the EU and from national funds (ARIMR, 2017). ARMA is also responsible for monitoring farms that receive payments to verify if they fulfil norms and standards under cross compliance and Good Agricultural Practices. About 1 000 200 Polish farms obtains payments and about 5% of these farms is controlled. Standard procedures are followed during a farm visit when monitoring.

County governor or voivodship marshal in compliance with the Environmental Protection Law insures permits to big farms that are required to obtain license for their production. This is obligatory for poultry farms above 40 000, for pig farms above 2000 pigs at 30 kg and 750 sows (eco- academia, 2017). Regional Inspectorate of Environmental Protection (Wojewódzki Inspektorat Ochrony Środowiska) monitors these farms. For selecting the farms for monitoring, computer system is used that puts farms in risk categories. How often a farm is inspected is also based on these risk categories, farms in the

category of the highest risk must be controlled every year. Different procedures apply to small farms that can be controlled by the town mayor who may impose sanctions on them.

Inspectorate of Environmental Protection (IEP) (in Polish: PMS, Panstwowy Monitoring Srodowiska) is responsible for developing long-term programmes under the State Environmental Monitoring (SEM). One of the tasks of IEP is to determine the waters vulnerable to pollution from the agricultural sources.

The main aim of SEM is to assure high quality of measurements and assessments under EU legislation requirement and to provide reliable data on the state of the environment (Environmental monitoring program, 2015).

There are strict procedures for monitoring pollutants in waters, the EU requirements are well followed. Stations also monitor nutrient levels in Baltic Sea. Poland has permanent stations for monitoring nutrients levels, their location is based on water characteristics and pollution level, pollution risk (GIOS, 2016). Underground waters are monitored twice a year, the high-risk areas more often. Polish Geological Institute is responsible for groundwater monitoring. Surface waters are monitored once a month by National Inspectorate of Environmental Protection.

Research institutes are also involved in counselling, training and preparing materials about nutrient management for advice agencies, advice centres and farmers. Knowledge about new measures is disseminated through seminars, materials and agriculture advisors are trained to a high level. There is some interest in mitigation measures such as wetlands in Poland among farmers, however these are voluntary and many farmers are not motivated, as they do not get financial benefits from it. Ecological awareness of many farmers is still not adequate.

4 Policy implementation and stakeholder involvement

The President of the National Water Management Board (Prezes Krajowego Zarządu Gospodarki Wodnej) in agreement with the minister responsible for water management and the minister of the environment prepares the Water and Environment Program (Program Wodno- Srodowiskowy Kraju). Water and Environment Program is the most important planning document for the protection and management of water sources in Poland. It has been developed in accordance with Water Law Act and its aim is to fulfil the requirements of Water Frame Directive 2000/60 / EC of the European Parliament (RZGW, 2017). This document is reviewed and updated every six years (RZGW, 2017). The tasks, goals in the Water Environmental Program are implemented by seven Regional Water Management Boards (Regionalny Zarząd Gospodarki Wodnej) that are under the authority of National Water Management Board (KZGW, 2017). Each Regional Board of Water Management consists of 30 members appointed by Minister of the Environment at the request of the Director of the Regional Water Management Board. The role of the members is advisory. Members are representatives of local authorities, economic agricultural institutions, fisheries and non- state water owners and scientists. The term of office of the board members is four years. The Board elects a chairman, vice- chairman and a secretary that form a committee. The committee represent the board

and organises its work. Long and short- term groups are also formed where other people from outside the board can advise and participate (RZGW, 2017). Management of the Water Catchment areas carries out the tasks designated by Regional Water Management Boards.

The President of the National Water Management Board is obliged by law to provide information and the opportunity for society to participate in developing Water and Environment Programme (Act of 3rd of October 2008). During consultation period before a new law is accepted the ministry of agriculture cooperates with research institutes to get the experts advice.

Farmers and province governors also have an impact on policy implementation. For example, in Kujawsko- Pomorskie voivodeship, they pressured government organisations and their actions resulted in 66% reduction of NVZs areas in this region (Farmer, 2012).

5 Recent changes

The Polish Government lost a case before the Court of Justice of the EU over incorrect transposition of the Water Framework Directive and not fulfilling the requirements of the Nitrates Directive (Client Earth, 2017).

As a result, the draft of the new Water Law was introduced to the Sejm on April, this new law should apply from the 1st of July 2017, however it is now known that it will take much longer time (Gazeta prawna, 2017). Members of parliament vote and must gain majority to accept all acts new policies. The aim is to fully implement the WFD into national law and related environmental directives (Ustawa, prawo wodne, 2017).

In the New Water Law (which is not yet finally approved), it has been proposed not to differentiate regulations for farms on Nitrate Vulnerable Zones (OSN) and other regions of Poland. Nitrate Vulnerable Zones will not be distinguished, but the stricter regulations like on NVZs will apply on the most areas on Poland, with exception of some few areas with low agricultural production, particularly in mountainous areas (Fratczak, 2017; Eco- academia Nowe Prawo Wodne, 2017). The decision was based on the experiences in Germany and Austria (Nowe Prawo Wodne Projekt, 2017). For example, fertilizer will be stored for longer and containers will have to have capacity to store manure for 6 months.

Regulations for farmers with aim to reduce pollution from farms will be included in the action program (called „ program działań" in Polish) (Nowe Prawo Wodne Projekt, 2017). The Action Program will include measures and practices in the field of agricultural practices, particularly those related to fertilization procedures and farm manure management. Some regulations of measures and procedures may vary from one part of the country to the other, considering:

1) soil conditions;

2) climatic conditions;

3) water and environmental conditions;

4) terrain formation;

5) land management and agricultural practices, including crop rotation

The minister of the water management in agreement with the minister of agriculture will be in charge of the action program. Society, stakeholders have the right to express their opinion and contribute to the project. Project will be introduced to the council of ministers. Their role is to adopt the action plan and to ensure it meets certain environmental goals. Every four years the action program will be reviewed and updated if necessary. The minister of water management will be responsible for assessing the effectiveness of the action program (Nowe Prawo Wodne Projekt, 2017).

According to proposed criteria 466 000 farms will be obliged to implement “the action program”. Farmers will be obliged to keep records of nitrogen fertilization and some will have to prepare annual plans for fertilizer use. Expenditure resulting from these duties were estimated at 41.3 million PLN per year (Nowe Prawo Wodne Projekt, 2017).

New requirements about the fertilizer storage will apply to 335 000 farms. Estimated expenditure to meet the new requirements, infrastructure for natural fertilizers storage is estimated at 754.7 mln PLN (Nowe Prawo Wodne Projekt, 2017). This is likely to have a negative impact on medium size farms. Competitiveness of medium farms with pigs and horses may be weakened, as these holdings may not be able to afford new investments (Nowe Prawo Wodne Projekt, 2017).

Within 6 months after the action report is enforced the Minister of Water Management is required to submit a report to the European Commission. The minister will be required to submit reports every 4 years after the action program is updated (Nowe Prawo Wodne Projekt, 2017). Farms that do not meet the requirements stated in the action plan will incur financial penalty.

Information system will change under the New Water Law also. The current information system is kept in the water cadastre. It will be replaced with a tele informatic system where more various information that is required for water managements will be kept, among other information about: hydrology, water quality, ecological and chemical state, ecological potential, information about point sources. Country will be divided into new river basin areas, Regional Water Management Boards will also operate (Nowe Prawo Wodne Projekt, 2017).

The New Law result in a reform and a new system will be centralized. Polish Waters (Panstwowe Gospodarstwo Wodne "Wody Polskie") will be the state legal entity, the main institution responsible for water management in Poland. The central information system also will be led by the Polish Waters. Minister of the Water Management will have the power of to provide guidelines and instructions to the President of Polish Waters.

Monitoring of farms will be challenging in Poland because of the high number of small farms . Farms smaller than 10 ha will not be considered under the new regulations. About 100 000- 200 000 farms will be required to fulfil the requirements under the new regulation.

6 Overview of policy measures

	Poland
P-ceiling	-
Manure storage and use	X
Catch crops	X
Perennial energy crops	-
Set-aside (non permanent)	-
Ban against soil management in particular periods	X
Permanent land-use conversion	X
Buffer zones	X
Forestation	-
Controlled drainage	-
Miniwetlands with surface flow	-
Miniwetlands with filter matrix	-
Wetlands	-
Wet buffer zones	-

Note: x indicate that the measures is in use, - indicate that the measure is not in use

7 Details of policy measures

Nutrient management		
Changing manure handling in autumn	Tillage	Manure storage
		Wymagania dotyczace przechowywania nawozow naturalnych
Should not be used in time of rainfall. From early December to the end of February, it is not allowed the use natural fertilizers in solid and liquid form and organic fertilizers, including compost. In other periods, fertilizer should not be applied when the soil is unsown or plants are not very advanced in growth, and more rainfall may occur (country report for Poland).	Currently in Poland, reduced tillage practices are mainly applied to zones vulnerable to nitrates.	Slurry manure and liquid manure: closed, sealed containers with a capacity to collect at least **4** month's production of this fertilizer, outlet vent and entry slot that can be closed is required. Containers should be placed in the shaded from sun and wind area , even surface, for containers lower than 1,8m should have protective wall, fencing, In the case of vulnerable zones the capacity of storage of fertilizers should be for at least six months. Large commercial farms: with 40 000 poultry, or breeding rising pigs above 2000 (pigs` weight above 30kg) or 750 sows should store other natural fertilizer consisting of (urine+ fasces + animal bedding) (in Polish: obornik) on special impervious boards with walls. No formal obligations in regard to these solid fertilizers for smaller farms. It can be stored directly on the ground in the fields. In animal housing with deep bedding, straw, impervious floors required. Farmers on **OSN** areas (nitrogen sensitive zones) (4.46% area of Poland, 7.37 % of farmlands) storage capicity of slurry, liquid manure should be adjusted to animal production however, should store at least **6** months of this fertilizer. Obornik (solid manure) can be stored on impervious boards from 1st of March to 31st of October, but no longer than 12 weeks, terrain slope no more than 3%. Not allowed on sandy and wet soils, in depressions in the grounds, at least 20 m from surface waters. In the next growing season the boards (pryzmy) have to be located in other locations. Farmers are obliged to keep maps of locations. Authorities should be informed about the excess manure how the farmer manages it. Manure storage containers should be in adjustment to utility buildings. No legal authorization required for setting up storage facilities (tanks, boards) up to 25m3, but authorities have to be informed. Above this capicity formal proposal must be submitted

Field and farm management					
Catch crops	Intermediate crops (Autumn)	Winter crops	Intercrops in stubble field	Crop Diversification (Part of Greening)	Ecological Focus Areas (EFA) (Part of Greening programme))
Poplony (Part of EFA, cell Q)		Poplony	Miedzyplon scierniskowy (jary)	Dywersyfikacja upraw (Zazielenienie)	Obszary proekologiczne Obszary EFA
Farmers benefiting from PROW programme since 2012 are required to sow Intercrops crops should be composed of at least 3 species of crop types. It is also required that in the mix one species or combination cereal species do not exceed 70%. Earlier beneficials (2011) must sow one species: spring or winter	Farmers must saw crops till 15th or 30th of September (beneficiary of PROW 2007-2017 program to obtain subsidy, date required for sowing depends on the conditions that were different in some years). Farmers that benefited from the program since 2012: winter crops should be composed of at least 3 species of crop types. It is also required that in the mix a species or combination cereal species do not exceed 70%. Recommended agrimony (low soil and climatic requirements, cultivated after cereals, sowing in the first week of September), /ii/ rapeseed Brassica napus) (requires medium and fertile soil, in culture - grown after cereals, sowing not later than August 25), /iii/ mix of agrimony (Agrimonia) and rye (principles of cultivation and fertilization are the same as for rzepik -agrimony), /iv/ rye (Secale cereale) (sowing a little earlier than rye grain), /v/ mix of perennial ryegrass (Lolium perenne) or Italian ryegrass (Lolium multiflorum) with winter vetch (Vicia villosa) (possibly with the addition of Italian clover (Trifolium incarnatum)) - optimum sowing takes place in the second half of August, /vi/ Lolium multiflorum westerwoldicum or Lolium multiflorum in single-species crops: sowing until August 25 (crop gave the best results on warm soils.	From 1st of July until 1st of Oct, on the field till 15th Feb. At least two different plant species from groups: cereals, oilseeds, fodder, legume, melliferous,	Sowed from 1st July till 20th August, must stay on the field till 1st of Oct	Farmers with 10 to 30 ha are required a sow minimum of two different crop types. The main crop should not take more than 75% of arable land. Farmers with arable land above 30ha are required to cultivate at least three crop types (main crop taking no more than 75%; two main crop types no taking more than 95% of all arable land). Exceptions: farms with more than 75% of fallow land, grasses, green fodder. Under PROW 2014-2020,sustainble agriculture program to get financial support minimum four crop types are required. Main crop or cereals types not to exceed 65%. Each crop has to grow on at least 10% of arable land. (under EU parlament legislation)	Obligatory for farmers with more than 15 ha of arable land, at least 5% of EFA required (short coppice rotation areas, buffer zones, fallow grounds, hedges in adjustment to arable land, forested areas after 2008, trees with protected status, maintaining areas along the forests, intercrops, areas within fields 1=20m without production, and other landscape elements (e.g. ponds less than 100m2, protected trees, ditches no wider than 2m) legumes that enhance biodiversity

Measures adjacent to fields
Buffer zones
Strefy buforowe
Minimum length of buffer zone to obtain payment is 50m, it has to remain in the same place for 5 years. In intensively farmed arable lands 2-5 m width buffer zones that separate agro fields from water bodies. Grass and other plants can be planted. Vegetation can be cut twice a year till sod (green dense vegetation) forms, and once after 15th of June until the next growth. Farmer has to deliver a map of the fields buildings and buffer zones to apply for payment. (miedze śródpolne)Areas with bushes, trees should be planted in big fields with intensive agriculture

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Annex 8
Country report - Brittany

Contents

1. Context

France is a unitary state with a central government structure, however since the 1980's a process of decentralization has taken place and today the powers are somewhat distributed between the central government and regions. Hence, today the governance arrangement is quite complex. For instance the ND and WFD is centrally administered by the Ministry of Agriculture and the Ministry of Environment, but the regions also play an important role in the local implementation of some policies. This is illustrated in the implementation of the Rural Development Program: the programs are now overseen by the Regions but there is a central coordination on some measures (notably agro-environmental measures), to ensure consistent implementation across the country. However, there are regional reinforcements of the national Nitrogen Action Plan (NAP), but these are overseen by state administrative offices. Hence, a national framework detailing possible agro-environmental measures is developed by the Ministry of Agriculture in collaboration with the Regions, which provide an inventory all Types of Operation (TO) that may be implemented. The national framework determines the objectives and contribution in EU's priority domains (Gault, Guillet et al. 2015).

On a national level, the major regulation on nitrogen management in agriculture is in the form of the French nitrates action plans (NAP). Currently, the 6th generation of action plan has been initiated in 2016 and it contains 8 measures: 1) Prohibited periods for applying fertilisers, 2) storage capacity for livestock manure, 3) limitation of application of fertilisers based on fertilisation balance, 4) provisional fertiliser plan (estimation) and logbook by the farmer, 5) limitation of 170 kg N / ha per year of livestock manure, 6) specific conditions for application of fertiliser (near watercourses, on sloping lands, waterlogged, flooded, frozen or snow-covered land), 7) soil covering in order to absorb soil nitrogen (since 4th AP) and 8) vegetated strips along watercourses .

Other policies also play a role on nitrogen management in agriculture:

- Other regulations, such as the regulations on intensive livestock farms and on their manure management.
- Incentive schemes to support investments and adoption of best practices by farmers (financial support through RDPs, training, etc.).
- General policies on agriculture and environment, such as the agro-ecology project, which aims to make agriculture performant environmentally, economically and socially.
- Policies targeting specific issues with a localized approach, such as contamination of water resources used for drinking water production (local action plans are prepared and implemented by stakeholders under this policy), or "schémas d'aménagement et de gestion des eaux" (these are small basin management plans).

Brittany provides for an interesting case study. It is one of the regions in France with the most intensive agricultural production. 1.73 million hectares are dedicated to agricultural production, which constitute 63 % of the total regional area. The share of land use devoted to agriculture is actually quite average in France, but

Brittany has an intensive livestock production and therefore it is more prone to nutrient loss. The Britton production account for 12 % of the national income from agricultural production (2012), although it only comprise 6 % of the national surface area (Sarteel, Tostivint et al. 2016). Rearing of livestock is an important production activity and nutrient leaching from agricultural areas constitute a significant environmental problem in the region. Brittany has the highest N and P surplus in France and is amongst the regions with high surplus in the EU however, there is a considerable variation across the region (Sarteel, Tostivint et al. 2016). For instance 6 % of the river monitoring stations recorded nitrate concentrations above 50 mg/l in 2014 and 70 % recorded concentrations ranging between 25-50 mg/l. Particularly the areas along the northern coast is highly impacted. Marine eutrophication is therefore also a problem, in the period 2004-2013 53 beach sites and 32 estuaries were on average affected with at least one algae bloom during the year, although, this is not entirely attributed to the agricultural loss of nutrients but also due environmental characteristics such as closed and shallow bays with a low dilution and water exchange.

One of the reasons is the high excess of nutrient production, as 10 million tons of manure annually is produced in Brittany. This manure is unevenly distributed across the region, therefore, locally there is an excess of the amount of nutrients which can be applied in relation to the limits set by the nitrate directive and the local crop needs. Furthermore, about 1/3 of the agricultural area is allocated for the production of maize for grain or fodder, cereals and vegetables, which require a high level of fertilization.

To reduce nutrient leaching a continuous effort has been going on for the past 25 years. In effect, all of Brittany has been appointed as a Nitrate Vulnerable Zone (NVZ), since 1994, hence, farmers in the region must comply with mandatory requirements under the French Nitrates Action Program, and its regional reinforcements since the 5th action program. This includes mandatory fertilization management plans, mandatory catch-crops, prohibition against wetland drainage, restrictions of old grassland destruction and more restrictive requirements concerning catch-crops. Furthermore, Brittany is designated as “Enhanced Action Areas” (Zones d’Actions Renforcées (ZAR). These zones are considered more vulnerable and additional restrictive measures are introduced, including a soil N balance at farm scale less than 50 kg/ha, calculated as a three-year average. . In addition, buffer zones should be at least 10 m (5 m in other places).

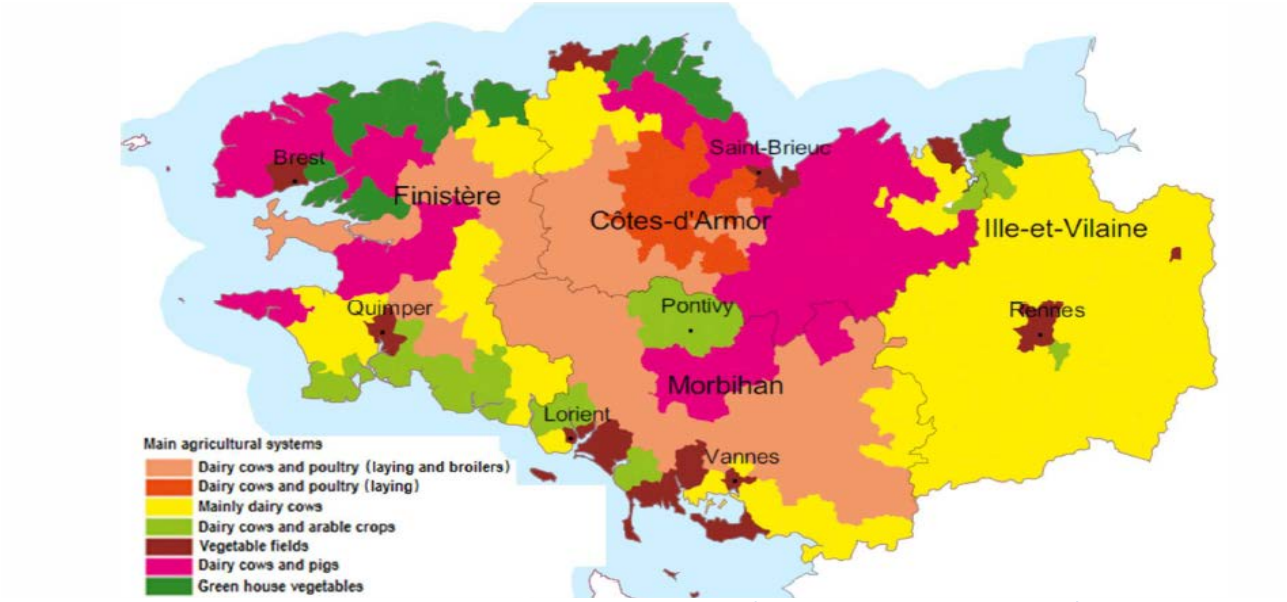

Figure 1: Main agricultural production systems across the region (Sarteel, Tostivint et al. 2016).

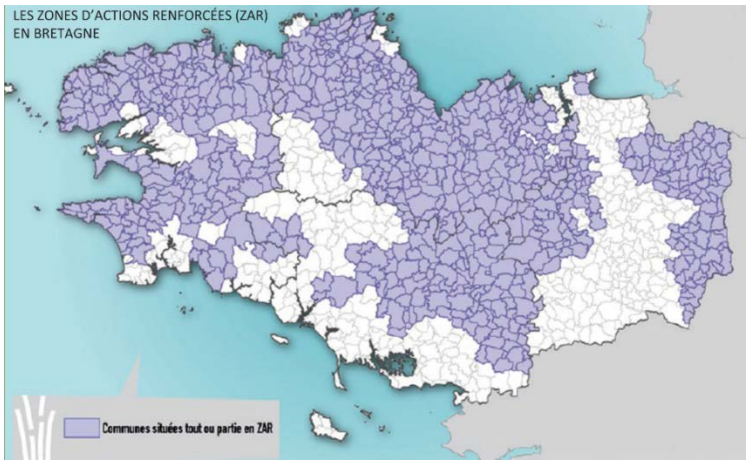

Figure 2: Communes that are a appointed as ZAR ("Enhances actions areas")

2. Drivers behind nutrient policy

Generally, in France there is mostly focus on the implementation of the ND, which is driven by the Ministry of Agriculture and the Ministry of Environment, and has recently been a high priority due to the recent transposition lawsuits. However, in regions with a high livestock density such as Brittany, there has also been a focus for 30 years on reducing the nutrient leaching due to impact of eutrophication, such as two severe cases of toxic algal blooms in 2009-10 (Lieue de Grève bay where mean concentration of river waters was about 35 mg/l)).

The River Basin Management Plans provide an overview of agricultural pressures and their impacts on water resources, identify the water bodies at risk, and list the different policy responses to implement. It appears that, in the case of nitrogen management in agriculture, the RBMPs are not the driving policy tools, as they primarily gather initiatives that are initiated by other policies, hence, the RBMP's constitute an inventory of

initiatives already in place. Generally, the measures that are used to reduce nutrients are found in the actions plans in effect of the ND. In other areas, the RBMP introduce specific policy tools. For example, the Loire-Bretagne RBMP introduces measures to reduce P-loss from agriculture, as this constitute a particular problem in this area due to the high livestock density.

In terms of policy responses, it should be noted that preserving farmland for food production is an important policy concern in France. Measures that introduce other land uses over large areas, such as energy crops or forest are often not favored. Nevertheless the role of grass strips, wetlands and hedges to control/regulate part of the nitrate transfer in landscape are largely studied and favored.

3. Organization of the scientific advice to policy makers

Generally, agro-hydrological modelling seems to play an important role in the assessment of policy measures, action plans and in the diagnosis of reduction targets in particular catchment areas.

The French National Institute for Agricultural Research (INRA) is an important advisor and knowledge producer in the field of agriculture and food sciences and conducts multidisciplinary studies of impacts and services from agriculture. The institute was created in 1946 from a network of agronomic laboratories, and kept a strong regional representation due to a decentralization process initiated in the 1980's. Hence, today there are 17 Research Centres, gathering 150 INRA sites distributed all over France. The stated aim of INRA is to adopted collaborative and multidisciplinary approaches to help shaping national and international public policy, provide support in debates regarding science's role in society and identify important new research directions. This is work is carried out in, advanced studies and foresight analysis. It produces collective expertise e.g. on Biodiversity (2008), Nitrogen in livestock systems (2012), Greenhouse Gazes (2014), Services from livestock production (2016) etc.

In addition to the INRA and other research institutes, a number of technical institutes sectorial in focus (herbivores, pigs, poultry, cereal crops, oilseeds and protein crops) and of Chambres d'Agriculture (regional) conduct very practical research activities such as level of demonstrations and testing fertilizer norms etc. These applied research and technical institutes are funded by a tax collected when farmers purchase supplies such as pesticides and fertilizer and governed by a board that are composed by representatives of the agricultural associations. Hence, the research activities that are carried out in these departments takes place in close coordination with the agricultural community and in most cases in collaboration with INRA researchers.

The implementation of the French nitrates action plan, in particular, the measure related to fertilisation equilibrium, relies on several technical committees. At the national level, the COMIFER (Fertilization Committee) elaborates methods and references and adapts them to technical progress. It gathers members from the public (administration, research and technical institutes) and private sectors (fertilizer companies). These references are then adapted to regional conditions (soil, climate, particular crops) by the GREN

(Regional groups on Nitrate expertise). The GREN gather experts from administration, research, and agricultural associations (unions, cooperatives and extension services).

4. Policy implementation and stakeholder involvement

A number of standing committees are present all over France and have an important role to play in relation to nutrient management and as a forum for stakeholder involvement. Some of these are developed in response to particular local issues or on a national level as forums to develop proposals for government interventions.

In formulating a policy change to adapt the French regulation to be in accordance with EU's nitrate directive to the response to the French government has been advised by two standing committees. One consisting of national level stakeholder representatives , which have participated in a strategic or political forum discussing the perspectives for how to manage nutrient issues on a national scale, members of this committee. The second committee had a more technical focus and consisted of various experts from the technical institutes, universities and research institutes providing a more practical or technical advice on specific parts of the regulation . Following the ending of the transposition case in December 2016 these two forums are merged and currently it is being debated how to develop a structure for the future.

In the water sector, there are several governance bodies in place, at all levels:

- The "comité national de l'eau" (CNE) at the national level, comprising all stakeholders ;
- The "comités de bassin" (river basin committees) at the basin level. They were established by the French water act of 1964. They consist of 20% representatives from the local administration, 40% elected officials and 40 % representatives of stakeholders (NGOs and economic stakeholders). They are in charge of preparing the RBMPs. They are also consulted on the program of intervention of the Water Agencies (these programs specify which actions are supported financially by the Water Agencies); the CLE "commission locale de l'Eau" (small basin management committee). The CLE were created by the French Water act of 1992, following the principles of the river basin committees. These commissions do not exist everywhere (around half of the French territory is covered by a SAGE) ; they are established usually in relation to a specific issue with water resources. The CLE prepares a SAGE (shéma d'aménagement et de gestion de l'eau), an action plan for the particular area, typically for a duration of 3-5 years.

A number of policies in the water sector focus on territorial approaches; drinking water catchment protection against diffuse pollutions, CLE and SAGE, actions plans in basins with algae blooms in Brittany. A common factor in these policies is that the State puts in place a general framework for the process, including guidance documents on the initial diagnosis of the issues in the particular area and on the need for stakeholders involvement. However, in principal there is no restriction on which actions, measures or proposals that may be included in the action plan, as long as it can be argued that they may have an effect on nutrient leaching.

Interviewees note that the outcome of this process vary quite a lot depending on the local conditions, stakeholders and local traditions. Hence, in some cases the action plans are strong and effective, whereas in other cases they are less so. Furthermore, in some areas it is difficult to allocate finance for the activities and therefore they depend on local voluntary efforts, which is sometimes not so effective. This mode of public involvement indicate a change from the traditional top down mode of planning to a more participatory and locally flexible approach. The process is not without its limits, for example, although the CLE constitute a shift towards a more participatory mode of governance it has also been criticized for being very formal, as involvement is organized via representatives. Many stakeholders are not well organized and therefore do not participate, furthermore, debates that take place in the CLE are often quite technical and are not easy to follow for ordinary citizens. The activities that are proposed in the SAGE are partly funded by a water use tax, which is collected by Water Agencies at the basin levels. The tax is used to subsidize all sorts of water projects (actions under SAGE, but also other activities).

A lot of the time the local stakeholders will agree on standard measures, such as farm diagnosis and advice, and there can be a dialogue on how to get farmers to subscribe to agro-environmental measures which are included in the Rural Development Program. However for nutrient management, there are not a lot of initiatives to choose between, as plant fertilization equilibrium is mandatory while no regulation concern animal nutrition but professional organization advices. In some of the larger catchment areas with a significant budget the action plans are assessed ex-ante using modelling, as carried out for example for the watershed with rivers exceeding maximum authorized nitrate concentrations or with green algae blooms (Durand, Raimbault et al. 2014), but in many cases this is too costly or there is not enough data available to make a proper evaluation, in these situations evaluations are carried out qualitatively using existing knowledge on the policy measures. Help to decision-support tools at watershed *level* were also developed to help territorial managers to make a diagnosis on contributive areas to nitrate pollutions and identify efficient action levers (Territ'Eau 2017).

5. Recent changes

Many changes took place prior to the recent update of the French nutrient management to fulfill the requirements in the EU nitrate directive. The transposition case against France was settled in December 2016, hence no changes are currently planned (the 7th action program should be implemented from 2021).

6. Mode of regulation

The French mode of regulation is characterized by far reaching state regulation to manage nitrates in agriculture, for instance including centrally coordinated appointment of sensitive areas and mandatory measures such as catch crops on all fields, completed by regional adaptations. Hence, there is a preference for policy solutions through state intervention, however, there is also a stakeholder involvement process that exert some power on development and implementation of solutions. The political power is concentrated in government institutions. France lack the strong municipal structure, as is seen in northern Europe, hence

policies are often enforced via state actions and a number of the standing committees and ad hoc institutions are quite important in France. However, though these activities are also locally embedded, but much of the work is structured according to nationally developed guidelines.

7. Overview of regulatory policy measures in Brittany

	Bretagne
P-ceiling	(X[1])
Manure storage and use	X
Catch crops	X
Perennial energy crops	(x)
Set-aside (non permanent)	-
Ban against soil management in particular periods	X
Permanent land-use conversion	-
Buffer zones	X
Forestation	-
Controlled drainage	-
Miniwetlands with surface flow	-
Miniwetlands with filter matrix	-
Wetlands	X[2]
Wet buffer zones	X

Note: x indicate that the measures is in use, (x) indicate that the measure is in use in some areas or only of marginal importance, - indicate that the measure is not in use and.

[1] The ceiling applies through requirements on minimum surface for manure spreading. It is not a "full" ceiling applying to the quantity of inputs applied annually to a plot.

[2] Although primarily related to wetland protection.

8. Detail of policy measures

Nutrient management			
Fertilizer standards	Utilization of N in manure	Manure storage and use	P-norms
Norms are mandatory in nitrate sensitive areas and they are not reduced below economical optimum. Crop needs are decided based on crop type, previous crop, catch crop effect and N-min in the soil. Documented in Decree nr. 2011-1257 10/10/2011. Nitrates of Regional expertise group in Brittany (GREN) proposes an operational method of calculation of N- Norms based on the COMIFER method (N-min approach). Norms are adjusted after crop, yield, soiltype, previous crop, decomposition of straw and N-min samples in early spring. The norm calculation method is documented in a report, (COMIFER: Calcul de la fertilisation azotée Guide méthodologique pour l'établissement des prescriptions locales). Supplementary limitations to the EU limit of 170 kg N/ha: There are no national requirements, but regionally the departments may implement limitations based on local conditions. Most of the area in Britany is also appointed as "Enhanced actions area" (ZAR). This regulation is stricter than vulnerable zone. For the enhanced actions zones, you have to respect an overall nitrogen balance of 50kg/ha/year at the farm scale (or in average over three years). There are no exceptions from the ND. Waters affected by nitrates or likely to be contaminated and classified as vulnerable zones: • Nitrates in waters are calculated on the basis of the 90th percentile, ie the 10% of the highest values are not taken into account (Article 1); • If the contents are greater than 40 mg / L and in the absence of a downward trend, water is considered susceptible to be polluted (Article 2); • The threshold for defining surface water likely to be eutrophic is set at 18 mg / L in p90 (Article 3) The 6th Action Program provides for enhanced or additional measures targeting areas with high nitrate content. Zones of reinforced actions are defined. It is part of catchment areas for human consumption in surface and ground water with concentration for nitrate by more than 50 mg / L and significant algal blooms on beaches. Finally, there are also specific areas defined in the 4th departmental action programs (area of structural surpluses 1) linked to livestock farming and complementary action areas. 2) (ie watersheds for surface water intended for human consumption, whose concentration of nitrate exceeds 50 mg / L)).	Norms are decided by technical institutes for each animal type, fertilizer is divided in three categories: type I: C/N above 8 (solid manure); type II C/N below 8 (liquid manure) and type III industrial fertilizer. Utilization percentages: Liquid cow manure 50-60 %, liquid pig manure 60-70 % solid manure 20-30 %, poultry 50-60. Active N depends on the season where the manure is dispersed the crop it is supplied to. Degassed manure 80-90 %. (In reality it is a bit more complicated than this, it will be elaborated a bit in the next iteration).	No national requirements concerning method for manure application. From 2020 all manure must be injected directly within buffer zones, from 2025 onwards also on grass fields. Type II and III may not be distributed in the period between November 1st and January 15th. Type 1 manure prohibited in July and August in spring crops. Ban on the use of fertilizer on slopes exceeding 10 % towards recipients with fertilizer type II. Fertilizer ban on slopes exceeding 15 % towards recipients with fertilizer type I and type 3. The slope can be increased to 20 % if a barrier is established, there are some exceptions for specific types of crops or soil types. No manure on frozen land (10 cm). if spread in proximity to rivers, except on sloping land. Fertilizers type I and II, can not be used: - less than 35 meters from the banks of rivers; Or - less than 10 meters if a 10-meter permanent vegetation cover (for example grassland), not receiving any input except those applied by the animals themselves, is located along the stream. Fertilizer type III: they can't be used in the grass strips along the stream. The minimum distances to respect in vulnerable zones varies from 5-200 meters depending on the content of the protected zone and the type of manure.	Norms are developed regionally, has to be a part of the fertilizer account.

Farm and field management		Measures adjacent to fields		
Catch crops	Limits on soil management	Buffer zones	Forestation and permanent fallow	Wetlands
Catch crops are mandatory, requirement for a total ground cover. Catch crops and intermediate crops must be sown prior to September 10th and no longer than 15 days after harvest and may not be ploughed down before December 1st. The fields near a stream have to be cover all the year. For the short period of inter-culture You have to sow a cover crop between rapeseed and autumn culture. For the long period of inter-culture Minimum period when you have to sow cover crop is: General case: the fields must be sown at least from the September 10th to the February 1st Specific case after maize: the fields must be sown at least from the November 1st to the February 1st Fabaceae (or Leguminosae) are not allowed as catchcrop in Brittany, but can be allowed in other regional program	Requirements concerning soil management is regionally decided and therefore it varies in France. In Brittany there are requirements concerning the destruction of grasslands: 1) In the floodplain, the ploughing up of grass land is forbidden. For grasslands over 3 years old 2) The ploughing up of grass land at the end of winter is prohibited before February 1st. 3) If grasslands are grazed in summer or fall so you have avoided ploughing up the grass land except when planting a new grass land. 4) In the event of grassland destruction in late summer or autumn, a crop must be planted immediately after the ploughing up and no later than 1 November	Buffer zones are both mandatory and voluntary. Requirements dictate: no growing, fertilization or pesticides in buffer zones. Minimum 5 meters in all places, can be wider depending on levees, natural flora etc. opportunity for expanding to 10 meters. This is mandatory in Enhanced Action Areas (ZAR). The buffer zone can be used for grazing. It can be harvested but the cover must remain all year long. Farmers are not compensated for establishing 10 meter buffer zones.	Land use changes, such as forestation and permanent fallow are not planned.	Development is planned, as a part of the RBMP's Voluntary for the farmer to participate, but they are compensated.

9. References

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Institut for Molekylærbiologi og Genetik

Herudover har DCA mulighed for at inddrage andre enheder ved AU, som har forskning af relevans for fagområdet.

RESUME

Nærværende rapport indeholder DCA's analyse af anvendelsen af forskellige kvælstof- og fosforvirkemidler i Danmark, Sverige, Holland, Polen, Schleswig-Holstein, Niedersachsen og Bretagne. Undersøgelsen fokuserer på forskelle mellem landene i forhold til de tilgængelige virkemidler, godkendelsesprocedurer for nye virkemidler samt anbefalinger for en hurtigere godkendelsesprocedure af nye lovende virkemidler. Undersøgelsen er blevet gennemført som et desktopstudie af de virkemidler der anvendes i de syv landområder og en interviewundersøgelse blandt forskere, rådgivere og ansatte i den offentlige forvaltning. På baggrund af undersøgelsen konkluderes det at ingen af de undersøgte lande har en på forhånd fastlagt procedure for godkendelsen af virkemidler, samt at der ikke er en stor forskel på hvilke virkemidler der er tilgængelig for anvendelse i næringsstofforvaltningen i de undersøgte lande. Der kan med baggrund i undersøgelsen således ikke dokumenteres en generelt hurtigere og mere præcis godkendelsesprocedure i andre af de undersøgte lande i forhold til Danmark. Med udgangspunkt i analysen og DCA's erfaringer fra arbejdet med godkendelse af virkemidler anbefales det at arbejde for: 1) Integration af forskellige synergieffekter, 2) aktiv dialog med interessenter, 3) formaliseret tværnationalt samarbejde og 4) ikke en fast godkendelsesprocedure.

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