Workshop 1: "Working with farmers and regulators to minimise nutrient loss to water"

Friday, 2nd November 2018, 08.30 – 11.00, Durham University, Lindisfarne Centre

Background and objective of workshop

In order to increase the impact of tested measures, and the transfer of TOPSOIL modelling results, WP6 focuses on improving transnational learning on the different governance settings. For this, a case study approach has been set up. At the workshop, the approach was implemented for the 3rd time, this time focusing on the TOPSOIL challenges 4 (improving soil conditions) and 5 (improving break-down capacity).

OOWV and Wear Rivers Trust provided case studies which framed the challenges linked to nutrient losses into groundwater as depending not only on the geological conditions (high permeability of soil, complex hydro-geological contexts for assessing impact of measures), the acknowledgement of land users on the interaction between and groundwater quality and also on the governance settings: resources need to be available to monitor the implementation and the impact of measures, and to cooperate during their development.

The workshop provided the floor for consultation and discussion on the following question:
How can farmers be better motivated to implement the precautionary principle (for groundwater protection), in the context of voluntary agreements and local regulations?
This version (Version of 12th August 2019) includes comments from the presenters in DK, UK, NL and B. Presentations can be accessed only internally in the TOPSOIL midtrum shared space (folder WP6).

Based on this summary, a TOPSOIL roadmap will present the central steps towards minimizing nutrient losses to groundwater.

The OOWV case (GE5): Nutrient increase despite a variety of measures

Groundwater for drinking water provision in the area of the OOWV is pumped from deep groundwater layers[1], and is still of good quality. However, the shallow groundwater layers where future groundwater is stored are highly impacted by agriculture. Large parts of the provision area of OOWV are characterized by intensive agricultural land use combined with little buffering soil conditions, i.e. with vulnerable underlying groundwater bodies. OOWV as the largest water provider in this area works closely with local farmers in drinking water cooperation to support groundwater protection. There have been successes with regard to the reduction of nitrate in groundwater. Still, the trend of increasing nitrates concentration in groundwater shows that this is not sufficient. A new, more result driven approach has been implemented as part of the GE5 TOPSOIL pilot. Central questions to the other TOPSOIL partners was: How can farmers be better motivated to implement the precautionary principle (for groundwater protection), in the existing context of voluntary agreements and local regulations?

More information can be found in the full case study description (Annex IV).

The UK1 situation: Linking agricultural land use to surface and groundwater protection

The Wear Magnesian Limestone groundwater body is currently at Poor WFD (chemical) status due to agricultural (livestock and arable) pressures. This failure of the groundwater drinking water protected area test is at high confidence due to known single drinking water source having a statistically significant rising trend and levels of nitrate above the Drinking Water Standard. However, 7 of 8 public water supply boreholes and 4 of 5nvironment Agency observation boreholes, have nitrate levels well below the regulatory limit of 50 mg/l as NO_3, and show either level, or decreasing, trends which whilst an improving situation shows there remains known localised impacts from nitrate. There are a couple of possible reasons for the improving groundwater quality, namely: the measures required as part of the NVZ action plan are having an effect and /or there has been a reduction in production and hence fertiliser application post war years.

The area is potentially highly vulnerable to rising nitrate levels from agricultural sources due to widespread presence of thin, permeable superficial deposits. The unsaturated bedrock, from 60 to 120m thick, comprises the Magnesian Limestone which is classified by the Environment Agency (UK) (EA) as a Principal Aquifer in the UK. Groundwater flow is heavily dominated by the presence and trend of fractures, the distribution and hydrogeological properties of which are largely unknown. As is common with many limestone aquifers, uncertainty with regard to hydrogeological properties, including contaminant transport pathways, is high. There are a couple of localised areas of groundwater known to the EA which are impacted by nitrate which may be particularly vulnerable and where the NVZ rules may not be stringent enough.

Dealing with this situation presents several challenges such as a paucity of well distributed regional data on groundwater quality, as well as limited spatial coverage of monitoring points. Due to the impact being localised there are no strong drivers to justify additional monitoring points. A more

[1] Groundwater is pumped from up to 160 m, and needs up to 60 years from surface to the deep layer.

proactive and cost effective approach can be taken to prevent and limit nitrate entering the groundwater rather than to monitor groundwater and enforce though regulation. the UK1 Topsoil pilot will utilise the Catchment Based Approach, specifically the Wear Catchment Partnership and the cross catchment regional network, used to communicate the integrated land, surface water and groundwater message, for example focussing on the Farming Rules for Water introduced in 2017 The WCP was interested particularly in how to get the interest of commercial farmers, and how other countries deal with the gap between legislation and implementation (if there is such a gap).

More information can be found in the full case study description (Annex V).

Responses from the other TOPSOIL countries

Both case studies face vulnerable groundwater bodies impacted by agricultural land use. Excess nitrates are found in groundwater bodies in the other TOPSOIL countries as well. Responses to that and challenges were introduced as follows:

Belgium, Dieter Vandervelde on behalf of Frank Stubbe, VMM

Belgium is since 2007 a nitrate sensitive area according to EU law. The Flemish Land Agency (Vlaamse Landmaatschappij) has set up a manure bank to help farmers to fulfil their obligations and guide them to more environmentally friendly management. Current farmers' obligations are prescribed by the Flanders Action Program for the Nitrates Directive 2015-2018 (MAP 5) which aims at a better water quality and a more sustainable agriculture. The manure bank informs, heightens awareness and advises about the application of the manure legislation, supports the monitoring activities ensuring fair and correct enforcement.

In addition, on a voluntary basis, farmers can engage in management agreements/scheme committing to less environmental impact of their activities. One option is the water management contract. Here, farmers agree on cultivation of crops with a low risk profile (i.e. less nitrate leaching, improvement of soil conditions, less sensitive to erosion). Farmers must grow no less than 4 main crops, of which 3 must be low-risk crops other than grassland, and the low-risk crops must occupy at least 90% of their arable land each year.

Before signing the agri-environment-climate contract, the farmer must have on-site advice from a specialist farm adviser, who will explain the requirements of the scheme and discuss how these will/could fit with the farm's crop rotation system and nutrient management planning. In the first year of the contract the farmer has to carry out a soil analysis for carbon content (organic matter) and pH (acidity) which are used for the farm's nutrient management planning but are not part of the result indicator. The result indicator is the residual soil N at the end of each growing season in all the fields on the farm, and the threshold for payment is a residual soil N level on all fields (grassland and arable) which is at least 4 kg N ha−1 yr below the lowest threshold value set by Flanders regulations. The indicator is measured by an approved laboratory, this includes soil sampling and analysing the soil samples. The cost for this is payed by the farmer and controlled by the paying agency.

However the result indicator must be achieved on all fields, not just these arable fields. This ensures that the farmer does not 'compensate for' reducing nutrient inputs on one part of the farm by increasing inputs elsewhere. The payment of €245/ha.year applies to the total area of low-risk arable

crops on the farm each year (the precise area varies a little from year to year because of the crop rotation).

The farmers show only limited interest in joining the voluntary water management contracts. Farmers need to see financial benefits and an easy integration of the management requirements in their normal business.

More information will be available in the presentation at the TOPSOIL webpages.

The Netherlands, Nico van der Moot, WMD Drinkwater

The starting point for WMD is that if a farmer keeps to the law he does nothing wrong. WMD tries to stimulate farmers to make better choices/ take conscious measures to improve the situation for soil and groundwater. If WMD invests time/energy/money in this, the results should be measurable. A strong tool for WMD are the so called knowledge groups which are often organized as part of a funding project. The knowledge groups consist of farmers from crop production and cattle breeding (max. 10-12 participants per group). They are supported by a scientific mentor (consultant) to develop nutrient management strategies. Participation is voluntary but the farmers pay a financial contribution (€250) and are expected to participate in the group meetings on a regular basis. In general this seems to work and their own financial contribution connects the farmers stronger to the knowledge group.

Basic motto of the groups is “Show, don’t tell”: Knowledge gained from experimental farms is brought into practice at farms of the participants. Nothing is more convincing than the results at your own farm, or the farm of the neighbour, and it leads to some form of “competition” among the farmers for the better nutrient management.

More information will be available in the presentation at the TOPSOIL website.

Denmark, Børge O. Nielsen, LMO

In Denmark, strong nutrient management regulations have succeeded in a reduction of nitrate loss to costal water with 50% from 1985 to today. Nearly the same reduction is expected in leach to groundwater because of the measures that has been taken in this period mostly has been effectuated direct on the arable land.

This includes a prescribed nitrogen input for each field, based on the current crop, the previous crop, the soil type, yield-documentation and irrigation. Also, liquid manure is only allowed just before or during the plant growth, and fully banned between 1. October and to 1. February.

Agricultural practice has changed so that the exact planning of nitrogen need per field is combined with an optimized yield potential for fields (e.g. drainage, liming), and a focus on those fields with best potential. This increases also other possibilities for land to be set aside (headlands, forrest edges, triangle-parts). Plantcoverage (catch crop or early crop) is required on every field in autumn.

These changes have not come easily: Farmers do not want to raise costs to establish catch crop or extra applications of nitrogen, or to set areas out of productions. Agricultural practice needs to be adapted, and sometimes needs a change in crop rotation. Negative side effects can also be green bridges for weeds or diseases. From farmers perspective, the lack of payment and control is a strong

barrier to apply more nutrient management. On the other hand farmers using reduced soil management is more keen on using catch crops for optimizing root growth in next year crop.

It is estimated roughly that catch crops or set aside areas do have the largest benefits with regard to reducing nitrates' leaching. Further positive impacts of nutrient management are explored (e.g. the after effect of catch crops on spring barley). Also, the regional water company offered farmers a one-time-payment of 5-8.000€ for a reduction of nitrate leaching below intensive farming areas down to 25 mg/L $N0_3$ – which means grassland and no fertilizer as main management options. Still, measuring the direct impact of single measure is difficult. Modelling approaches or of graduated fertilizing e.g. based on satellite images are tested.

More information on the Danish approach will be available at the TOPSOIL webpage.

Discussion and Conclusions: how to balance top-down and cooperation for minimising nutrient loss to water?

Reducing nutrient leaching into groundwater is a central challenge in all countries represented in TOPSOIL. The possible developments of nitrate leaching due to climate change and the (potentially different) impact of measures under future climate have been discussed only to a limited extent because participants felt that the current pressure will most likely be even stronger but the basic barriers to protect groundwater will not change and need to be dealt with today already. It is possible the current thresholds are not yet tight enough for sustainable surface and groundwater protection. The participants appreciated the range of measures which can get farmers interested in additional groundwater protection. To support pro-active work in groundwater protection, the impact of the different measures depends also on the governance context (see table in Annex I). For example, the Dutch study groups would probably not work in Germany where the chamber of agriculture provides a good advisory system, and competition between farmers is considered too high for cooperation.

The discussion showed different aspects of how to balance the need for strong legal framing, action taken against non-compliance and the strong need for a cooperative development of voluntary engagement delivering additional benefits to the farm business.

Strong Legal Framing: Who is in charge?

Nitrates' management is framed by EU regulations. A strong, harmonized legal frame sets a minimum standard for nutrient management, and might act as a driver for additional action to prevent further restrictions. While the Dutch presentation highlights that if farmers manage the nutrient according to the legal requirements they do nothing wrong, other examples pointed more towards remaining gap of current management requirements, and actual groundwater quality.

In most countries there is a gap to monitor compliance due to regulations or regulatory capacity, as well as the success / impact of measures on nutrient leaching. The authorities' resources are limited. They often monitor the baseline groundwater quality beyond the minimum requested by law, due to local specific risks. They are required to justify the need for the monitoring over and above the minimum on a regular basis. UKTAG provides the monitoring requirements to assess WFD status and this does not make provision for identifying pollution in terms of Source-Pathway-Receptor or cause-impact-relations. Given the often complex hydro-geological context, monitoring the groundwater quality needs to be different if insights on cause-impact-relations are requested: for example a single measurement point in the Wear Magnesian Limestone groundwater body leads to a poor Water Framework Directive (WFD) status due to agricultural (livestock and arable) pressures. The current monitoring provision therefore makes it difficult to identify specific pollution sources and subsequent detailed mitigation. Therefore a spatial high level risk screening approach based on groundwater quality, land use and geology has been developed to show where best farming practice should be carried out as a generic mitigation measure to protect groundwater quality. In this area, land with thin glacial drift, assumed to be at greater risk of surface-ground connectivity, have been mapped and mitigation approaches to protect surface and groundwaters, including precision farming, the use of cover crops and minimum and no tillage cultivations are being promoted to farmers. Elsewhere at the same time, it is not clear which areas need to be differently managed to improve the status, and which measures would be most effective for improving water quality.

From the perspective of direct groundwater users who do have direct economic and public interest in good water quality (e.g. water providers) water quality needs to be better monitored and protected. In UK and D, for example water providers monitor groundwater quality to meet their legal requirements. In NL, UK, and D, water providers set up voluntary contracts to achieve additional nutrient reduction. In Belgium, voluntary contracts are organized by the regional authority.

To protect groundwater from nutrient leaching in future, the regulatory frame is unlikely to succeed.

Voluntary engagement and additional benefits: When can farmers take their share of responsibility?

Farmers as main land user are the central stakeholders and managers of nutrients with regard to groundwater protection. Agricultural businesses are generally under pressure to cope with a highly competitive economic environment. Successful agriculture business currently is perceived often only possible by high specialization on e.g. pork and meat production. The focus is in general on short term maximum yields and farm business income approaches. There is not a practical live mechanism to take into account external costs (e.g. for cleaning up drinking water production or decreased environmental quality, which may not always be quantified financially). Restrictions on management, such as areas set aside from intensive agriculture, are less supported. Further, in areas of high competition for land, it is more difficult to get access to land on a voluntarily basis.

At the same time, farmers are becoming aware that their impact on the environment with larger inputs than necessary, wasting money and causing pollution and costs elsewhere. In family business, negative impact of agriculture (and the resulting conflicts in the municipality or in public media) may decrease next generation's interest to take over the farm and thus reduce the business perspective. In large scale business, less negative environmental impact may create an additional marketing value. Thus, raising awareness among farmers on the impact of their individual management practice can be an important factor in increasing support for further voluntary agreements, as was reported in Dutch example. Farmers are more likely to engage in voluntary agreements if they can control its implementation (e.g. control the change of crop rotation or the application of manure). Dutch experience also shows that manure uptake as an additional income can also provide a strong incentive.

Most examples showed, unsurprisingly, that farmers are most likely to engage in voluntary contracts for reducing nitrate leaching, if the management and control structures can easily be included in the daily farming business, **and** if the farmers perceive relevant financial, social or personal benefits for changing their practice. This may be – in some of the outcome based approaches- the reward for less leaching, or – in the Dutch study groups- the easier access to knowledge. In Germany, economic benefits are the main driver. In the UK good environmental practice, delivering financial benefits coupled with reduced risk of non-compliance with environmental rules is gaining attention from farmers as individuals, and their representatives.

Further, farmers appreciate when the results of their efforts and lessons learned from all perspectives are fed back to them. This helps also to raise awareness and commitment to consider further actions and awareness of further benefits to agriculture with less nutrient loss to the wider environment.

Conclusions

The range of measure for reducing nutrient loss showed that cooperative approaches together with the farmers are obligatory but may not be sufficient for achieving and maintaining good surface and groundwater quality. A strong legal framework and effective monitoring capacity, with a real risk action taken over non-compliance can together act as positive drivers for cooperation.

It remained open during the discussion what such a legal framework could look like. The current agricultural structure promotes food production which is nutrient rich, and requires a high N balance. The cooperative approach was considered by most participants the only way to improve this balance in agriculture. Considering the difficulty to engage high level commercial farmers, there is a need for a systematic change which gives environmental protection through integrated land surface and groundwater management and protection a stronger edge. One water provider raised the question if in high density areas of meat production water protection should be linked more strongly with animal welfare to reduce the manure production and the nutrient surplus by a lower regional production capacity. In any case, European support for a harmonized approach needs to be strengthened. The range of measure for reducing nutrient loss showed that cooperative approaches together with the farmers are obligatory but may not be sufficient for achieving and maintaining good groundwater quality. One option would be that the EU nitrate directive could give regulation possibilities in sensitive areas (down from 170 kg N/ha to lower). A strong legal framework and good monitoring capacity act as a driver for cooperation.

Annex I Applied measures for minimizing nutrient losses

In the following table, applied measures presented during the workshop are listed.

Measures	Country	Voluntary / Obligatory	Monitoring by… / Success documented?	Acceptance by farmers
Compensations of other planning: use money for reforestation, more broadleaf trees	D	Voluntary by municipalities or water providers		
Buying land and expanding organic farming)	NL, D	Voluntary by water providers		
Regionalize measures / adapt to soil conditions	DK	obligatory	Monitoring by state	Good acceptance after N-norm is made economical optimal
Banned manure application in no-grow seasons (also on catch crops)	DK	obligatory	Monitoring by municipality and state	Completely accepted
Timing of agricultural practices (application of fertilizer / manure)	DK, D, NL	Voluntary		
No tillage in autumn – if no crop sawn	DK	obligatory	Monitoring by state	Accepted – but gives challenges in management practice
Targeted Catch crops in autum – 10-35% of arable land is obligatory	DK	Both obligatory and voluntary	Obligatory monitoring by state	Much better than at the first time of introduction in 1998. Now also widespread used in reduced soil treatment

Measures	Country	Voluntary / Obligatory	Monitoring by… / Success documented?	Acceptance by farmers
				concepts
Raising awareness on impact of agricultural management on surface and groundwater quality UK: Higher probability of action taken by regulator if there is non-compliance	NL, UK, B	Voluntary (B: via Manure bank)	UK Farming Rules for Water.	NL: good, additional access to knowledge
Management based: reward / compensation for additional efforts is payed independent from actual nitrate concentration but only for application of specific management practice	D, B	Voluntary NL: Since about 10 years NL stopped financial stimulation. They only aim at the voluntary knowledge groups		Good with small / medium sized farmers, less with large scale farmers
Outcomes based: leachate needs to contain less than specific nitrate's concentration for reward to be payed.	(D), UK	voluntary	D: Regular local monitoring with specific measuring point	(new approach)
Manure bank to document and monitor	B	obligatory	FLA	
Cattle feed	NL	Voluntary (as part of N-balance)		
4R: Right manure, time, dose, method	B			
Integrated Constructed Wetlands				
Knowledge Groups including scientific mentor" (Motto: "Show don't tell")				

Measures	Country	Voluntary / Obligatory	Monitoring by… / Success documented?	Acceptance by farmers
"Champion" farmer (UK)	UK	Voluntary	Demonstration Farms	Established process. Popular with farmers
Payed-extract-catch crops				
Paying for N-Balance				
Tool: N-leaching modelling tool				
Reverse auction modelling: rights to apply manure are sold.	UK 2	voluntary		
Soil nitrate profiling/ mapping				
Precision farming				
On farm water management				

Annex II Agenda

8.30	**Welcome & Scope of Workshop**
8.35	**The OOWV case: Experiencing the limits of voluntary agreement for groundwater protection? How to improve?** Christina Aue, OOWV
8.50	**The UK situation: Linking agricultural land use to surface and groundwater protection within a multi-agency regulatory framework** Martin Colling & Peter Nailon, Wear Rivers Trust
9.05	**Responses (10 min each) from…** **Belgium:** Dieter Vandevelde , Vlaamse Milieumaatschappij **The Netherlands**: Nico van der Moot, Water company Drenthe (WMD) **Denmark:** Børge Olesen Nielsen, LMO (agricultural consultant).
9.45	**Discussion**: • How do you interest commercial farmers in protecting and improving the environment? • How would you identify the measures with the largest positive impact on groundwater protection? • Which practices would you want farmers to change and how would you achieve those changes? • What barriers are in the way of making these changes and how should they be overcome?
10.45	**Summary:** What have been your major lessons learnt on governance related to solving the challenge of groundwater protection?
11.00	**Closing**

Moderation: Ilke Borowski-Maaser, Interessen Im Fluss

Annex III Participants

Nico van der Moot	WMD
Peter Nailon	Wear Rivers Trust
Martin Colling	Wear Rivers Trust
Suzanne Kloosterman-Vennix	Waterschap Noorderzijlvest
Harry Jager	Waterschap Hunze en Aa's
Jes Pedersen	Region Midtjylland
Flemming Jørgensen	Region Midtjylland
Helle Blasbjerg	Region Midtjylland
Leo de Vree	Provincie Drenthe
Rinke van Veen	Provincie Drenthe
Christina Aue	Oldenburgisch Ostfriesischer Wasserverband
Silke Mollenhauer	Oldenburgisch Ostfriesischer Wasserverband
Jeremy Dearlove	NWL
Elisabeth Schulz	Landwirtschaftskammer Niedersachsen
Ilke Borowski-Maaser	Interessen Im Fluss
Sören Brandt	Herning Kommune
Hans-Jørgen Henrisksen	GEUS
Jane Herbert	Essex and Suffolk Rivers Trust
Melissa Swartz	Environment Agency UK
Sally Gallagher	Environment Agency UK
Katherine Birdsall	Environment Agency UK
Louise Bracken	Durham University
Dave Hutchinson	

Annex IV OOWV case study

TOPSOIL Governance Case Studies: How can farmers be better motivated to implement the precautionary principle (for groundwater protection), in the context of voluntary agreements and local regulations?

Background: TOPSOIL wants to improve groundwater management by taking a focused look at all aspects from sampling and modelling geological characteristics to understanding legal and organisational contexts, stakeholder involvement, financial barriers etc. Work package 6 deals with best governance practice emphasizing the relations and interactions of legislative and institutional frames but also relevant issues about stakeholders, funding etc. .

Purpose: For this purpose, partners are invited to document cases with a central issue they want to solve (Step 1). These case studies will be commented by TOPSOIL partners from other countries, providing insight on the situation from different perspectives: "How would the case look like, if I had this case study in my area?" (Step 2) The results will be discussed (e.g. at a transnational Challenge Workshop or a partner meeting), and synthesized into road-maps for tackling central challenges in groundwater management (Step3).

The present document introduces a case study of the OOWV.

For further information on the case study, please either contact **one of the** members of the Transnational Governance Team in your country:

D: Ilke Borowski-Maaser, Interessen Im Fluss bm@interessen-im-fluss.de;

UK: Barry Bendall, The Rivers Trust, barry@theriverstrust.org

NL: Rinke van Veen l, Province Drenthe, R.Veen@drenthe.nl

DK: Anette Specht, Central Denmark Region, anespe@rm.dk, phone:

BE: Dieter van de Velde, Flanders Environment Agency, di.vandevelde@vmm.be,

or the case study providers:

Dr. Christina Aue, OOWV, Tel. 0049 4401 916-3336, aue@oowv.de

Silke Mollenhauer, OOWV, Tel. 0049 4401 916-3302, mollenhauer@oowv.de

Version of 4th September 2018

1. Facts on Case Study

GE-5 / Groundwater Bodies in South of Oldenburg, Lower Saxony, see also p.56 in the TOPSOIL pilots' catalogue: http://www.topsoil.eu/siteassets/documents/topsoil_pilot_catalogue_temp.pdf

Groundwater for drinking water provision in the area of the OOWV is pumped from deep groundwater layers[2], and is still of good quality. However, the shallow groundwater layers where future groundwater is stored are highly impacted by agriculture. Large parts of the provision area of OOWV are characterized by intensive agricultural land use combined with little buffering soil conditions, i.e. with vulnerable underlying groundwater bodies. OOWV as the largest water provider in this area works closely with local farmers in drinking water cooperation to support groundwater protection. However, the development of groundwater quality (e.g. re-increasing nitrate concentrations in shallow groundwater) shows that this is not sufficient.

On the basis of Lower Saxony Water Law, the so-called "Cooperation Model for Drinking Water Protection" has been developed. Since 1993, groundwater protection has been practiced successfully in the water protection areas in Lower Saxony via the "cooperative water protection": Farmers use the free advice on water protection and optimize their management methods through the implementation of "voluntary agreements". Accompanying investigations monitor the efficiency of the measures. Representatives of water management and agriculture regularly discuss the current issues of groundwater protection. Farmers receive compensation from drinking water companies for the implementation of groundwater protection measures. They receive subsidies from the water collection fee. This fee attracts Lower Saxony for the use of water. For example, the drinking water companies pay 7.5 cents per thousand liters of water to the land, the so-called "Wassergroschen".

The results of 2016 show at many measurement points in Lower Saxony more than 50mg/l of nitrogen. The question is what we can do and what needs to be done to improve the groundwater quality together with the farmers based on the precautionary principle.

2. Environmental context of case study

In the northern part of the OOWV provision area, clayey layers protect strongly the deeper groundwater layers. The drinking water production areas southern of Oldenburg (where the case study is located) are characterized by glacial sands (kaltzeitliche Sande) with a higher infiltration rate, and a resulting high vulnerability towards migrating pollution. As sandy areas provide naturally less fertile soil, animal husbandry often dominates the local agriculture activities. This generates high amounts of organic fertilizer which needs to be disposed of.

3. Management issue – simplified

- Major challenge?

  Groundwater protection, motivate all stakeholders but especially farmers to adapt their management practices towards the precautionary principle.

- General Approach / Solution?
  Main focus in the OOWV area has been to compensate farmers at an individual basis for implementing specific management activities. Since 2015, this approach is further developed so that the compensation is results' depending: if a specific concentration is not achieved, (part of) the compensation is not paid.

[2] Groundwater is pumped from up to 160 m, and needs up to 60 years from surface to the deep layer.

- Major Obstacles to implement solution?
  The partly instable context reduces the benefits for the farmers to stronger engage in precautionary groundwater protection but emphasizes short term benefits of less protective management. Thus, it is difficult to convince farmers to engage in groundwater protection.

4. Management issue – expanded

- *Main issue*

OOWV needs to ensure better protection of groundwater resources. For this, agricultural commitment needs to be improved by all stakeholders – farmers, regulatory authorities and legislative bodies. Groundwater protection has to be prioritized, and agricultural management activities need to better consider their impact on underlying groundwater bodies.

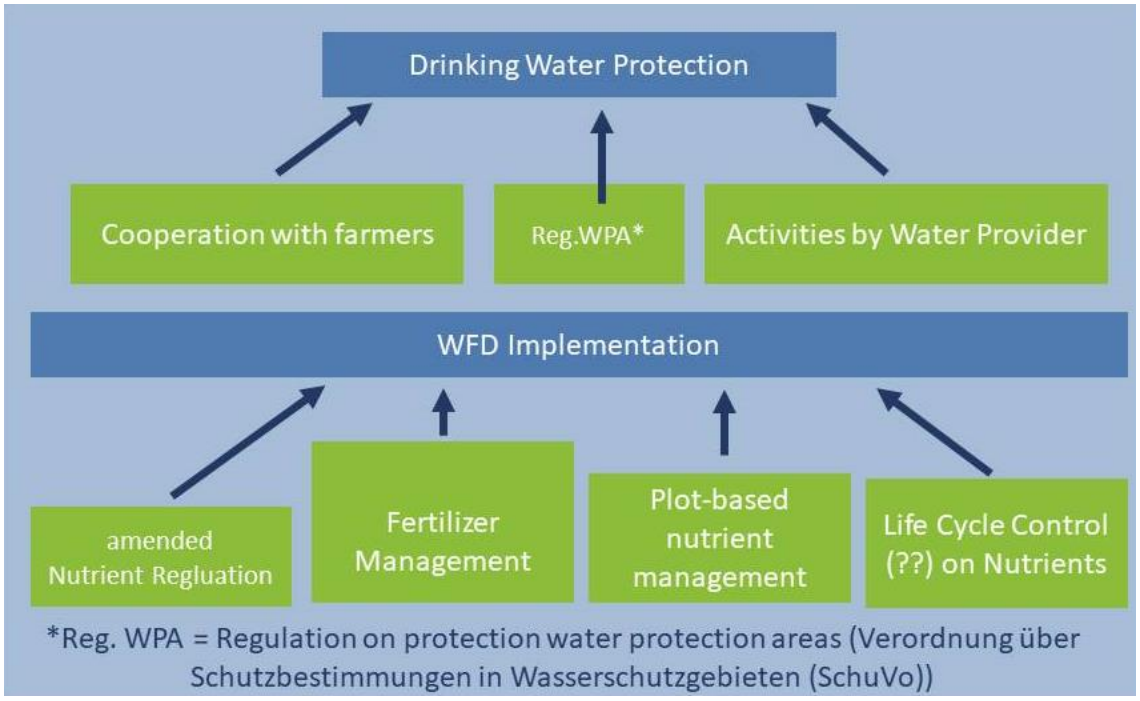
The current recommendations for fertilizing are not focused on sustainability but on maximizing the agricultural income. Regulations on protecting the environment and on subsidies for farmers and fertilization are sometimes incoherent. The national regulations in Germany are not sufficient to protect the groundwater from nitrogen. Some experts say that even the renewed laws on fertilization are no enough to protect the groundwater.

Still, there seem to be also some gaps with regard to comprehensive implementation of the existing groundwater protection regulations.

- *legal frame (local / regional / national / European law) and legal obstacles?*

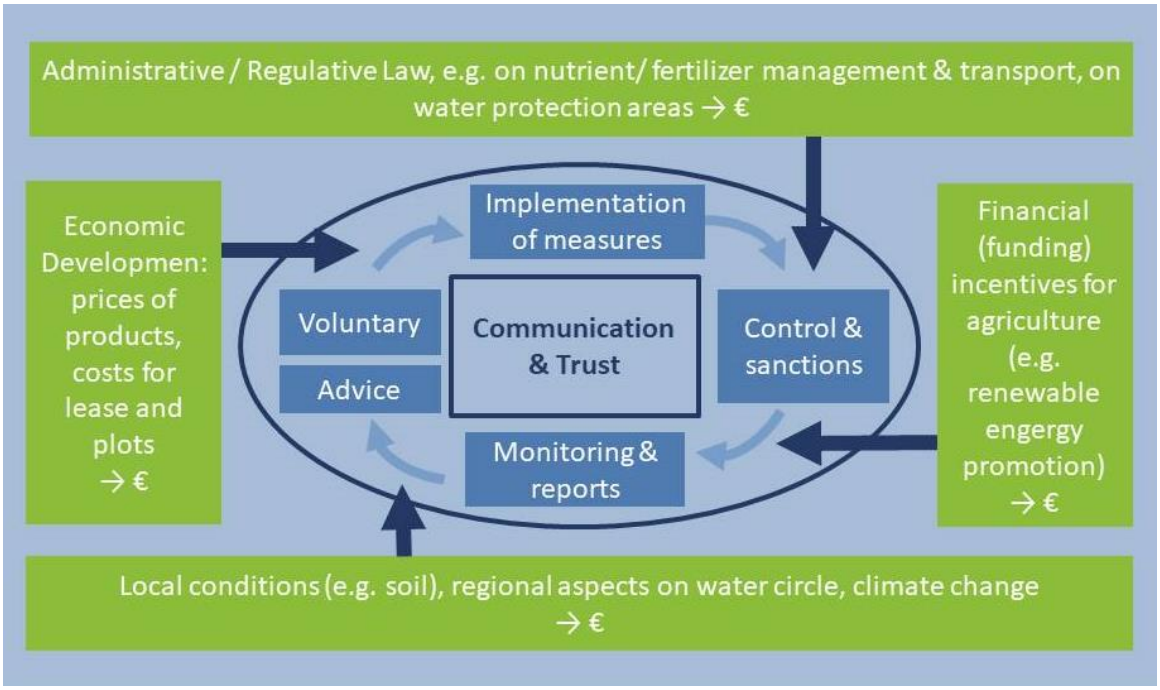
Groundwater management takes place within a system of voluntary and regulatory instruments (see graphic below):

Figure 1: Regulatory and voluntary measures for groundwater protection. Translated and adapted from Aue(2017): Grenzen und Möglichkeiten des Grundwasserschutzes. Der Kritische Agrarbericht. S. 35, Abbildung 2



While Germany has been sued by European Commission for the insufficient implementation of nitrate's regulation, in general support by the municipalities could be expanded. However, the context of voluntary measures is not only regulatory, but also the larger economic context as well as incentive based instruments embedded in EU regulation:

Figure 2: (Dynamic) boundary conditions for cooperation between agriculture and water provider. Translated from Aue(2017): Grenzen und Möglichkeiten des Grundwasserschutzes. Der Kritische Agrarbericht. S. 35, Abbildung 3



- *Is any approval procedure relevant (e.g. for groundwater abstraction permits)*

No.

- *Is the funding of measure(s) secured by the responsible person / organization or supported by other funds?*

The voluntary cooperation for groundwater protection were introduced with the water abstraction fee (so called "Wassergroschen") in 1972, which is paid to the Land by the water providers (and other water users) for abstracting groundwater. 40% of this income (about 17 Mio Euro) is fed back by the Land for cooperative groundwater protection in areas protected for water production.

- *Who is responsible for planning, initiating or implementation of (potential) measures? Who is the problem owner?*

As the OOWV relies on suitable groundwater, its statutes include the duty for groundwater protection. Thus, the water provider takes responsibility for ensuring this and takes problem ownership. However, municipalities are the regulatory authorities to control and implement regulatory instruments for groundwater protection.

5. Options and obstacles

What are the different options and obstacles currently possible within legislation, funding and stakeholder involvement should be mentioned here - please elaborate each bullet.

Options / Solutions:

Technical solutions (to be avoided due to additional costs):

- Dilution of raw water with less polluted groundwater or dismiss use of highly polluted groundwater for drinking water-

Financial Instruments – funded by water abstraction fee

- Compensation for adapted management practice,
- Compensation for reduced nitrate concentration

Legislation changes:

Strengthening of regulation on nutrient management:

- Controllable and plot-depended nutrient management and qualified resource management, including sanctions for non-compliance
- Consideration of all relevant nutrient loads for management of fertilizer application

Obstacles to implement the solutions:

Resources and preparedness / willingness to implement groundwater protection are limited. If a large number of farmers engages, how well do the remaining farmers manage? It is difficult to identify most effective measures, and how to prioritize.

6. Questions to TOPSOIL partners

The following questions are not only from OOWV, but include also the questions from the TOPSOIL case study UK 1, as they face a rather similar situation. As a responder, please respond to the first 3 questions if possible, and select all those below you can respond to.

- **How would you deal with the situation in your area?**
- **How do you interest commercial farmers in protecting and improving the environment?**
- **How would you identify the measures with the largest positive impact on groundwater protection?**
- Can you provide good example on improving nutrient efficiency in farms?
- Which practices would you want farmers to change and how would you achieve those changes?
- What barriers are in the way of making these changes and how should they be overcome?
- Do farmers engage in voluntary agreements for protecting groundwater? Why? What is their benefit?
- Is there any experience with participatory / co-governance management processes in vulnerable areas?
- How do you measure environmental improvements arising from the measures taken?
- Are there any established methodologies to monitor nitrate percolation to groundwater?
- What modelling softwares/methodologies would you recommend for; 1) nitrate percolation, 2) minewater/groundwater interactions, 3) Phosphate (sewerage) inputs.
- Who would be responsible in dealing with the challenges in your country? Who are good persons to contact on this issue?
- Any specific references (including page-numbers…) you would recommend?

Annex V UK1 TOPSOIL Governance Case Study
Linking agricultural land use to surface and groundwater protection within a multi-agency regulatory framework

Facts on case study

This case study focuses on the role of the Wear Rivers Trust (WRT) as host for the Wear Catchment Partnership (WCP) in facilitating communications between various partners on the Wear Magnesian Limestone groundwater body, via the Topsoil UK1 project. Numerous partners are active in this area including the Environment Agency (EA, the Government's environmental regulatory authority), Northumbrian Water (NW, the local water company), Natural England (the Government's advisor for the natural environment), Local Authorities (local county-level control of the built environment), and local land managers and owners (farmers, industry, etc.). Due to prioritisation of work areas (based on limited resources), these organisations can not engage to the same level everywhere in the Wear catchment. Through Topsoil UK1, the WRT have identified methods for improving coordination and communication around environmental issues on the Magnesian Limestone.

The Wear Magnesian Limestone groundwater body is currently at poor Water Framework Directive (WFD) status due to agricultural (livestock and arable) pressures. The EA have assessed the Magnesian Limestone groundwater body as failing due to a private single drinking water supply. This borehole represents a single failing source, as discussed above, and shows that there is a localised impact from agricultural practices giving rise to the rising trend in nitrate in the groundwater. The EA are confident that farming practices in this localised area are compliant with the NVZ rules. The area is vulnerable to impacts by surface activities. In addition to the single point failure above, the ML also experiences a rising trend in nitrate levels at one of the water companies potable supply boreholes which is currently under investigation through Topsoil.

The WRT, via Topsoil UK1, is engaging with the farming community in this local area to raise awareness of the potential pollution of groundwater from farming activities, and to gain buy-in to make voluntary changes in farming practice, and help find funding for mitigation measures over and above those required by regulation. WRT is doing this by facilitating a network of communication within the farming community, providing information and advice sessions, producing StoryMap websites to communicate the issues, and establishing a farming trial with a "champion farmer". This farmer is a well-respected member of the farming community who, by hosting the trial and working collaboratively with the WRT, will help disseminate understanding to a wider network, and convince other farmers of the benefits of engaging with the WRT. This type of working encapsulates the ideals of the Catchment Based Approach (CaBA).

Environmental context of case study

The project area, highlighted in Figure 1 below, represents an area of fractured limestone aquifer. Groundwater connectivity (shown in Figure 2) can be used as a proxy for, or as another line of evidence to indicate, the potential vulnerability of groundwater in the area in terms of risk.

The area is largely rural with agricultural diffuse pollution impacting at least locally on groundwater quality, however, there are two major urbanised areas (Sunderland & Peterlee) which heavily rely upon groundwater as a potable resource. Magnesian Limestone groundwater quality is also 'at risk' of being impacted by rising mine waters from the Coal Measures, which underlie the limestone. These mine waters within the Wear Carboniferous Limestone and Coal Measures groundwater body are also classed as POOR under WFD due to mining impacts. The EA have reported in the Northumbria RBMP that it is technically infeasible to treat the mine water within the Coal Measures; therefore, long-term management of the mine water is required. This long-term management of mine waters is carried out by the Coal Authority, a non-departmental public body of the UK Government with responsibility for pollution associated with legacy mining activities in the UK.

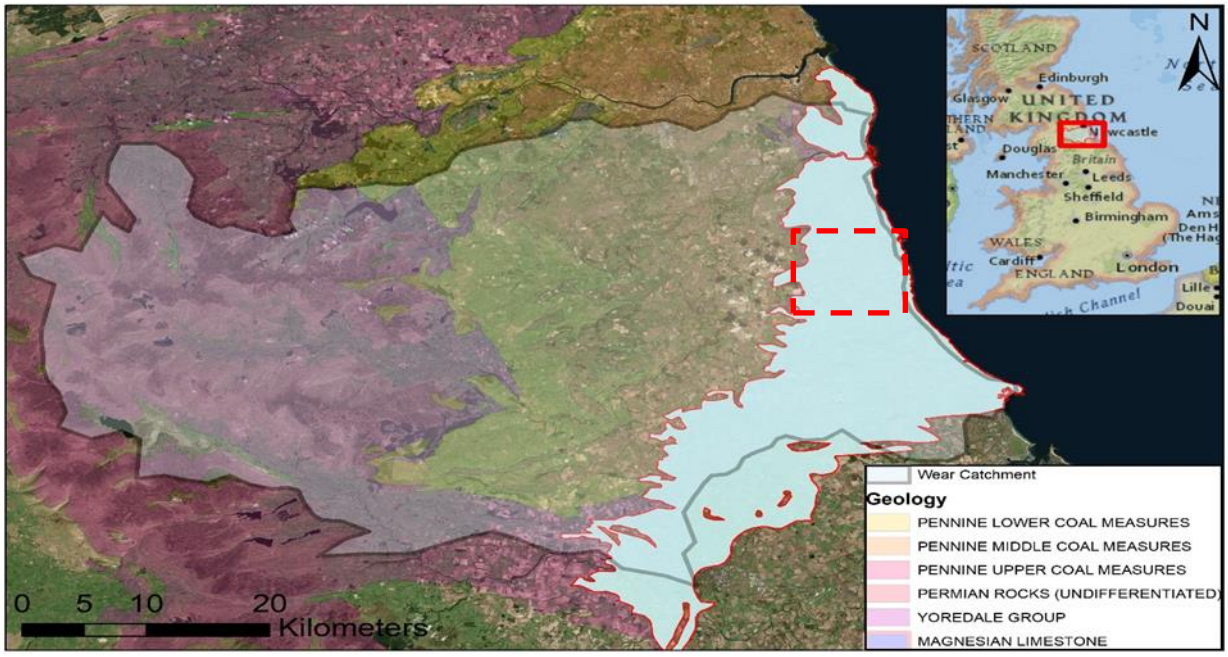


Figure 1: Magnesian limestone location within UK, and Wear Catchment and Topsoil UK1 Study Area (red rectangle).

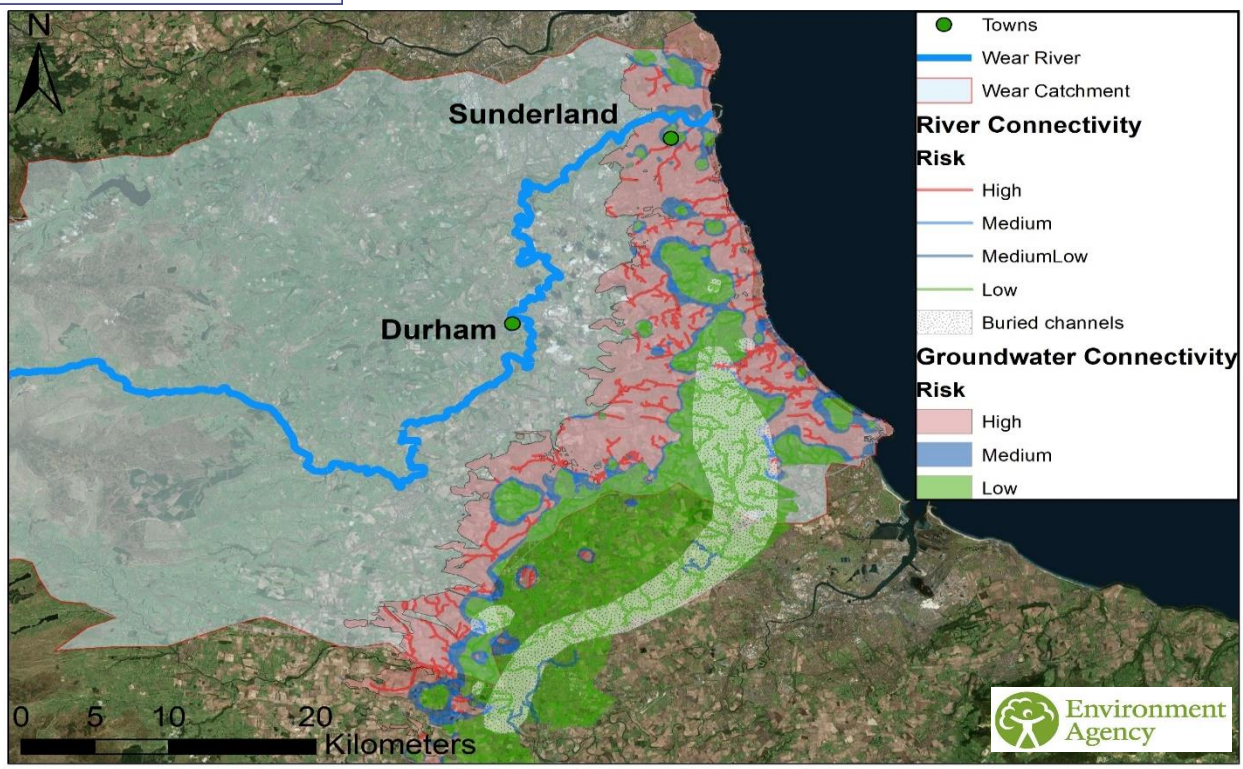


Figure 2: Groundwater Connectivity map for the Magnesian Limestone aquifer, showing areas of higher likely connection between land-surface activities, surface water and the groundwater. (Produced by the EA).

Management issue – simplified

Major Challenges

- Groundwater is often "out of sight, out of mind". Awareness of land-use impacts on groundwater needs raising.
- This area has complex geology (including superficial deposits) and understanding of how this complex geology influences the hydrogeological processes in the area is currently evolving. This makes it difficult to communicate the issues clearly with stakeholders and decide on actions.
- Limited resources means regulatory authorities focus their activity where it is most needed. Some areas where groundwater may be highly vulnerable therefore fall outside their prioritisation.
- The existing groundwater monitoring network is not widespread. It was established at a number of locations to monitor background water quality of the aquifer, and is expensive to extend, therefore it is very often difficult and expensive to gather evidence of potential localised groundwater issues.
- The intensive management of arable land in some areas promoted management practices which exacerbate the loss of nitrates into both surface and groundwater. These farming practices may be culturally deep-set and change may be difficult.
- There is a gap between regulatory powers and the ability of authorities to effectively monitor compliance with Statutory Management Requirements and Good Agricultural and Environmental

Conditions of land standards, and measures implemented under Countryside Stewardship agreements.

General approach / Solutions proposed?

- The WRT, via Topsoil UK1, is uniquely positioned to bring partners together to agree a communication strategy for highlighting risks from diffuse agricultural pollution amongst the farming community. Three partners are formally designated as project beneficiaries: WRT, Durham University and NW. The EA and the Heritage Coast partnership are also actively involved, with wider catchment partners, including Local Authorities, involved through engagement at WCP meetings.
- The three partners are actively investigating surface water – groundwater interaction on the ground to increase understanding in three sub-catchments: Hawthorn Dene, Cut Throat Dene and Lumley Park Burn.
- Data capture within Topsoil and wider partner projects, data sharing between partners, and evaluation of current understanding by technical groundwater specialists at the EA and NWL will support improved catchment management for water quality benefits.
- Storymaps – a web-based platform utilising maps and text – will be developed for each sub-catchment to explain environmental issues to a broad audience.
- A farming trial has been established at Seaham Grange Farm to compare the impact of different tillage methods on water quality (http://seahamgrangefarm.com/site). This trial includes partnership working between Seaham Grange Farm, Frontier Agriculture, WRT and wider farming networks. This trial will promote profitable, commercially viable farming, reducing input costs, whilst directly delivering perceived environmental benefits.

Major Obstacles to Implement Solution

- It is difficult to secure adequate funding and resources to deliver effective partnership working which can tackle these issues.
- Land and surface/ groundwater dynamics and interactions are very complex, and expert understanding of this system is still evolving.
- Data sharing between organisations is difficult and can take time to arrange and agree due largely to data protection legislation to which all partners must comply.
- There is a need to generate farmer-credible evidence that there is no conflict in principle between long term business profitability and environmental protection.
- There is a lack of resources available to close the gap between regulatory requirements and ensuring compliance, regarding both maintenance of records and comparison of records to physical conditions. Anecdotal farmer evidence suggests in some cases records may not reflect on the ground management practices. Regulatory authorities can only focus efforts in accordance with resource, e.g. taking an evidence-led and risk-based approach to determine priorities: catchments which are at-risk or failing to meet WFD objectives in areas which are designated as high priority, including Drinking Water Protected Areas (safeguard zones and groundwater source protection zones), Bathing waters, Shellfish waters, Natura 2000 sites, Nitrate Vulnerable Zones (NVZs) and No Deterioration of WFD status. Not all potentially highly-vulnerable areas fall within these designations.

- Water companies generally focus resources on groundwater management to protect drinking water, with activity focused on issues in areas where drinking water quality is at risk. The EA is responsible for dealing with issues of WFD groundwater failures. Differing objectives and standards, if not dealt with through effective partnerships between water companies and Regulators, can lead to major obstacles to implement solutions.

Management issue – expanded

What has been the main issue you want to solve?

The main issue to resolve is how best to utilise WCP, cross catchment and regional relationships to better facilitate improved understanding and communications between all partners for more effective management of surface and groundwater. More consideration of the anthropogenic impacts on the Magnesian Limestone Aquifer of surface- groundwater interaction is needed.

A supporting issue is to provide farmers and landowners with balanced information on the impact of their farming practices and different management practices, so that they can consider if making changes will benefit the environment without putting their businesses at risk.

Is the legal framework suitable to solve the issue?

Yes. Through Topsoil UK1, the WRT are helping to proactively provide advice to the farming community about groundwater protection, while at the same time ensuring mitigation measures do not impact on the farmers' yields / profit. The project area is in a potentially high-risk area (hydrogeologically speaking), which is compliant with NVZ rules, but where additional measures that are above and beyond NVZ rules may be needed.

Is any approval procedure relevant?

No. Topsoil UK1 builds upon the Catchment Based Approach, which brings partners together to work at a catchment* scale. Approval may be required for different funding streams; however, the overall approach is not subject to approval other than Project Board agreeing the direction of travel for the project. (And maybe Trustees of the WRT?)

Who is responsible for planning, initiating or implementation of (potential) measures?

Statutory regulation for both surface and groundwater bodies is, as discussed above, divided between Government agencies and Local Authorities. The WCP, operating under Defra's Catchment Based Approach, provides an open forum and framework for statutory agencies (including water companies who retain statutory rights and responsibilities), to work with environmental Non-Governmental Organisations (eNGOs), universities and wider business interests. This approach can allow effective sharing of information and challenges which cascades knowledge across and between organisations and raises awareness of issues at catchment[3] scale to which joint solutions can be developed.

[3] *Note a groundwater catchment would rarely be the same, in terms of physical area, as a surface water catchment.

Whilst individual organisations are responsible for planning, initiating and implementing their own objectives, coming together collectively through the WCP improves visibility of each other's activities; allows opportunities for joined up thinking, both on regulatory and non-regulatory issues, delivery of existing cross cutting activities and identifies new opportunities through the pooling of information and ideas.

Options and solutions

Local activity

The Catchment Based Approach (CaBA) has provided a Catchment Partnership structure within the WCP for WRT to access key land management stakeholders, engaging and utilizing specialist input from the regulatory agencies, water providers and academic research institutions.

In the three years that Topsoil UK1 has been active, farmers have begun participating in activities, and those that have engaged have been receptive to the message around protecting surface and groundwater quality.

Future project objectives will ensure that management interventions for groundwater protection through changes to land management techniques are widely discussed and disseminated amongst those on the ground that can deliver changes with local regulatory support available.

Legislation

The post-Brexit move to a UK-specific agricultural support framework working towards the objectives in the Governments 25 Year Plan is expected to provide more UK-specific measures for agricultural management than those currently available through the EU Common Agricultural Policy (CAP).

A new Agriculture Bill published last month has set out an expectation that public money should be used for public goods, however, the degree to which interventions for water quality protection will be included is still under development.

In the interim new Farming Rules for Water will be implemented which aim to provide a win-win for farmers and the environment. Topsoil UK1 can help raise awareness of these.

Although further additional legislation may be needed, it may be better to consider options to improve and simplify existing legislation and policies, including reviewing funding for agricultural support, looking at robust implementation, and considering how outcomes are monitored, building on the lessons learned from effective partnership working.

Questions to TOPSOIL partners

- How do regulatory authorities and those who are involved in environmental/catchment management co-ordinate their activities in other countries?
- Is there a similar governance gap around surface and groundwater management in other countries, and if so how could it be closed?
- Is there any European experience which can be shared illustrating participatory / co-governance management processes in vulnerable areas?
- How could we interest farmers of both large commercial farms and small holdings in protecting and improving the environment? Are the approaches the same or different for all types of farm?
- Which practices would we want farmers to change?

- How could we best achieve those changes/what barriers are in the way and how should they be overcome?
- How can environmental improvements arising from changes best be measured?
- Is there experience of how complex technical issues around groundwater management can be successfully discussed/presented to a non-technical audience?