Managing Diffuse Water Pollution from Agriculture through Integrated Catchment Management in the Age of Uncertainty: Experiences from East Anglia

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Abstract

On 24th June 2016, UK voters made a decision to leave the country's EU membership. This raised many uncertainties around the future of the UK's environmental policies. This paper discusses post-Brexit uncertainties to be considered by the UK water sector to mitigate Diffuse Water Pollution from Agriculture, by engaging with stakeholders in the agricultural sector as part of their Integrated Catchment Management strategies. In the agriculture-intensive eastern region of England, pesticides carried by surface runoff present in raw water used to produce drinking water is a recurring issue, especially those that are not easily removed through conventional treatment such as Metaldehyde. The local water company, Anglian Water Services Ltd. has taken on the catchment advisory role to actively engage with the agricultural community within the region to encourage behavioural changes and the implementation of best practices to reduce pollution at source, in line with Article 7 and 14 of the EU Water Framework Directive (Directive 2000/60/EC). Though measures such as product substitution may seem straightforward, the agricultural sector's decisions are heavily reliant on their regulatory and economic priorities. The question is, what will the future of agricultural policies look like after Brexit, and how will this impact the water environment?

Keywords: Integrated Catchment Management, Stakeholder Engagement, Water Framework Directive, Brexit, Agriculture

1. Introduction

Agriculture in the UK plays a significant role in defining the country's rural landscapes and contributing towards the economy and food security. Defra (2016) reported that in 2016, 71% (17.36 million ha) of land use in the UK is utilised by agricultural activities and the country is 76% self-sufficient at producing locally grown food. The agricultural sector contributed £8.5 billion (0.5%) of Gross Value Added to the UK's economy in 2015 (Defra *et al.*, 2015) and employed 466,000 agricultural workforce in 2016 (Defra, 2016). Anglian Water Services Ltd. (herewith Anglian Water) is the largest water and water recycling undertaker by geographical area in England and Wales (Anglian Water, 2017) with an increasing demand for the supply of potable water from more than 6 million customers **(Fig. 1)**. Although East Anglia is the driest region in England, it is one of the most productive agricultural landscapes in the world. Due to this agricultural intensity, high concentrations of pesticides and herbicides are applied during each crop rotation to prevent damages and yield losses from pests and diseases. Therefore, these chemicals can be present in raw water used to produce drinking water above the limits stipulated by the EU's Drinking Water Directive (Council Directive 98/83/EC) of 0.1 µg/l and 0.5 µg/l for individual and total pesticides (DWD 1998).

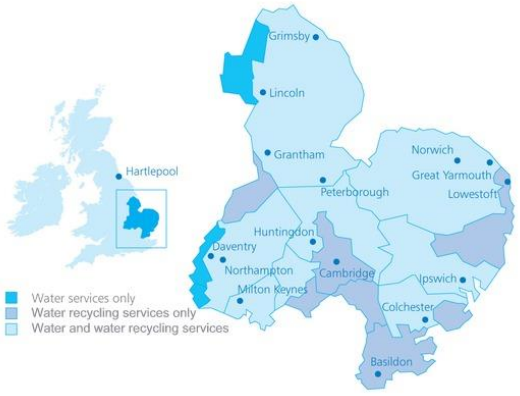

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Figure 1. Anglian Water's Service Region (Anglian Water, 2017)

The East Anglian region is underlain with heavy clay soils which is suitable for growing cereal crops and oilseed rape (Dolan *et al.*, 2014). These crops are particularly vulnerable to slug damage and competition against the grass weed 'blackgrass'. To protect their crops, farmers would apply the molluscicide metaldehyde or herbicides such as clopyralid and propyzamide onto their land. Heavy clay soils exhibit high runoff potentials which creates pathways for these chemicals to reach nearby watercourses. Metaldehyde has been a challenge to the UK water sector, particularly during the wetter autumn and

winter months. This molluscicide cannot be easily removed through conventional water treatment works (Anglian Water, 2017; Dillon *et al*., 2011 and Dolan, 2013). In addition, the presence of clopyralid, propyzamide and other Plant Protection Products (PPPs) at peak levels have also emerged as a treatment challenge (Dillon *et al*., 2011). Effective removal of metaldehyde would require an upgrade in water treatment facilities across East Anglia with an estimated CAPEX of £600 million and an additional OPEX of £17 million annually, which would reflect into a 21% increase of water customers' bills (Anglian Water, 2016). An upgrade or installation of new water treatment facilities would also mean an infraction against Article 7 of the Water Framework Directive (Directive 2000/60/EC) to depart from end-of-pipe treatment (WFD 2000). Through the WFD, EU Member States need to take on the prevention led approach (Dolan, 2013) to address pollution in raw drinking water resources (Art. 7) at the river basin or catchment level (Art. 13) (WFD 2000). Article 14 outlines the requirements to include participatory approaches (active involvement, access to information and consultation) as part of the strategies to meet WFD objectives (WFD 2000). Integrated Catchment Management (ICM) provides a favourable opportunity for the water sector to address the pesticide challenge based on the principles of the WFD. The UK water sector has taken on the role to engage with stakeholders in the agricultural sector to promote behavioural changes and best farming practices to minimise, if not eliminate diffuse water pollution from agriculture (DWPA) at the source and pathways. However, it is recognised across both sectors that engaging with stakeholders in the farming community and encouraging participation and behaviour change for water quality improvement is not a straightforward exercise that can be achieved over a short time frame. On top of water policies, the agricultural industry faces pressures to comply with multiple obligations under the Common Agricultural Policy. Market pressures and demand, the impacts of climate change (Gibbon and Ramsden, 2008), the price and efficacy of PPPs, and funding streams through agri-environment schemes at the local and EU level (Rodgers, 2016 and Collins *et al*., 2016) are among the many priorities that farmers have to consider when making decisions for their businesses. For four decades the face of the UK's environmental and agricultural policies were shaped by the European Union's (EU) laws. However, the future of these policies will be met with uncertainties following the success of the 'Brexit' campaign in the EU Referendum. On 24th June 2016, 51.9% of UK voters made the decision to leave the European Union and Article 50 of the Treaty of Lisbon, giving the rights for Member States to withdraw from the EU, was triggered on 29 March 2017. This paper will firstly highlight the ICM strategies and measures currently undertaken by Anglian Water to address the metaldehyde challenge in their region. The uncertainties that would influence decision making across the water and agricultural sector in a post-Brexit environment will then be outlined and discussed. Opportunities for both sectors will also be identified.

2. Addressing the Metaldehyde Challenge in the Anglian Region through ICM

2.1. Planning and Implementing ICM Strategies

Since the fifth Asset Management Planning (AMP5) period (April 2010 – March 2015), Anglian Water has incorporated ICM into their business strategies to address the presence of metaldehyde in raw water. In this AMP, Anglian Water identified high risk areas through detailed catchment modelling of surface water bodies. The migration of DWPA was modelled in response to three main criteria: soil type, slope and proximity to water bodies. As a result, primary and secondary target areas for ICM in the Anglian Region were identified **(Fig. 2)** which has enabled the company to target mitigation measures in areas of high risk and inform strategies for AMP6 (April 2015 – March 2020).

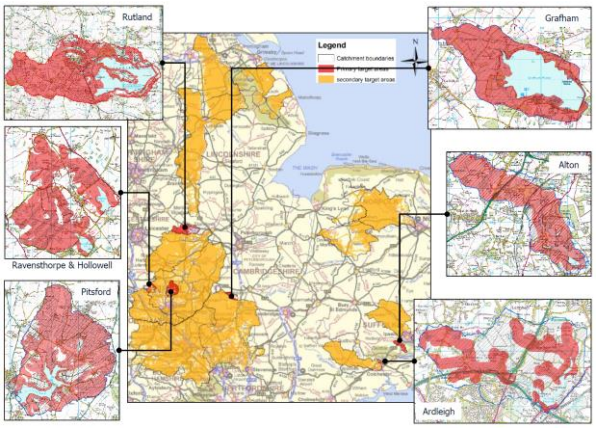

Figure 2. Primary and Secondary Target Areas for ICM (map provided by Anglian Water, 2015a)

In the AMP6 period, Anglian Water's primary focus is to deliver ICM measures, establish relationships with stakeholders and continuously building up knowledge of their catchments. Measures with potential to address DWPA at source and improve water quality were implemented on the ground. A product substitution trial, *Slug It Out* was designed for implementation at the seven primary target areas identified in AMP5. These natural catchments flow gravitationally into Anglian Water's water abstraction reservoirs – Ravensthorpe Reservoir, Hollowell Reservoir and Pitsford Water in Northamptonshire, Grafham Water in Cambridgeshire, Alton Water in Suffolk, Ardleigh Reservoir near Colchester and Rutland Water near Oakham.

2.2. Product Substitution Trial – Slug It Out

Slug It Out incentivises farmers in the primary target areas to apply ferric phosphate as an alternative to metaldehyde for slug protection. It was hypothesised that complete removal of agricultural sources of metaldehyde from the natural catchments can minimise the risk of peaks in the reservoirs. Ferric phosphate is a desirable alternative as it is insoluble, exhibits low degradation in soils and does not present any water treatment issues. However, it is recognised that farmers have reservations towards ferric phosphate due to its cost and efficacy (Anglian Water, 2015b and Dolan, 2013). Ferric phosphate is costlier than the cheaper metaldehyde variety, and its mode of action causes slugs to die underground which does not provide the visual assurance of seeing dead slugs on the surface that farmers are accustomed to with metaldehyde.

To overcome the cost barrier, Anglian Water offered three levels of subsidies to participating farmers on a pound (£) per hectare basis comprising of (i) a one-off hosting payment, (ii) cost difference between ferric phosphate and metaldehyde (3%, dry processed), and (iii) a water quality bonus for reservoirs that do not exceed the DWD standards throughout the duration of the trial. In addition to product substitution, farmers were encouraged to adopt cultural control measures and good practices to reduce slug and DWPA risks on their land. The trial is currently in its second year of implementation with 100% participation in both years, with participation from 89 farmers (7679.3ha) in 2015/16 and 121 farmers (9829.6ha including Rutland Water) in 2016/17. Key learnings from Year 1 of Slug It Out are highlighted based on the following themes:

2.3 *The Role of Multiple Stakeholders in the Agricultural Sector.*

It is essential to understand the motivations behind individual farmers' decisions. It was observed that 'peer pressure' amongst the farming communities can lead to positive outcomes; e.g. encouraging participation and ensuring only ferric phosphate was applied. It is also recognised that agronomists have significant influences towards farmers' decisions for pest, weed and disease management – they are the main decision makers for pesticide use (Dolan *et al*., 2014). Regular engagement with agronomists gives the opportunity to raise farmers' confidence towards the programme and demystify ferric phosphate. Collaboration with other relevant stakeholders such as agricultural contractors, pesticide suppliers and the market supply chain (e.g. food manufacturers, supermarkets and consumers) could also influence farmers' decisions and practices. Experiences in the trial have also fostered advocates of ferric phosphate in the farming community who are able to influence other farmers' choice of product.

2.4 Non-agricultural Sources and Pathways of Metaldehyde.

Despite 100% removal of metaldehyde, peak levels were still observed at some of the natural catchments. This provided an opportunity to investigate non-agricultural sources and pathways for metaldehyde. These include pesticide handling yards, gardens and allotments, private irrigation reservoirs and 'legacy' metaldehyde from previous applications in soils or drains. Although catchment models are an accurate representation of the system, some pathways were not captured due to unanticipated connectivity factors. These connections include additional land, road and railway drainage and extended land drains. Initial ground-truthing would further enhance the catchment models and identify other pollution pathways.

2.5 Optimising Stakeholder Engagement: Processes vs. Outcomes.

Despite the peak levels observed, Anglian Water was able to raise awareness on the metaldehyde challenge to the farming community. The company appointed Catchment Advisors with prior experience in the agricultural sector to facilitate knowledge transfer effectively between the water and agricultural sector. Effective communication is crucial in building the stakeholders' confidence, trust and willingness to cooperate. This has enabled conversations on a wider range of shared concerns between both sectors beyond metaldehyde such as safe disposal of unwanted pesticides through a Pesticide Amnesty programme.

3. Brexit: Uncertainties and Opportunities for the Water and Agricultural Sector

3.1. Potential Brexit Scenarios

Following the Article 50 trigger, the UK will have two years to negotiate their terms of withdrawal with the EU. While industries continue to operate on a business-as-usual basis in this period, conversations on the uncertainties and the impacts of Brexit are ongoing among policy makers, industries and interest groups to shape future strategies. The impacts are dependent on the UK's post-negotiation relationship with the EU (Global Counsel, 2015 and Harward, 2016). Two potential Brexit models or scenarios are anticipated (Menon and Fowler, 2016):

i. Clean (or Hard) Brexit. The UK would be fully independent from the EU and forgo the Single Market and Customs Union (Menon and Fowler, 2016); similar to Canada. The UK does not need to contribute to the EU budget and will fully restrict free movement of people, goods, services and capital. Trade deals will be negotiated based on the World Trade Organisation rules (Menon and Fowler, 2016).

ii. Soft Brexit. An independent UK with continued EU membership through the European Economic Area (EEA) (Menon and Fowler, 2016); similar to Norway (Global Counsel, 2015). In the Norwegian-style model, the UK would maintain full access in the Single Market, be subject to the majority of EU laws and must contribute to the EU budget (Global Counsel, 2015, Ffoulkes, 2016, and Menon and Fowler, 2016).

3.2. Potential Impacts of Brexit to the Water Sector

The UK's water policies were largely influenced by EU Directives on the water environment and codified into national law (Ofwat and Defra, 2006). Although the EU Directives will no longer apply in the UK in a Clean Brexit, those already transposed into national law will remain unless repealed (Dollar and Dewhurst, 2016 and Harward, 2016). Alternatively, in Soft Brexit it is likely that the UK may be obligated to some key Directives as a member of the EEA (Dollar and Dewhurst, 2016 and Harward, 2016). Independence from EU legislations would mean that the UK will have the freedom to develop laws or standards that are fit-for-purpose to suit the needs of the local environment (Dollar and Dewhurst, 2016; House of Lords, 2016; and MacNee, 2016). For example, a blanket ban on metaldehyde might not immediately reduce metaldehyde levels to the DWD's standard for individual pesticides (0.1 µg/l), as observed in the case study *(Section 2)*. In addition, the metaldehyde observed at present levels are not harmful to human health. Rather than taking a 'shoot the messenger' approach, further investigations on the potential sources, pathways and properties of the molluscicide can inform strategies to address the wider pesticide challenge. Some stakeholders have shown concerns towards a potential relaxation of environmental standards following a Clean Brexit (Dollar and Dewhurst, 2016). However, it was suggested that Brexit is an

opportunity to improve current environmental laws by retaining the standards adopted from EU legislations (House of Commons, 2016), but also having more flexibility and creativity in the process and delivery of outcomes. For example, a revision of the 'one-out-all-out' principle of the WFD which potentially leads to a 'pessimism bias' or 'optimism bias' in the classification of water bodies, which does not reflect actual conditions (Cunningham, 2012). Nevertheless, a review or repeal of legislations would be a lengthy and time consuming process and is highly unlikely until the next general election as the UK's legislative process is influenced by political cycles (Dollar and Dewhurst, 2016).

3.3. The Impacts of Brexit to the Agricultural Sector

The landscape of farming in the UK is also heavily influenced by EU policies and legislations. In a Clean Brexit, the UK food and farming sector can expect significant changes in the primary drivers behind the agri-industry such as future trade models, policies and regulations, environmental protection, labour and employment, research and development, food safety and animal welfare (ADAS UK, 2016). Some key impacts to consider are discussed below.

i. Trade Agreements. The UK is a net importer of agri-food products, importing twice as many agri-food products from other EU countries than what is exported (Moorhouse, 2016). Approximately 73% of the UK's total exports are distributed in the EU (NFU England and Wales, 2015). Setting up new trade agreements with the EU and non-EU countries will have impacts on competitiveness and security of supply in agricultural businesses (ADAS UK, 2016). In Hard Brexit, the Common Customs Tariff for goods imported from outside the EU could be replaced with lower tariffs based on WTO rules which could potentially bring cheaper agricultural raw materials and food products (NFU England and Wales, 2016 and ADAS UK, 2016). However, taking this step would also give rise to constraints and uncertainties such as new international obligations and trade agreements with the EU (Swinbank, 2016).

ii. Common Agricultural Policy (CAP). The CAP is an EU agricultural support scheme that has largely influenced the UK's agricultural landscape. About 55% of UK total income from farming comes from CAP where farmers receive direct support payment or through agri-environment schemes, investment grants and skills training (ADAS UK, 2016 and NFU England and Wales, 2016). The CAP ensures that farmers receive a fair level of income whilst producing safe, secure and affordable food products for consumers (NFU England and Wales, 2016). In the Norwegian-model, Norway does not receive the CAP subsidies and instead receives support from the Norwegian government (Ffoulkes, 2016). The Department of Exiting the EU (DEEU) stated that the UK agricultural sector will continue to receive funding at the same level as Pillar 1 of CAP until the end of 2020 (DEEU, 2017). In the longer term, the funding is likely to reduce and this will increase competitiveness in the local agricultural sector (ADAS UK, 2016). However, if new agricultural policies do not meet the EU standards, there is a risk that there would be unfair competition against competitors in the EU market, and would significantly impact the UK economy (NFU England and Wales, 2016).

iii. Environmental Protection. A wide range of EU environmental directives influence the agricultural sector such as the Habitats Directive and Sustainable Use of Pesticides Directive. In a Soft Brexit scenario, countries like Norway still have to fully comply with all relevant environmental legislations for trade in agricultural products with the EU as a member of the EEA (NFU England and Wales, 2016). Should the UK go for Hard Brexit, bilateral agreements would enable the country to have their own set of laws that are tailored to local needs and conditions, whilst meeting the high standards required by the EU.

4. Discussion and Conclusion

In the next two years, the UK is riddled with uncertainties as it continues to redefine its future relationship with the EU. Although there are opportunities for both the water and agricultural sector to provide feedback in improving current laws and practices that are tailored to local conditions, there is a need to identify the emerging risks. This will enable both sectors to engage more sustainably and holistically despite the uncertainties to ensure that the water environment continues to improve whilst sustaining food security and agricultural income.

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