
eagasc
Agriculture and Food Development Authority
Agri-Environment Conference 2015
Thursday, 5th November | Tullamore Court Hotel

9.30am	Registration
9.50am	Opening Address *Paddy Browne, Head of Crops, Environment and Land Use Programme, Teagasc*

Session I Agricultural Catchments Programme (ACP)

Chaired by: Dr. Patricia Torpey, DAFM

10.00am	A study of nutrient management best practice adoption by farmers *Dr. Cathal Buckley, ACP Teagasc*
10.30am	Soil Nutrient Trends and Variation in Phosphorous Legacy *Dr. Noeleen McDonald, ACP Teagasc*
11.00am	Tea/Coffee

Session II Ag Catchments

Chaired by: Ray Spain, Project Coordinator, South Eastern River Basin Project

11.15am	Influence of Soil Type and Weather on Nutrient Movement *Dr. Per-Erik Mellander, ACP Teagasc*
11.45am	Practical Mitigation Options for reducing nutrient losses to water *Dr. Mairead Shore, ACP Teagasc*
12.15pm	Sediment losses - where and how? *Sophie Sherriff, ACP Teagasc*
12.30pm	Identifying the "at risk areas" on Irish Farms *Ian Thomas, ACP, Teagasc*
12.45pm	Lunch

Session III Catchment Characterisation & GLAS

Chaired by: Tom Dawson, ACA President & Con Feighery, Teagasc Regional Manager

1.45pm	GLAS: Outcome of Tranche 1 - Changes in Tranche 2 as result of the outcomes of Tranche 1 *David Buckley, DAFM*
2.30pm	Farmland Birds in GLAS *Dr. Alex Copland, Senior Conservation Officer, BWI*
3.00pm	The relevance of catchment characterisation and WFD River Basin Management Planning for Farming *Donal Daly & Jenny Deakin, Catchment Science & Management Unit, EPA*
3.30pm	NMP online for GLAS farmers and GLAS planners *Pat Murphy, Head of Environment KT, Teagasc*
4.15pm	Close of Conference

Agri-Environmental Conference 2015 – Foreword

On behalf of Teagasc I would like to welcome you to our annual Agri-Environmental Conference. While it has been a challenging year for farmers in terms of output prices and farm incomes it has equally been a challenging period, for everyone involved in supporting the industry with the introduction of CAP reform measures, including Greening, the introduction of GLAS. The ending of milk quotas has seen a dramatic increase in milk output which clarifies for the industry the need to make the increases in output under FH2020 and Foodwise 2025 sustainable.

Seven years ago Teagasc, with the support of the Department of Agriculture, Food and the Marine established the Agricultural Catchments Programme. After two phases of the programme DAFM; have agreed recently to fund the programme for another 4 year term but have introduced an extra challenge to the programme – "to transfer the learning from the programme into improved practice at farm level and in so doing to achieve improvements in Irish water quality". Today, staff and students from the Agricultural Catchments Programme will present some of their key research findings which give pointers for future policy and for future practices at farm level. However, the key challenge to all Agricultural partners may well be the ability to embrace the reality that one size fits all solutions, will not deliver the outcomes we need and that we must improve in relation to developing and implementing targeted solutions.

The introduction of GLAS and the entry of 26,000 farmers into the scheme in Tranche 1 and a proposed 14,000 into Tranche II 2015 has proven to be a major challenge. Going forward it is important for GLAS approved planners to continue to support farmers in the implementation of their options to ensure that positive environmental outcomes are delivered. We will have an opportunity to look at some of the bird measures and outline best practice. We will also be introducing NMP Online which will be used for completing nutrient management plans for GLAS, derogation and agronomic purposes.

I hope you enjoy the programme that we have put together.

Pat Murphy

Session I

Agricultural Catchments Programme (ACP)

Chaired by:

Dr. Patricia Torpey, DAFM

A study of nutrient management best practice adoption by farmers

Dr. Cathal Buckley
Agricultural Catchments Programme, Teagasc, Athenry, Galway, Republic of Ireland.

Dr. Peter Howley
Environment Department, University of York, Heslington, York, UK.

Professor Phil Jordan
School of Environmental Sciences, University of Ulster, Cromore Road. Coleraine, BT52 1SA. Northern Ireland.

Farm and field level nutrient management best practice have been shown to significantly improve both farm profitability as well as end of catchment water quality outcomes. Best practice in the area of nutrient management promotes strict management of nutrients on land to reduce the risk of nutrient mobilisation in runoff pathways to water bodies.

This study examined nutrient management practice adoption across a cohort of farmers in the Republic of Ireland with particular emphasis on the role played by different farming motivations. Results indicate a number of distinct farming motivations are positively related to farmers' behaviour in the adoption of nutrient management best practices. Specifically farmers more motivated by classifications of 'farm stewardship', 'ecocentric' and 'productivist' considerations were more likely to adopt a greater number of the nutrient management best practices under review. Conversely, the results also indicated that 'anthropocentric' considerations were important to some farmers and this had a negative effect on adoption.

A number of demographic and structural variables such as age, off-farm employment status, contact with extension services were found to be significantly related to the probability of adoption of nutrient management practices examined. This analysis highlights important considerations for targeting farmer cohorts for forward land-use planning with regard to tailoring policy measures and incentives in onward reviews of environmental directives and schemes.

Soil Nutrient Trends and Variation in Phosphorous Legacy

Noeleen T. McDonald
Agricultural Catchment Programme, Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford, Ireland

David P. Wall
Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford, Ireland.

The EU Nitrates Directive under the Nitrates Action Programme (NAP) of measures aims to improve water quality by reducing a key pressure on trophic status, phosphorus (P) from entering Irish waterbodies. Soils with high plant available P levels (soil test P = STP), above crop and/ or animal requirement (P Index 4: >8-10 mg l^{-1}) are deemed to be at a higher risk for P loss.

When the agricultural catchments were established (2009-2010) the nutrient status of the soils in each catchment were evaluated through a soil census at a resolution of approx. 2ha per sample. Soils were analysed for STP (Morgan's P) potassium (K) and pH, with results returned to each catchment farmer followed up with further explanation and recommendations by their Teagasc catchment advisor. After 3-4 years this soil census was repeated across each catchment (2013-2015).

In four out of the five catchments, the proportion of soils (area weighed) that were in Index 4 for STP decreased by between 3% and 8 %. However, concurrently a large proportion of catchment soils deficient in STP (<5-6 mg l^{-1} for Index 1 and 2) have remained either unchanged or increased in these catchments to between 40% and 87% for Index 1 and 2 soil combined.

Assessment of the rate of STP decline across all catchment soils which were initially Index 4 when sampled, has found that between the sampling periods, soils with the highest initial STP levels (initial STP >20 mg l^{-1}), had a larger decline in STP (11.4 mg l^{-1}), compared to soils with moderately high initial STP levels (initial STP 10 to 15 mg l^{-1}, i.e. closer to the Index 3 thresholds) with an average reduction in STP of just 3.5 mg l^{-1}.

Based on nutrient and farm practice information, farm intensity and land use type also have an influence on the decline rate of legacy soil P. For example, two different fields (arable vs. grassland) with similar initial Index 4 STP (15 to 20 mg l^{-1}) had different decline rates in soil P. The arable field with average removal of 13 kg P ha^{-1} yr^{-1} had a STP reduction of 8.0 mg l^{-1}, compared to an intensively stocked grassland field with an average removal of 29 kg P ha^{-1}

yr^{-1}, which only reduced STP by 4.9 mg l^{-1}. The cycling of organic P by grazing livestock within the soil may explain the slower decline at a higher P removal for the grassland soil. Further understanding and consideration of factors such as soil type, soil chemistry and management are required to provide realistic expectations of the time needed for the drawdown of legacy P in Irish soils.

Overall, findings indicate that continued efforts in effective nutrient management practices on farms coupled with soil and spatial specific targeted P management strategies are warranted for effectively achieving production and water quality goals in these catchments.

Session II

Ag Catchments

Chaired by:

Ray Spain, Project Coordinator
South Eastern River Basin Project

Influence of soil type and weather on nutrient loss

Dr Per-Erik Mellander
Agricultural Catchments Programme, Teagasc

It is important to understand how water moves from rain to stream when interpreting the effectiveness of measures for reducing phosphorus (P) and nitrogen (N) losses from agricultural sources to ground water and surface waters. Interpretations are challenged by the influences of temporal and spatial variability of rainfall, water pathways, associated time lags and nutrient transformations along the pathways.

In studies made within the Agricultural Catchments Programme it was found that the rainfall-soil drainage effect on the proportions of surface and below ground pathways may influence nutrient loss from catchment rivers more than the source availability would. The inter-annual variability in rainfall may further influence P loss even more.

In well-drained soils the soil chemistry could have an effect on loss of excessive P to the groundwater. In particular iron-rich soils were found to favour P mobilisation into soluble form and transfer to surface water via the groundwater. We need to learn more about such processes in the field.

There may also be a risk that monitored changes in N concentrations in groundwater and rivers could be reflected by larger weather cycles, with a shift towards dryer and warmer summers together with wetter autumns/winters. Baseline N concentrations may be shifted due to climate shocks (such as hurricane rainfall or droughts).

Soil drainage, soil chemistry, geology and weather are key-components that may confound the effects of source management on the monitored water quality. It is important to take these into account when trying to find base lines, trends, expectations and targets of water quality.

Practical mitigation options for reducing nutrient losses to water

Mairead Shore
Hydrochemist, Agricultural Catchments Programme

Under the E.U. Nitrates Directive, nutrient applications are restricted during 'closed-periods' in winter. A review of the slurry closed-period in Ireland (15th October - 12/15/31st January), conducted by the Agricultural Catchments Programme (ACP), has shown that surface runoff remains high during the four weeks after the end of the slurry closed-period on poorly-drained soils. However in five representative agricultural catchments there was no evidence of nutrient transfers from slurry/manure applications during this time over a four year period. If slurry spreading was occurring during these four weeks, the data suggest that farmers were choosing to spread on more freely draining soils where surface runoff was low. Such practices could be promoted among farmers through appropriate knowledge transfer methods to mitigate risks associated with storm driven slurry transfers during the early closed-period, derogated periods and more importantly, during sensitive summer periods.

Surface drainage channels (referring to open drains and headwater streams) are common features of agricultural landscapes which have high annual precipitation and poor natural drainage. These channels can mediate transfers of fine sediment and associated phosphorus from up-stream sources to downstream water-bodies through physical retention and transfer processes. A study by the ACP has shown that the slopes and geometries of surface channels can have a large influence on their phosphorus retention/mobilisation/transfer potential, with lower slopes and wider geometries enhancing phosphorus retention on channel beds. Tailoring management strategies according to channel slopes and enlarging ditches may reduce downstream phosphorus transfers in 'risky' catchments.

These research findings can help inform farmers and policy makers of how to optimise slurry application timing and channel management to reduce nutrient mobilisation and transfer in risky catchments.

Sediment losses – where and how?

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Rowan, J.S.
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Excessive soil erosion and subsequent delivery of fine sediment into watercourses can reduce the sustainability of soils and degrade aquatic ecosystems. Agricultural land uses are frequently associated with increased soil erosion risk due to low groundcover on arable soils between cropping cycles or over-grazing and poaching on pasture soils. Within a river catchment, however, other sources of soil erosion may exist, for example, channel banks, drainage ditches, damaged road verges and un-metalled tracks. Measurement of soil erosion from each location is resource intensive and does not consider the efficiency of sediment transport from hillslopes into rivers. Novel sediment provenance methodologies such as sediment fingerprinting offer an alternative catchment scale approach to identify the sources of fine sediments. Sediment samples collected from the river are assumed to be a mixture of potential upstream sources and are related by their natural physico-chemical characteristics. The proportion of sediment sources can then be determined by a statistical 'un-mixing' model. In this study, sediment fingerprinting was used to investigate sediment sources in three intensive agricultural catchments. Sediment fingerprinting results estimated contributions from field, channel and road sources which varied between and within catchments. These results also indicated the dominant hydrological pathways in each catchment and their interaction with changing source availability over time. Cost-effective management of sediment loss risk must consider catchment specific conditions to tailor mitigation strategies.

Identifying the "at risk areas" for nutrient losses on Irish Farms

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Areas of farms at highest risk of losing soil phosphorus (P) to streams are called Critical Source Areas (CSAs). These are where fields above agronomic optimum soil P concentration (> index 3) coincide with areas of high surface runoff generation. CSAs are generally very small areas of larger landscapes and must be accurately identified if best management practices designed to reduce losses are to be cost-effectively targeted. A new CSA Index is presented which generates risk maps of P loss potential at the sub-field scale for a farm or catchment by combining datasets within a Geographical Information System. The source of P and its potential to move is described by normal agronomic Morgan P data and also data on the soil's chemical ability to fix P. The risk of P being moved in surface runoff is described using a new index which accounts

for slope, upslope drainage area and other soil properties. This surface runoff index also accounts for areas on a farm at low risk, where soil P movement is being impeded by depressions or hedgerows in the landscape. The approach uses high resolution (0.25 m) LiDAR Digital Elevation Models (DEMs), surveyed by helipcopter, to capture microtopographic features responsible for routing and impeding surface runoff pathways. The CSA Index was applied to four intensively monitored Irish agricultural catchments with contrasting soil and land use conditions. Results showed that the new CSA Index identified sub-field scale areas where P is transported between fields or delivered to the stream. This could allow the cost-effective and unobtrusive targeting of sub-field scale schemes at field margins to conserve soil fertility and reduce P losses. The approach is scientifically robust and could also be applied to identify surface runoff CSAs of other potentially polluting substances such as pesticides and fine sediment.

Session III

Catchment Characterisation & GLAS

Chaired by:

Tom Dawson, ACA President & Con Feighery, Teagasc Regional Manager

Farmland Birds in GLAS

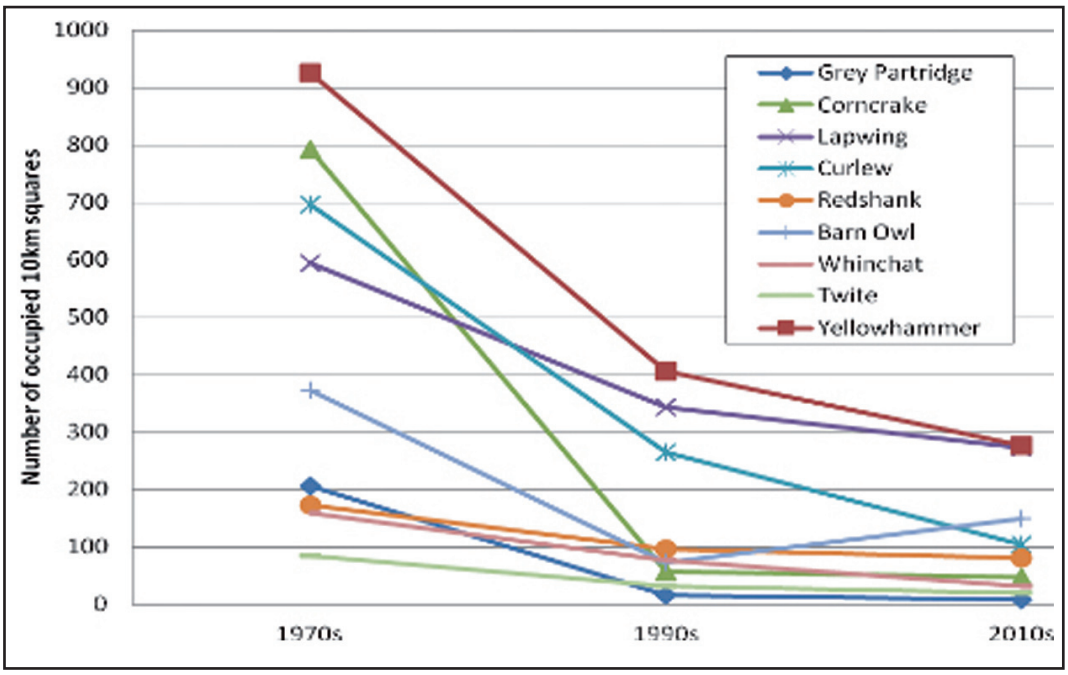
Dr. Alex Copland,
Alex Copland, BirdWatch Ireland

Ireland's biodiversity is facing very severe threats, as evidenced by declining populations of many farmland birds and the loss in extent and quality of many semi-natural habitats in the mosaic of Ireland's farmed landscapes. Target 3(A) of the EU Biodiversity Action Plan states *"By 2020, maximise areas under agriculture across grasslands, arable land and permanent crops that are covered by biodiversity-related measures under the CAP so as to ensure the conservation of biodiversity and to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by agriculture and in the provision of ecosystem services as compared to the EU2010 Baseline, thus contributing to enhance sustainable management[1]"*. The Overall Target of Ireland's National Biodiversity Plan is *"that biodiversity loss and degradation of ecosystems are reduced by 2016 and progress is made towards substantial recovery by 2020.[2]"*. Internationally, Ireland has obligations for biodiversity conservation at a European level (preventing biodiversity loss is a priority for the Europe 2020 strategy)[3] as well as globally. [4]

However, it is well-documented that many modern, intensive farming practices leave little space for birds or biodiversity.[5] Many birds that use farmland habitats that were previously common have suffered major population declines since the 1970's (see Figure 1). In Ireland, these include Lapwing, Corncrake and Yellowhammer, with Corn Bunting (a tillage-specialist) becoming extinct as a breeding bird in Ireland, with the last confirmed breeding in the 1990s.[6] Like the canary in the coalmine, birds can provide early warning systems for the degradation or loss of ecosystems, and the services such ecosystems provide. Birds satisfy many of the criteria of effective indicators, are often used as an early-warning system to detect emergence of environmental problems.[7] Bird indicators have been widely used to inform decision making and land use management policy including within agricultural ecosystems.[8] The decline in

1 **Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions:** Our life insurance, our natural capital: an EU biodiversity strategy to 2020. July 2011.
2 **Department of Arts, Heritage and the Gaeltacht, 2011.** *Actions for Biodiversity 2011-2016: Ireland's National Biodiversity Plan.* Department of Arts, Heritage and the Gaeltacht, Dublin.
3 European Commission. 2010. *Europe 2020: A strategy for smart, sustainable and inclusive growth.* Communication COM(2010) 2020 final, European Commission, Brussels. "http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF (accessed January 2013)
4 Convention on Biological Diversity. 2010. *Strategic Plan for Biodiversity 2011-2020.* http://www.cbd.int/decision/cop/?id=12268 (accessed August 2012).
5 Newton, I. 2004. The recent declines of farmland bird populations in Britain: an appraisal of causal factors and conservation actions. *Ibis* 146: 579-600.
6 Lynas, P., Newton, S.F. & Robinson, J.A. 2007. The status of birds in Ireland: an analysis of conservation concern 2008 – 2013. *Irish Birds* 8: 149-166.
7 2010 Biodiversity Indicators Partnership 2010
8 Gregory, R. D., A. van Strien, P. Vorisek, A. W. Gmelig Meyling, D. G. Noble, R. P. B. Foppen and D. W. Gibbons. 2005. Developing indicators for European birds. *Philos. T. R. Soc.* B 360: 269-288.

Figure 1:
Range (number of occupied 10km squares) in 1970, 1990 and 2010 breeding bird atlases of Red-listed lowland farmland bird species in Ireland



farmland bird populations is telling us that we need to do more to maintain a healthy balance of nature across Irish farmland.

There has been extensive research in the UK in particular which has related farmland bird declines to changes in agricultural practices since the 1970s. Specific causes for change included a variety of practices, including increased use of pesticides and fertilisers, increased mechanisation and loss of hedgerow extent and quality.[9] [10] These changes in agriculture also took place in Ireland over the same period.

Today, agri-environment schemes (AES) are considered the most important mechanism to halt the decline of farmland birds in the EU.[11] [12] [13] The design of these AES are critical to their success, with broad, un-targeted schemes (such as REPS) largely failing to deliver on biodliversity targets EU.[14] However, there are several national and international examples where targeted measures incorporated in AES have helped reverse the decline of threatened farmland bird species at the local scale. The examples that are most effective involve

9 Newton, I. 2004. The recent declines of farmland bird populations in Britain: an appraisal of causal factors and conservation actions. *Ibis* 146: 579-600.
10 Donald, P.F. Green, R.E. & Heath, M.F. (2001) Agricultural intensification and the collapse of Europe's farmland bird populations. *Proceedings of the Royal Society of London B* 268: 25-29.
11 Vickery, J.A.; Bradbury, R.B.; Henderson, I.G.; Eaton, M.A.; Grice, P.V. The role of agri-environment schemes and farm management practices in reversing the decline of farmland birds in England. *Biol. Conserv.* 2004, 119, 19-39.
12 Bright, J.A.; Morris, A.J.; Field, R.H.; Cooke, A. I.; Grice, P.V.; Walker, L.K.; Fern, J.; Peach, W.J Higher-tier agri-environment scheme enhances breeding densities of some priority farmland bird in England. *Agri. Ecosyst. Environ.* 2015, 203, 69-79.
13 Donald, P.F.; Evans, A.D. Habitat connectivity and matrix restoration: the wider implications of agri-environment schemes. *J. Appl. Ecol.* 2006, 43, 209-218.
14 Finn, J.A. & Ó hUallacháin, D. 2012. A review of evidence on the environmental impact of Ireland's Rural Environment Protection Scheme (REPS). *Biol. Environ.* 112b, 11-35.

the design, targeting and establishment of bespoke conservation measures tailored to the requirements of individual species.[15] [16]

The design of GLAS, with measures addressing the specifc requirements of prioirty farmland bird species (breeding waders, Chough, Corncrake, geese/swans, Grey Partridge, Hen Harrier and Twite) offers the best opportunity for the scheme to address conservation issues for these species. The targeting of these actions to specific geographical locations should enhance the efficiency of delivery for these measures. However, even with measures containing all the ecological requirements for the target species, delivered within core parts of their range, the need for good advisory supports for farmers undertaking the actions, along with approporiate monitoring and evaluation, remain essential to ensure success.

15 Kolecek, J.; Schleuning, M.; Burfield, I.J.; Baldi, A.; Bohning-Gaese, K.; Devictor, V.; Fernandez-Garcia, J.M.; Horak, D.; van Turnhout, C.A.M.; Hnatyna, O.; Reif, J. B. Birds protected by national legislation show improved population trends in Eastern Europe. *Biol. Conserv.* 2014, 172, 109-116

16 Bright, J.A.; Morris, A.J.; Field, R.H.; Cooke, A. I.; Grice, P.V.; Walker, L.K.; Fern, J.; Peach, W.J Higher-tier agri-environment scheme enhances breeding densities of some priority farmland bird in England. *Agri. Ecosyst. Environ*. 2015, 203, 69-79.

The relevance of catchment characterisation and WFD River Basin Management Planning for Farming

Donal Daly and Jenny Deakin
Catchment Science & Management Unit, Environmental Protection Agency

Context

- The Water Framework Directive (WFD) sets specific requirements regarding the protection of existing satisfactory water resources and restoration of unsatisfactory water resources. The deadline set for the improvement of substandard water is 2015, although this can be extended to either 2021 or 2027 where there are good scientific and/or economic reasons.
- There has been a general decrease in phosphate and nitrate in water nationally. However, based on data to 2012, 47% rivers, 57% lakes, 55% of transitional and 7% coastal waters require improvement to satisfactory condition. The two most important suspected causes of pollution in rivers are agriculture and municipal sources, accounting for 53% and 34% of cases respectively.
- The main sources of impact to water from farming are: phosphorus/phosphate; sediment; pathogens; nitrate; and pesticides.
- The target of 13.6% improvement in ecological status for surface waters from the 2009 baseline by 2015 included in the 1st cycle River Basin Management Plans (RBMPs) is unlikely to be achieved in spite of significant expenditure by government departments and farmers on, for instance, farm buildings, wastewater treatment facilities and REPS measures.
- The 2nd Irish RBMP has to be completed by December 2017, two years later than the date specified in the WFD.
- FH2020 and Food Wise 2025 strategies anticipate growth in farm outputs and value in a context of sustainable intensification (SI).
- Achieving environmental sustainability, as the basis for economic sustainability and the Origin Green commitments, will require compliance with the WFD and Nitrates Directive. This will be challenging as the WFD requirements are, in certain circumstances, more stringent than the Nitrates Directive. Water quality could become the new quota, unless the achievement and maintenance of satisfactory water is prioritised and acted upon.

Catchment Characterisation

- Catchment characterisation is the foundation of integrated catchment management as it provides an understanding of the physical characteristics, impacts, sources of impacts and quantification of pollutant loads and abstraction pressures in the catchment.
- A key component of characterisation is the determination of the 'risk' of not meeting WFD objectives. While on-going measures, such as implementation of the GAP Regulations and capital investment in wastewater treatment under the Urban Waste Water Treatment Directive will be undertaken generally, specific additional measures, with the corresponding requirement for resources, will need to be considered where water bodies are determined to be 'at risk'.
- Three tiers of characterisation will be undertaken:
  1. Preliminary water body risk screening, based on monitoring data into 'at risk', 'review' and 'not at risk'categories. This has been undertaken on all 4933 water bodies in the country.
  2. Initial subcatchment (there are 582 subcatchments in the country, varying in size from 100-200 km^2) and catchment (46) characterisation, building on the preliminary water body risk screening and influenced by: information on the physical settings; more detailed information on the biology, hydrochemistry and pressures; load apportionment estimations; and analysis of the interactions between sources, pathways and receptors. This is desk-based.
  3. Further characterisation of subcatchments with 'at risk' and 'review' water bodies, and of the catchments. This is based on local information from public bodies, particularly local authorities, and on investigative assessments.
- Characterisation of the subcatchments in the Suir and Nore catchments has commenced; completion of all subcatchments will occur by July 2016.
- Characterisation will show the areas where farming, as well as other activities, is impacting on water, will indicate the pollutant(s) causing the problems and provide an essential basis for evaluation of management strategies and mitigation measures, including economic analysis.

Management Strategies & Measures for Farming Activities

- The following potential strategies are proposed: i) Investigative assessment; ii) engagement & knowledge exchange; iii) incentives; iv) compliance checking; v) licensing of intensive agricultural activities; vi) integration into the planning process; and vii) local mitigation measures.
- Investigative assessments will consist of some or most the following, depending on the situation:
  1. Catchment walks and visual assessments.

2. Location and description of potential pollution sources and information on landuse.
3. Field measurements of water conductivity, temp, DO and pH in local streams and springs.
4. Physico-chemical and chemical sampling & analysis.
5. Small stream risk score assessments.
6. Soil sampling and testing results, with NMP evaluation.
7. Location of field drainage, drains and small streams, with an evaluation of their role in transmitting water and pollutants.
8. Tracing, e.g., with dye.
9. Hand augering, trial pitting and, on occasions perhaps, drilling to evaluate soils, subsoils and bedrock, as relevant.
10. Flow measurements.
11. Well pumping tests.
12. Evaluation of hydromorphology.
13. Evaluation of local/site specific data and reports, where available.
14. Modelling.
15. Analysis of information and conceptualisation of the situation thereby obtaining a 3-D understanding of water and contaminant movement and attenuation in the site/area, followed by conclusions.

- In assessing local potential mitigation measures for farming activities, in so far as is practicable, account will be taken of:
  1. Biophysical setting *(hydrology, hydrogeology, topography, hydrometeorology, sensitive ecosystems, etc.)* for farming activities, as identified by the characterisation process.
  2. The mobility & significance of the pollutants – P, N, sediment, pathogens, pesticides.
  3. The potential for multiple benefits – water quality, biodiversity, flood mitigation, GHG reduction.
  4. Classification of potential interventions according to the point in the source-pathway-receptor continuum: i) source control; ii) mobilisation control; iii) pathway interception; and iv) receptor/in-stream works.
- Economic analysis of the potential strategies and measures will need to be undertaken and final decisions for inclusion in the River Basin Management Plan will be made by the Minister for Environment, Community and Local Government.

Working Together

A key element in achieving satisfactory water resources in the context of sustainable intensification will be the ability of all stakeholders – farmers, agri-industry, scientific bodies, disciplines, environmental NGOs and public bodies – to work together sufficiently to achieve multiple benefits, while not necessarily agreeing on everything.

NMP-Online- An integrated tool for adaptive nutrient management planning Summary

Pat Murphy
Head of Environment KT, Teagasc

- The combined effect of the implementation of the Water Framework / Nitrates Directives and the increase in fertiliser prices has made effective nutrient management difficult at farm level
- Regulatory based NMP tools have proven to be ineffective in communicating with farmers
- Farmers indicated a clear preference for map based outputs
- NMP online has been developed to meet the regulatory requirements while at the same time delivering map based outputs to clearly set out action plans for farmers
- NMP Online will be available to all agricultural professionals for use on Derogation and GLAS nutrient management plans.

Introduction

Nutrient management planning has become a key skill for farmers, one which is essential in the achievement of a balance between achieving high levels of output and protection of the environment. In the past the task was relatively straightforward based on following recommendations from a soil sample. However, environmental regulation and the increase in price of fertiliser have been game changers. A new approach is needed which delivers effective nutrient management planning meeting the regulatory requirements while at the same time facilitating farmers in implementing those plans at farm level. NMP Online has been developed to meet this need.

The Problems

The introduction of the Water Framework and Nitrates Directives were a game changer for nutrient management on Irish farms. They set strict limits on the amounts of nutrients that could be used and on the timing of their application. From a farmers perspective the regulation shifted the focus from a field by field approach to nutrient management to one where field by field recommendations have to be proofed against overall farm limits, based on

farm gate inflows and outflows of nutrient. This created the need for complex computational systems and complex outputs.

The introduction of regulation, the dramatic increase in the price of fertiliser in 2008 and severe pressure on farm incomes combined to lead to a dramatic fall in the utilisation of fertiliser in the 2008 to 2010 period with P usage falling by more than 50%. While this was good news from an environmental perspective, falling fertility levels on Irish farms emerged as a treat to the future growth of the agri-food industry. For soil samples analysed by Teagasc the proportion of soils at P index 4 (Very High) dropped from 32% to 18% - a considerable drop in the proportion of soils which were perceived as posing a risk. However, during the same period the proportion of soils P index 1 (Very Low) rose dramatically from 14% to 30%. Similar falls were observed in soil K despite the fact that it was not subject environmental regulation. A more detailed examination of soil analysis results shed further light on some further trends. Falls in soil fertility were more pronounced on dairy farms than on beef farmers (where off-takes are higher). Only 11% of soils sampled could be classified as having "Good overall fertility status" (P and K at Index 3 or 4 and soil pH above 6.2).

The falling trend in soil fertility represented a significant threat to the productivity of the Agri-food industry. Teagasc implemented a soil fertility campaign in 2012 to tackle the issue and to support improved nutrient management at farm level. The drop in fertility was largely blamed on a combination regulation and fertiliser price increases. However, a couple of pieces of research challenged this view. An examination of case studies where soil fertility had fallen estimated that the third factor in the equation related to farmers capabilities in relation to nutrient management and in their willingness to fully utilise the level of allowable nutrient. The same study identified that only a small proportion of farmers for whom nutrient management plans were produced for statutory purposed used them for agronomic purposes. The clear implication was that the nutrient management plans that were being prepared for farmers, involving considerable expense for farmers, were not fit for purpose, in that they were not effective in communicating to the farmers for which they were prepared.

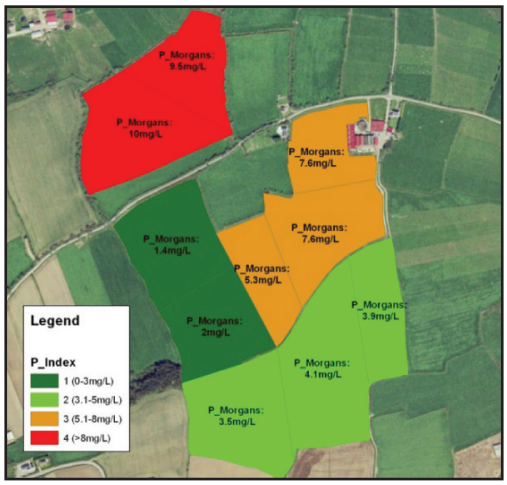
Development of NMP Online

In an exercise co-ordinated by staff from the Agricultural Catchments Programme farmers and their advisers were asked in focus groups to indicate how nutrient management plans could be made more usable. Their answer was clear, indicating that a map based output was required to enable farmers to understand and follow nutrient management plans. Figure 1 sets out

an example of the type of mapping solution suggested by the group - in this instance to indicate soil P levels.

Figure 1 – Colour Coded map of Soil P

Teagasc has undertaken the development of NMP Online to be meet a number of key criteria including:



- Ease of use
- Integration of nutrient advice from the Teagasc Green Book
- Integration with DAFM data for land parcels and animal numbers
- Capability to import soil analysis results
- Flexible plan formats to include Agri-environmental schemes and Derogation
- A statutory record of nutrient usage
- Farm facilities computation and mapping
- Map Based outputs for farmers

NMP Online is being launched at the Soil Fertility conference in October 2015. It will begin operation in November following the provision of training to users. Teagasc will provide comprehensive training on the use of the system and will backup its implementation with a package of on-going training and support in soil fertility and nutrient management. The ultimate objective of the NMP Online is to deliver production and environmental outcomes through better soil fertility management across all farms based on improved utilisation of organic manures, increased lime utilisation and the achievement of more effective use of the chemical fertiliser input.

Conclusions

The current poor fertility status of soils in Ireland poses a significant threat to the achievement of growth targets for the industry. The challenge facing the industry is to improve soil fertility while at the same time achieving environmental objectives. This can only be achieved by improving nutrient management planning at farm level, which in turn can only be achieved if farmers have a good understanding of the principles of soil fertility management and a clear understandable plan for its implementation. NMP Online is a first step to achieving this.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