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Authority

FUTURE WEATHER
FUTURE FARMING

A Conference on Agriculture and FutureWeather Patterns

5 December, 2013
Teagasc, Ashtown, Dublin

Teagasc

AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

FOREWORD

Professor Gerry Boyle, Director

Weather has always been a factor in farming. Expert analysis of climate change outlines that we can expect increased variability, and more frequent occurrence of extreme weather events. This requires that our farming systems are resilient to weather shocks. Weather is particularly important to tillage farmers, but this year, grassland farmers were severely impacted by poor weather in the summer /autumn of 2012 and the spring of 2013. This was a costly experience for farmers, particularly so on heavy soil farms which are especially vulnerable to wet weather. Teagasc has monitored the situation on the ground over the year, and data from the Teagasc National Farm Survey will show the impact on farm profitability. The fantastic weather this autumn has been a huge help in terms of late season grass growth, and the excellent grazing conditions that allowed this grass to be utilized has been very helpful. This has greatly improved the fodder situation on farms as we face into the winter of 2013/14. Importantly, we need to learn lessons from this experience, particularly on how we manage systems and maintain fodder reserves. It has also highlighted the need for better systems to monitor grass growth at a national and farm level that allow weather-based decision support and risk assessment/risk management in the sector. There have been recent advances in remote sensing technology that offer exciting prospects of better grass growth monitoring, and when combined with local weather forecasts, there is a great opportunity to improve grass growth projections and grass budgeting on Irish farms. In addition, the new grass database recently developed by Teagasc, Pasturebase Ireland, will give up to date information on grass growth and utilization right around the country.

Weather has always been closely watched in the tillage sector, affecting field operations and crop growth very significantly. Indeed, we have seen the best and the worst of weather in recent years for tillage crop production, which adds to the price variability that this sector has to deal with. Ultimately for both grassland and tillage farms, there is a need to generate adaptation strategies for extreme weather and to build weather resilience into our production systems.

Adapting to and coping with weather events like those recently experienced will be important in meeting the ambitious targets for Irish Agriculture set out in Food Harvest 2020, and ensuring the profitability and competitiveness of Irish agriculture.

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11.00 – 11.30	Tea-coffee
11.30 – 13.10	**Session 2 - Dealing with extreme weather on farms** Chairperson: Tommy Cooke, ICMSA The 2012/2013 Fodder Crisis – extent, cost and implications Dr Thia Hennessy, Teagasc Current fodder stocks and lessons learned Dr Siobhan Kavanagh, Teagasc Dairying on wet land: the Teagasc Heavy Soils Programme James O'Loughlin, Pat Tuohy and Ger Courtney, Teagasc Drainage solutions for agricultural land Owen Fenton and Pat Tuohy, Teagasc Minimising the impact of extreme weather events in tillage production John Spink, Dermot Forristal and Shane Kennedy, Teagasc

Conference Programme

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3.00 – 3.40	**Session 4 - Panel discussion** Chairperson: Ella McSweeney, RTE Ger Courtney, Teagasc dairy adviser Shay Phelan, Teagasc tillage adviser Gary Lanigan, Teagasc researcher Danny Bermingham, dairy farmer, Co. Clare John Rogers, tillage and drystock farmer, Co. Dublin
3.45	**Conference Close**

INTRODUCTION

Food Harvest 2020 has set ambitious targets for Irish Agriculture with a 50% increase in milk production targeted along with an increase in the output value of beef by 40% and sheep by 20% by 2020. Irish livestock production is pasture-based and grass growth is a key factor both in terms of the production potential and profitability of the livestock sector.

This means Irish agricultural systems and weather are inextricably linked. This was exemplified by the fodder crisis during the winter and spring of 2012-13 which resulted in significant losses to Irish agriculture. Increased weather volatility may pose serious challenges for Irish agriculture.

This has highlighted the need for better systems to monitor grass growth at a national and farm level that allow weather-based decision support and risk assessment and risk management in the sector. Ultimately, there is a need to generate adaptation strategies for and to build weather resilience into our production systems.

This conference will:

- Update stakeholders on the most current assessments of climate and future weather volatility
- Provide an assessment of the impact of the recent fodder crisis on agriculture and lessons learned
- Unveil exciting new research in monitoring grass growth and providing decision -support
- Identify stakeholder needs in terms of building on-farm adaptive capacity

IRISH WEATHER: PAST, PRESENT AND FUTURE

Ray Mc Grath,

Met Éireann, Glasnevin Hill Dublin 9

Met Éireann monitors the climate of Ireland by recording and analysing data from a network of observing stations. The data are a national resource, providing information on local climate change and the linkage with the global climate system. Consistent with the global picture the records show a robust warming trend in recent decades. An increase in precipitation is also also evident but this may be partly a feature of natural variability.

Recent work on global and regional climate modelling by Met Éireann is discussed and sample results presented on how the Irish climate is likely to change in response to different scenarios of future greenhouse gas emissions. Rising temperatures and changes in precipitation patterns will impact on Irish agriculture but there is still uncertainty regarding specific details. How this uncertainty can be addressed is discussed.

Seasonal forecasting is an active area of research at present. The skill of these forecasts for Ireland remains slight but they could have potential as part of a decision support system. It is unlikely that the weather related to the recent fodder crisis could have been anticipated months in advance but it is important to investigate such events and improve our understanding of the climate.

Met Éireann is committed to supporting Irish agriculture and intends to develop tailored forecast services for the community. In 2014 it is planned to 're-analyse' the past climate and to generate high-resolution gridded datasets of weather parameters to facilitate agricultural research. Work on seasonal and decadal forecasting will continue in collaboration with our national and international partners.

LATEST MEDIUM TO LONG TERM CLIMATE IMPACTS FOR EUROPE AND IRELAND

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2 National University of Ireland, Galway

3 Environmental Protection Agency, Richview, Dublin 4

Whilst there are challenges to projection of the potential impacts of Climate Change on a local scale, there is good confidence at more regional (and global) scales. Within Europe, climate impacts can be broadly divided along north/south and east/west lines. There is also concern over projected adverse impacts in Alpine regions.

In the north of Europe, warming may cause growing seasons and crop range to extend. This has already been observed in the phenological record (bud burst, insect emergence and flight times, migrant species arrival, departure and range). However, the attendant concern is for similar extension of range and viability of diseases, pests and invasive species. The north is also projected to experience increased precipitation.

The picture emerging from southern Europe, is drier and warmer, intensifying challenges to water resources. Crop yields have already been observed to decrease, and there are major concerns with animal health, heat stress and a decline in productivity.

In central and eastern Europe, the expectation is of an intensification of the continental climate summer time conditions. Winters may also be warmer. The impacts on precipitation, the warmer central conditions may drive more intense bursts if rain, leading to high runoff, and challenge water resources at other times.

There is considerable uncertainty as to the impacts on climate in the west, coastal areas of Europe. Sea level rise will clearly impact low lying coastal areas.

The ocean will continue to act as a buffer to extreme temperatures. However, potential changes to weather systems moving across the Atlantic (storm paths, etc.) and the influence of blocking systems has not been fully resolved. Models provide a variety of contrasting outputs especially with respect to precipitation.

Surprises may also emerge. For example, it has not been established whether the recent cold winters are linked to the exception loss of sea ice during the Arctic summers.A paradoxical situation might arise, with colder winters in certain parts of Europe due to global warming.

From an adaptation perspective, each regional will face different challenges. This will challenge European policies on rural development in these areas. Climate change presents us with a new set of circumstances.

It fundamentally changes the way we go about planning and decision making

- It changes the range of conditions we must plan for
- It changes time horizons-should be planning out to at least 2050
- We are no longer dealing with certainty and single figure solutions
- Decision making must be 'anticipatory' and proactive

Key message: we must move away from considering climate change impacts explicitly, but rather identifying where and when vulnerability to climate change may emerge and the application of frameworks for the identification and selection of robust adaptation options.

THE 2012/2013 FODDER CRISIS – EXTENT, COST AND IMPLICATIONS

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Rural Economy and Development Programme, Teagasc

This paper uses the nationally representative Teagasc National Farm Survey (NFS) data to examine the economic impact of the 2012/2013 fodder crisis. The impact of the recent atypical weather (high summer rainfall in 2012 followed by a long cold spring period in 2013) on input use, output volumes and overall farm performance in the years 2012 and 2013 is described.

The published 2012 NFS data show that average farm income fell by 15 percent in 2012. This income decline was partly driven by an increase in input expenditure associated with the fodder crisis. Purchased concentrate feed usage increased by approximately 15 percent on dairy farms and 20 percent on cattle farms relative to the previous year. Furthermore, expenditure on purchased bulky feed increased by almost 40 percent.

The Teagasc NFS data reveal significant regional variation in the impact of the weather conditions on farm performance. Although the Teagasc NFS data for farm activity in 2013 will not be finalised and published until spring 2014, this paper uses early estimates from a subsample of farms to estimate input expenditure and output levels for the current year.

Early estimates suggest that expenditure on animal feed in 2013 has remained at the very elevated 2012 levels and that on some farms has even increased relative to 2012. The data on farm performance in both the 2012 and 2013 years are used to estimate the total cost of the fodder crisis to the farm sector. The analysis is further supplemented with a discussion of farmers' management responses to the fodder crisis.

The degree to which farmers had to reduce animal numbers, change production systems and rely on fodder imported into the country will be also reviewed.

CURRENT FODDER STOCKS & LESSONS LEARNT FROM 2013

Siobhan Kavanagh

Teagasc Kildalton College, Piltown, Kilkenny.

Current Fodder Stocks

In early September, the country had a surplus of fodder (8%) for Winter 2013 / 2014. Farmers had assumed a length of winter of 140 days, which is a short winter, particularly on heavy soil types. Despite the excellent summer weather conditions, 23% of farmers were still short of winter feed at that stage, with an average deficit of 19%. Good grass growth and good underfoot conditions this Autumn have helped reduce the demand for winter feed in 2013/2014 but it is important that farmers manage stocks this winter and use supplements to stretch silage. A late Spring could result in a fodder deficit, if not managed correctly.

Fodder Situation July and September 2013

	1st July	1st September
Number of farmers	975	1240
Overall surplus / Deficit	12% Deficit	8% Surplus
% Farmers short of feed	64%	21%
% deficit on farms short of feed	23%	19%
Length of Winter (days)	150	140

Lessons Learnt

There were lessons learnt by farmers and the industry in terms of dealing with a fodder crisis and avoiding a fodder crisis. Lessons learnt include:

Dealing with a Deficit

1. Early action and the implementation of a planned approach to the problem is key to dealing with a fodder deficit.
2. Restricted access to silage and feeding supplements to fill the fodder gap worked well on many farms to overcome the deficit.
3. When purchasing supplements to fill a deficit, the relative value of purchased feeds is critical to minimise the additional costs involved.
4. Don't ignore the cash flow implications of a fodder deficit. Cash flow budgeting is as important as the feed budgeting.

Preventing a Deficit

1. The provision of an adequate forage reserve is crucial on farms, particularly with heavy soils, to ensure the system is sustainable in challenging conditions.
2. Whole farm feed budgeting is important to reduce the reliance on imported feed and exposure to volatile feeds market. It is important that farmers match the stocking rate on the farm to the grass growing capacity of the farm. This is particularly important in the context of expansion in the dairy sector.
3. Soil fertility, a planned fertiliser and reseeding programme are key to maximising forage production and reducing the risk of a fodder shortage.
4. The implementation of an early warning system is required to reduce the risk of a fodder crisis recurring. Recent developments with Grass Growth Satellite Mapping may enable us to characterise the threat early.

DAIRYING ON WET LAND: TEAGASC HEAVY SOILS PROGRAMME

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2Teagasc/KerryAgribusiness Joint Programme

A large proportion (approximately 30%) of milk produced in Ireland originates from farms where the soils can be classified as heavy. Heavy soils add complexities to the production system that are aggravated by inclement weather conditions like those experienced in 2012 and spring 2013. The heavy soils programme was initiated in 2009 to investigate the challenges facing farmers on heavy soils.

Farms in Macroom and Kishkeam in Co. Cork, Castleisland and Listowel in Co. Kerry, Athea, Co. Limerick, Rossmore, Co. Tipperary and Doonbeg, Co. Clare were selected representing a range of challenging soil types. All are participants in the Heavy Soils Programme, and can be followed on:
http://www.teagasc.ie/heavysoils/

Average grass production in 2011 on the seven farms was 11.6 tonnes of grass dry matter (DM) per ha. This was reduced to 7.8 tonnes DM per ha in 2012 showing the huge effect the wet summer of 2012 had on these farms. Compounding the drop in grass production was the difficulty in achieving good pasture utilization due to the very wet and soft ground conditions, farms with a good infrastructure of well laid out paddocks and roadways fared best.

The continuing downward trend in soil fertility nationally is also evident on the heavy soils programme farms, with recent soil analysis showing suboptimal results. The soil results 2013 (2010 results in brackets) were pH 5.73 (5.54), P 4.16 mg/l (5.54mg/l) and K 84.04 mg/l (116mg/l) To establish and maintain good ryegrass swards soil fertility has to be at optimal levels (pH 6.2, P 5.1 – 8, K 101 – 150)

All participating farms identified 2 ha of land to be drained. Soil type ranged from peat to carboniferous shale to red sandstone till. After site investigation, the most appropriate drainage solution was selected. Deep drains (1.7 m), shallow drains (0.9 m), mole drains and gravel mole drains were installed and ripping was carried out where necessary on the farms during the summer of 2013 when weather conditions were ideal.

Drainage costs ranged from €3,000/ha for collector drains and ripping, €6,000/ha for deep drains to €8,100/ha for gravel mole drains with average cost of €6,133/Ha for all farms. Measurements of milk and grass production together with meteorological and drainage flow rates are ongoing and will be used to evaluate the benefits of the drainage work.

Increased productivity on heavy soils requires clear management decisions that mitigate the risks in farming such land. The capacity to grow adequate quantities of grass in a three year cycle is dependant on high utilisation of productive perennial ryegrass swards and the provision of adequate silage reserves (at least 0.5 tonne DM/cow). Stocking rates must be matched to the grass growth and utilisation capacity of the farm. Based on potential grass grown of 12.5 tonnes DM/ha with all winter feed requirement conserved within the farm (including reserve) the optimum stocking rate is 2 LU/ha.

DRAINAGE SOLUTIONS FOR AGRICULTURAL LAND IN IRELAND

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Research now shows that it is possible to grow and utilise more grass than is currently the case on the majority of dairy farms. Land drainage is seen as one of the most important components for achievement of Food Harvest 2020 goals. Matching global trends, Irish drainage systems will continue to be modernised and maintained on existing and new lands. Due to the dry summer of 2013, the momentum of drainage works increased nationwide. The big questions for farmers with respect to land drainage in Ireland are: How do we go about diagnosing a drainage problem? What are appropriate Irish drainage solutions and costs? How do we maintain our drainage networks into the future?

Ireland receives some of the highest annual rainfall in Europe, with only limited variations between the summer and winter seasons, which means that Irish soils are vulnerable to drainage problems, especially in winter. Presently, net rainfall (rainfall – evapotranspiration), which is the amount of water that needs to be drained from land varies across the country, but typically on a wet farm is approximately 500 mm. At present the average drainage scheme is designed to export this amount of water from an agricultural site. Every field and drainage situation is different and a field may suffer from a number of different drainage problems (Anon, 2013).

Paramount to any diagnosis is a soil test pit investigation. Soil test pits are dug in problem versus reference areas to approximately 2.5 m. Next the soil profile is examined and permeable versus impermeable layers are identified. Permeable layers will be indicated by seepage of water into the soil test pit and collapsing layers. The presence of stones in shallow layers is important to note, as this may hinder some shallow drainage techniques.

Basically permeable layers allow water to be transported off site efficiently and therefore are amenable to groundwater drainage solutions (e.g. Corrugated pipe, clean gravel (10-40 mm size range) envelope and soil back fill).

The groundwater system should be installed within or at least on the upper part of the permeable layer to effectively control the position of the watertable. Such a system will also aid in shrinking and cracking the impermeable layers above. Spacing of groundwater drainage systems in Ireland has moved from 8 m (€6,200-€8,600/ha) to ≥15 m (€3,700-€6,200/ha) with the depth now identified by soil test pit investigation.

Impermeable layers are poor water transmitters and have typically > 30% clay content. Shallow drainage systems (e.g. mole (€125/ha) or gravel moles (€1,480/ha)) are seen as Irish-specific options in such cases where no permeable layers exist. These methods crack and fracture upper layers but also leave a mole channel in place. They have a short lifespan and for Irish soil and rainfall conditions, a mole drain spacing of 1 m (depth 0.45 m) or less is required to provide satisfactory control of the watertable (Rodgers et al., 2003).

However, mole ploughs typically operate off a 1.5 m - 2 m spacing. This system will drain infiltrating rainwater and minimise overland flow. Deep peats will need drainage work over a long period to gradually bring such land into production. Land forming and shallow open drains will remove some excess water. Once this has been achieved a network of closely spaced (4-5 m) piped drains supplemented by gravel mole channels may be needed. The perimeter of fields contains the main drainage system, which contains the outlet and open drains. This primary system receives water from the in-field drainage system (groundwater and shallow levels) and therefore must be maintained to the highest standards to efficiently transmit water off site. In a scenario where rainfall amounts or intensities change, effective maintenance will vastly improve the capacity and the lifespan of the drainage system. Pipes are easily cleaned using drain jetters, which are specifically designed high pressure hoses. Additionally simple rodding may relieve minor blockages. Increased net rainfall will have economic implications as drainage will need to be more intense (closer spacings and larger pipes) to cope with increased volumes of water.

MINIMISING THE IMPACT OF EXTREME WEATHER EVENTS IN TILLAGE PRODUCTION

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The performance of tillage crops can be adversely affected by extreme weather either by restricting access to the land to carry out operations or by affecting the growth of the crop directly.

High rainfall impacts the soils ability to support both machine traffic and soil operations without causing damage. All machinery operations from crop establishment to harvesting can be affected, resulting in yield reduction due to timeliness penalties and soil structure damage. Traffic management, including the number and timing of machinery operations, coupled with the reduction of machinery ground pressure, by the use of lower pressure tyres and tracks, can go some way to ameliorate these impacts.

Choice of cultivation equipment affects the risks associated with crop establishment with plough-based cultivations generally able to operate in poorer soil conditions than non-inversion techniques. However, non-inversion techniques are generally faster and may allow a larger area of crops to be planted earlier in the planting window if conditions permit. The risk to both application of inputs and harvesting can be reduced by increasing machine capacity relative to the area being harvested. Irish tillage farms tend to have a greater machinery capacity per unit area than those in drier climates, but this extra capacity brings a cost. For the future controlled traffic farming techniques, where machinery wheel tracks are restricted to limited parts of the field area using RTK GPS, may have a role in limiting soil damage in marginal operating conditions.

Crop growth can be directly affected by too much or too little rainfall, unseasonal high or low temperatures or low light levels. Excess rainfall leading to water logging can cause crop death particularly in wetter parts of fields the risk of which can only really be reduced by improving drainage.

Water logging and drought will also have less severe effects on crop growth through reducing or stopping photosynthetic activity. Extreme low temperatures can also cause crop death with the risk increasing as the crop proceeds through its lifecycle. The risk varies by crop with autumn sown spring oats being at highest risk and winter wheat probably the most resilient crop (as we saw in winter 2010-11.

In contrast to grass grown for grazing or silage, tillage crops go through a defined series of developmental phases and certain phases impact yield more than others depending on the crop. These phases include establishment, leaf formation, tillering or branching, stem growth, seed formation and seed filling. In most cases the rate at which tillage crops progress through a phase is determined by temperature (although some require vernalisation or a photoperiod response) with a phase being extended by low temperatures or shortened by high temperatures. The rate at which tillage crops accumulate biomass during a particular phase is determined by the amount of light received by the crop. The growth in any particular phase of a crops lifecycle is therefore determined by a combination of temperature and light or the 'photothermal quotient'. Cool bright conditions (a high photothermal quotient) will result in more growth in a given phase and warm dull conditions (a low photothermal quotient) less growth.

Crops differ in the time of year at which they go through specific phases of development and in the relative impact of different phases on eventual yield. Winter wheat generally produces sufficient grains in Irish conditions but yield is sensitive to poor growing conditions or drought during grain filling. Barley yield in contrast is less sensitive to growth conditions during grain filling but tends to be sensitive to conditions during the grain number formation period i.e. early season. Winter barley goes through these sensitive stages in the autumn and early spring whilst spring barley goes through them in late spring and early summer. Growing a mix of crops therefore reduces the risk of poor growing conditions in one particular part of the season resulting in a big reduction in production.

NEW REMOTE SENSING TOOLS TO MONITOR GRASS GROWTH

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The Spatial Analysis lab in Teagasc, with partners in the Department of Geography, UCC, are developing new tools to estimate grass growth in Ireland using satellite imaging. Along with colleagues in the Teagasc Grass Programme, the aim is to be able, in a short number of years, to give very local measurements of growth rates, and, more importantly, predictions for growth over the coming few days or even weeks. Here we show some current work that allows us to produce maps on a weekly basis that show how the grass growth at the scale of townlands can be compared to the ten year average for that period.

Satellite imaging is increasingly familiar through online mapping tools like Google Earth. However, the satellites used in this project have a wider application than just simple imaging. The NASA Aqua and Terra satellites each carry a version of the Moderate Resolution Imaging Spectroradiometer (MODIS). For the purposes of monitoring grass level MODIS can take images in the Near Infra Red (NIR). This is light that is just beyond the red wavelengths of visible light that we can see, and is important because it is strongly reflected by plants. This bright signal is directly related to the amount of plant material and how well it is growing.

Terra and Aqua are orbiting at an altitude of 705km carring a sensor called MODIS. A single MODIS image encompasses all of Great Britain and Ireland, with each pixel of the image representing an area on the ground of 250m by 250m. We can take the amount of NIR light in each pixel and divide by the corresponding red value to create a vegetation index VI, a single number in each pixel that represents the amount of living green vegetation in that pixel.

The value ranges from -1, no vegetation at all (e.g. desert) to 1 for completely covered by lush, vigorously growing vegetation. Using maps of this VI we can compare the performance of each pixel with past performance.

To look at how performance this year compares with the average a 10 year rolling archive of weekly satellite data has been created. With this archive we have been able to track grass growth over the spring of 2013 as the fodder crisis unfolded. However research has shown that information needs to be re-figured into a common language to be utilised fully. When discussing the effect of weather on farming, talk revolves around “slow growth” or “we’re two weeks behind”. To re-interpret our trend data into this “time domain” we created phenological growth models for every pixel, showing how, on average, the vegetation grows as a function of time. This allows us to compare current growth as seen by the satellite on a particular day with the model, and calculate whether the growth is on target or lagging behind where it would normally be, and express this difference in days or weeks.

Moving beyond trend mapping, the next stage is to estimate actual grassland yield using satellites. Using historical grass growth data from Moorpark, contained within the PastureBase service, Walsh Fellow Iftikhar Ali has been creating models of biomass (DM Kg/Ha) as a function of vegetation index.
These models are currently in early devolvement and are proving successful, with modelled biomass measurements for Moorepark matching field measurements with a correlation coefficient value of 0.79. In the coming 2 years this model will be refined and combined with RADAR data to produce reliable, parcel scale estimates of standing biomass.

PASTURE BASE IRELAND – NATIONAL GRASSLAND DATABASE

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The future of an efficient low cost milk production system in Ireland will depend on the development of new grassland technologies which can lead to greater efficiency in grass utilisation. The creation of Pasture Base Ireland (PBI) is an important step in the development of such technologies.

PBI represents a grassland management decision support tool which incorporates a mechanism to capture background data on both research and commercial farms. The database stores all grassland measurements in a common structure. This will allow the quantification of grass growth and DM production (total and seasonal) across different enterprises, grassland management systems, regions and soil types using a common measurement protocol and methodology.

Grass measurements are recorded on a regular basis and reports (grass wedge, distribution of growth and paddock summary reports) are automatically generated for management purposes. The reports are developed in a format that allows individual farms to be benchmarked with other farmers in their discussion group or to be benchmarked with farmers regionally.

The background data such as paddock soil fertility, grass cultivar, aspect, altitude, reseeding history, soil type, drainage characteristics and fertiliser applications are also recorded.

All farms on PBI are attached to their nearest Met Eireann weather station to allow the linkage between meteorological information to grass growth to be created. Information from different commercial grassland management software packages will be allowed into PBI once it meets rigorous quality assurance standards.

Incorporating this data will increase the value of the database and would ensure that all generated grassland data is stored in one national database. All of the information collated within this new database can be used for future research projects to increase the understanding around grass growth at farm level, which should ultimately contribute to increased grass growth and utilisation at farm level. In summary, PBI is a new national grassland database.

This database will enable the collection of regional grassland data across dairy, beef and sheep farms while providing decision support information for farmers and collating the background research information into a centralised grassland database.

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MERGING EARTH OBSERVATIONS WITH FORECASTS: THE BIG DATA CHALLENGE

Alistair McKinstry

Irish Centre for High End Computing (ICHEC)

Both weather models and Earth observations are moving to increasingly high resolutions: the Harmonie model run by Met Éireann at ICHEC has been demonstrated at 0.5 – 1km , while the next generation of ESA satellites, the Sentinel series, give multispectral data in > 10 bands at 20-100m resolution. These give the opportunity to test land models on a km scale on a national basis. Other observation sets, such as Teagasc and Met Éireann in-situ measurements, can be used to ground-truth such forecasts.

Both weather models (Harmonie) and climate models (EC-Earth) run by Met Éireann have land models incorporated, which are typically used to determine evapotranspiration and ground temperature. These typically track temperature and soil moisture at 6 levels down to 2m; the quality of these fields have not been validated to date, but may be so in future, against in-situ but also aerial magnetic and electromagnetic results, which the TELLUS project has shown correlate well with soil moisture. If valid, these forecasts could be invaluable for growth models.

Harmonie uses ECO_CLIMAP land coverage data at 1km resolution; this describes land cover in terms of 12 "nature" tiles, such as "grass", "conifer", "rock". Similarly, the underlying soil is described purely in terms of clay and soil fraction. By contrast, Harmonie has recently been upgraded to use 30m ASTER (satellite-based) topography by Enda O'Brien at ICHEC, and the new 1:250,000 scale soil map from the Teagasc EPA ISIS project details 240 soil series across Ireland. Hence scope exists to improve the land modelling within Harmonie, and use this as the basis of a national "land state forecast". Projects such as AgriSAR, collecting grass growth data via Radar with the upcoming Sentinel1 and Sentinel2 satellites at 20m resolution provide an opportunity to validate growth models based on this.

This requires huge data volumes: the Sentinel series of satellites are expected to generate 5 PB of data each per month. Downloading this to the desk will no longer be feasible. Hence collaborative "Thematic Exploitation Platforms" where data is co-located with HPC computing are being built. ICHEC is piloting such a TEP with Teagasc and Met Éireann for High-resolution agricultural forecasting. Based on existing ESA open-source software (e.g. BEAM and NEST for SAR) but with new algorithms for atmospheric correction, etc. This will provide a portal where user-defined workflows will be triggered on data arrival, processing directly on ICHEC HPC facilities and producing user-defined analysis products for analysis by Teagasc and Met Éireann. It is hoped that this TEP will form the core of an upcoming SFI research centre on Earth Observation.

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December 2013

NDP
National Development Plan 2007 - 2013

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

teagasc
Agriculture and Food Development Authority