

# **A Response to the Draft Climate Change Adaptation Sectoral Plan for Agriculture, Forest and Seafood Sector**

Teagasc submission to the  
Department of Agriculture, Food and the Marine

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## Introduction

Teagasc is pleased to have the opportunity to contribute to this Draft Climate Change Adaptation Sectoral Plan for Agriculture, Forest and Seafood Sectors, although our contribution will largely be limited to the agriculture and forestry sectors.

We have also taken the liberty to contribute in the form of ‘submissions, observations and comments’ as indicated in the call for contributions rather than in the formal questionnaire which appears to be more appropriate for an individual submission rather than an organisational contribution.

## General comments

Climate change adaptation is a hugely complicated issue involving the interaction of a huge number of variables and biological processes. There is a large degree of uncertainty both in terms of the extent of projected future global climate as modelled by global circulation models and large uncertainties associated with downscaling to a regional basis which makes predicting the likely impact very difficult. What is certain is that air temperature will increase and the frequency of extreme events may increase.

The potential impact of climate change on agriculture and forestry in Ireland should not just include direct effects on production in Ireland. Effects in other countries or regions are predicted to be much greater than in Ireland and could dramatically alter global supply and demand balances opening up opportunities for the sector in Ireland. For example some major horticultural supply countries are already suffering from a lack of water and this is predicted to become more severe as climate change progresses which could present market opportunities for the Irish sector which will have a greater water supply.

In section 4 it is difficult to see how the priority impacts have been selected and the consequences arrived at, it would help if the climate variable(s) resulting in the impact were identified.

Taking the first, ‘Greater Grass growth’ as an example, what is this predicted to be due to? Is it due to warmer spring and autumn weather, conversely hotter summers might be expected to reduce grass growth via increased soil moisture deficit, however the magnitude of this impact will depend on the length of such deficits. This is discussed in more detail below.

In some of the case studies, such as, tillage there is a highlighted section of ‘Actions included’. This is very useful and should be included in all of the case studies, with consistency of the heading which currently varies between case studies.

## Agriculture and Forest background documentation

### Impact and vulnerability assessment for agriculture and forest sector

We should start by recognising that this is a very, very complex area and disentangling the respective risk and impact pathways is incredibly challenging. The authors should be congratulated on producing a clear and succinct document that summarises both the issues and potential pathways to adaptation. The documentation points to a whole world of additional work that we could and should continue to expand on. If nothing else, this exercise will provoke our thoughts in this regard and highlight potential blind spots and deficiencies in national research and farmer advice.

We have some difficulty in understanding the approach taken in the risk and impact assessment. In particular the methodology which has many examples which are assessed as Low evidence, Low magnitude of impact, Low confidence of future impact and confusingly it is then also concluded that there is a Low potential future impact of magnitude. Where there are insufficient studies available (Low evidence), this leads to low confidence in the assessment of future impact rather than being combined to lead to a conclusion of Low potential future impact. We would have thought at best the conclusion arising from such a process of risk assessment should only lead to a conclusion of “insufficient evidence to make a judgement”. The logical pathway as pursued here risks leading to an interpretation of low impact and therefore the attendant risk of an inappropriate choice of action.

This lack of evidence is recognised in the report which alludes to the paucity of data available to assess impacts:

“...the brevity of some of the time series means that on a national level we are relatively poorly equipped to make conclusions as to how climate change is and will continue to affect Irish waters, ecosystems and the services that rely upon them.”

On foot of this we should actively consider the potential benefits both from a research and industry management perspective of establishing national monitoring to address the clear gap in data availability.....i.e. more work needs to be done!

Our concerns on the approach taken are somewhat exacerbated by the choice of some of the references relied upon to support outcomes which for some include studies done in other territories (eg Australia) along with (more concerning) reports in the national media.

We also wonder if greater consideration should be given to potential synergistic impacts. An example from the report: Increasing summer temperatures are judged to lead to ‘Lengthening of grazing season and greater risk of pasture borne disease and parasites, propensity towards infestations (e.g. worms)’. While it may lead to enhanced grass growth, we don’t see how increased temperatures will necessarily lead to a lengthening of the grazing season; this would surely require changes in the shoulder seasons. In parallel, decreases in summer rainfall is seen to lead to localised poor grass growth due to soil moisture deficit; therefore potential low fertiliser response which is likely true, but is scored as ‘Low, Low, Low, Low’ across the board. Also, increasing precipitation at

the shoulders of the year may limit soil trafficability and therefore the potential to exploit any extra grass growth that may occur.

The key challenge is that the impacts will of course not respond singularly in parallel but synergistically which will potentially lead to either increases in the impacts, or negating of potential benefits. So here it is not hard to envisage increased summer temperatures possibly leading to some increases in grass growth in some areas, but decreased summer precipitation leading to limitations in grass growth, while in tandem with increased winter precipitation leading to shorter-not longer-grazing seasons. Again, this will likely vary considerably spatially.

## Climate change and Grassland

A comprehensive analysis of future grass production trends in Ireland is warranted and required. The future approach to on-farm grass management must be more flexible and adaptive and needs to be planned. Teagasc have developed both PastureBase Ireland (PBI) and the Most (Moorepark and St Gilles) predictive grass growth model to assist in the management of grass and overcoming grass growth variations.

Recently there has been increased emphasis on the measurement, prediction and control of grass production on livestock farms (particularly dairy), allowing for more controlled reaction to anticipated growth variations. Future grass growth trends will result in more variable grass production patterns, therefore, future grassland management plans will need to embrace this properly. Ireland has seasonal differences in regional grass production (based on PBI data), while cumulative grass output is similar across the regions. Grass growth projections may forecast that certain parts of the country, i.e. the eastern half, maybe more exposed to soil moisture deficits. This will mean that certain areas will need to be more vigilant, regarding grass production monitoring and forecasting.

The report also mentions 'better nutrient uptake' as a consequence, presumably of higher grass output, but the literature would suggest a reduction in nutrient density in grass and crops due to CO<sub>2</sub> fertilisation which might lead to reduced nutrient supply to livestock. As for variation in grass growth nutrient management for quality during such periods will need to be more targeted and precise.

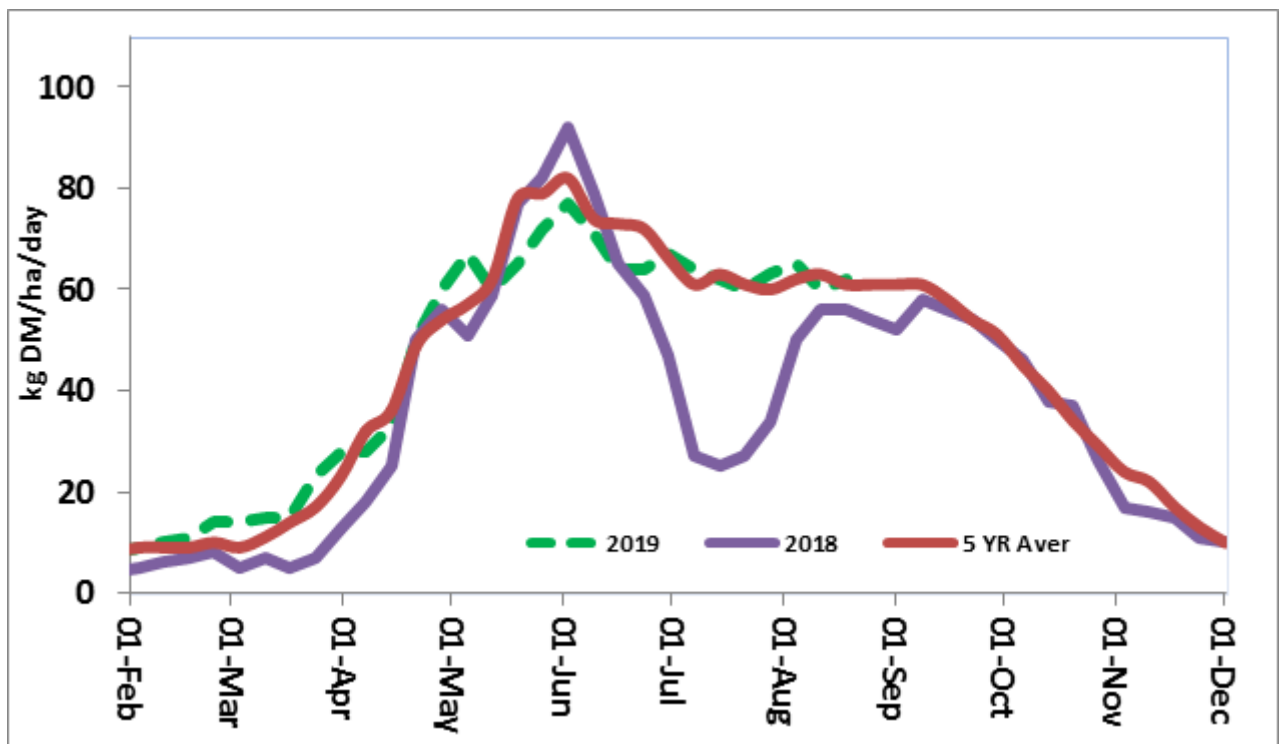
The overriding objective of dealing with grass production variation means that Ireland requires a focussed fodder management plan. For example, in Autumn 2017, fodder was moved from the southern half of the country to the North West region, this fodder deficit was caused by a prolonged period of excessive rainfall and lack of grazing periods, so it is not correct to predict that all feed deficits will be caused by soil moisture deficits.

Grass growth variation leads to surplus and deficits in grass supply during individual years (Case study 2 is very focussed on a grass deficit year). Ireland requires a more focussed approach to conserve grass surpluses that occur in high grass production years (for example 2017).

A more precise strategy is required to promote the conservation of this feed surplus to create a fodder reserve in the country, mitigating against feed importation and opportunistic increases in feed costs.

Therefore we conclude that, in the future, feed deficits will occur more frequently, but waiting to formulate a proper strategy until that deficit appears is not a forward thinking approach, and given the animal numbers in the country this needs to be established now. Ireland has the capacity to be more self-sufficient in its livestock feed supply management. This may require that fodder supply agreements or partnerships will need to be generated between livestock (dairy and drystock) and possibly tillage farms for the supply of feed between farms.

Figure 1. Weekly grass production from Pasturebase Ireland from 2013-2018 and individual years 2018 and 2019



## Climate change and the environment

Climate change and water quality are touched on in case study 12, but the wider implications of climate change on the environmental impact of the agriculture, forestry and seafood sectors don't appear to be addressed in the document. There may be changes required in order to adapt systems to avoid increased environmental impact, whilst these are alluded to in the document, for example, in relation to slurry storage and spreading, a more explicit analysis would show that due consideration is being given to the issues. In addition, increased extremes in soil moisture could lead to large N mineralisation events, increasing both nitrate leaching and nitrous oxide emissions, while a reduction in plant productivity will also have knock-on impacts in the ability of agricultural systems to sequester carbon. A more detailed discussion on water quality and climate change is given below as an example of consideration of the wider environmental impacts.

Despite difficulties in directly linking climate change with water quality, recent findings have stressed the importance of shifts in climate and weather conditions for agricultural nutrient loss. In NW Europe climate and weather conditions were found to alter the effectiveness of diffuse pollution measures (Mellander et al., 2018). Changes in air temperatures and precipitation patterns, together with hydrological and chemical controls; such as topography, soil type and bedrock, varies geographically and will either exacerbate or dilute the nutrient loss to water.

In the UK climate change is predicted to increase P loss to water by 30% by 2050. In order to reduce eutrophication and achieve good water status there is a need to develop more efficient and targeted measures (both spatial and temporal) to further reduce P fluxes to water under a changing climate. It has been suggested that in the UK current mitigation efforts will not be sufficient and up to 80% reductions in agricultural P loss are required to off-set the projected increased P loss associated with climate change (Ockenden et al., 2017). To be able to identify efficient measures, a clearer understanding of the combined effect of climate drivers, source management, and hydrological and chemical controls in the landscape is recommended. Simplified integrated climate-hydro-chemical indicators are useful for shaping future policy in managing and mitigating nutrient loss to water and can be considered at the field scale and up to the functional landscape scale (Mellander et al., 2018).

Scenarios of drier summers would lead to less dilution of pollutants from point sources and even relatively small sources could push P concentrations over the Ecological Quality Standards (EQS) and during an ecological sensitive time. Another scenario for dry and warm summers is a build-up of a large N pool in the soils due to poor grass growth, and thus reduced N uptake, in conjunction with an increased N mineralisation. Soil cracking may further create preferential flow paths enhancing the loss of N to water during large rain events in autumn.

A scenario of increased winter rainfall could provide conditions when more of the landscape and more of the P sources are hydrologically connected to rivers and so increase the loss of P to water. This typically leads to a net increase in diffuse P loss from catchments. Under extreme winter events, when soils often are saturated, such conditions may lead to more soil erosion, in particular from riverbanks and bare soils.

Scenarios of a rise in sea-level may increase the P loss from coastal areas due to i) more land being exposed for erosion, ii) the loss of natural buffers such as wetlands, and iii) mobilising P due to soil saturation causing a reduced environment that releases P locked up in the soil. The interaction of

warming oceans and increased P loads from terrestrial systems under climate change scenarios offer a daunting prospect of contributions to large-scale ocean anoxia (Watson et al. 2018).

Weather extremes may largely offset baseline nutrient concentrations, enhance nutrient loads and alter the type of nutrient loss risk. Strategies to mitigate nutrient loss need to consider the effects of both long-term climate changes and the short-term weather extremes. Targeted mitigation measures and knowledge transfer will be important to overcome some of these challenges.

## Climate change and Tillage

As clearly stated in DAFM and national strategies, the tillage sector is vital to support the expansion of the brewing/distilling industries, as well as potentially an increasing role in smoothing out variations in fodder supply for the livestock sectors. This needs to be underlined to provide further context to the economic impact of the tillage industry.

It is stated that *'Such events can be dealt with by having more robust varieties to deal with extended periods of drought and incorporating drought tolerance traits into new varieties arising from plant breeding programmes'*. However, the goal must be broader than this. Breeding for drought tolerance in isolation will not achieve what is required based on the fact that as we have seen in recent years, crops experience a contrasting range of environmental conditions in the same growing season. The goal must be to breed novel germplasm with increased environmental resilience against multiple a/biotic stresses that are likely to be encountered within the same season. The report correctly alludes to learning lessons from the South East of England or North West France, however, whilst the climate could be similar we will still have different day lengths which could adversely affect the adaptation of varieties and genetic resources from other regions.

The document highlights the important role of VICCI and enhanced plant genetics and this is to be welcomed but there must equally be a realisation that current conventional breeding practises, require 8-13 years to produce a single variety. The adoption of novel breeding techniques could significantly accelerate the rate of genetic gain.

Separately, it is stated that opportunities will arise to support increased potential for those crops currently accounting for limited areas such as Peas and Maize in the short-term and in the long term the expected development of soya varieties suitable for growing in the Irish climate by mid-century. Indeed, this is likely to occur and should be welcomed as it will reduce our reliance on imported animal feed and introduce the necessary diversity in current rotational choices. Actions to support this transition need to be accelerated however via grower incentives and enhanced resources to develop the required management regimes to support production practises.



## Climate change and Irish Forests

It is likely that the main effects on Irish Forests will be:

- Increased risk of damage from winter storms
- Changes in phenology for species in response to rising temperatures
- Increase in forest productivity
- Certain seed origins better adapted to changing conditions
- Increase risk of suitable conditions for damaging agents
- Lack of phenotypic plasticity in native species

It is likely that the increase in the frequency and severity of winter storms associated with climate change will increase the incidence of windthrow especially as the private estate in Ireland matures. Increase waterlogging and delayed thinning and poor thinning practices (incorporation of brown edges for timber stacking) may increase the risk of forests being blow down.

On the whole forest productivity is expected to increase in Ireland as a result of climate change, largely to an increase in temperature, longer growing seasons, increased CO<sub>2</sub> and wet deposition of nitrogen with the proviso that soils have adequate moisture. For soils with water deficits or prone to drought, decreasing spring and summer rainfall may result in drought stress limiting ecosystem productivity.

Species with a relatively small gene pool are most vulnerable to climate change and therefore high diversity within and among populations is important for a species survival. The potential of native and non-native trees (with large natural distributions) to respond to rapid climate change will depend on phenotypic plasticity and/or adaptive evolution. Certain native species may be more vulnerable to climate change than non-native species as these have a large distribution with distinct populations adapted to a wider range of conditions. For example Sitka spruce has a 3000 km range with many distinct populations. Adaptation of tree species which may take millennia to develop can be aided by assisted migration of genetic resources to ensure that the forest genetic resources will be adapted for climate change.

It is likely that growth phenology will be impacted by rising temperatures; which may result in delayed bud burst although this can be overcome by cold storage of plants in refrigerated conditions. On lowland sites in Ireland, an increase in average winter temperatures will result in later bud flushing of certain species including Sitka spruce, Norway spruce (*Picea abies*), ash (*Fraxinus excelsior*), beech (*Fagus sylvatica*) and sessile oak (*Quercus petraea*).

For many species increasing temperatures will present advancement in growth cessation, and therefore the length of the growing season. Milder autumn temperatures may provide opportunities to expand the range of suitable species and provenances in Ireland, for example in Sitka spruce and other tree species (e.g. Oregon and Californian provenances may suit. of Sitka spruce).

Climate change may present conditions for the successful establishment of pests and pathogens and additional measures to ensure the protection of Ireland's forest estate are necessary. A continued

high level of vigilance, monitoring and horizon scanning for potential forest pests and pathogens will be of high importance.

Additional research will be necessary to plan for these changes and monitor the impacts of climate change and the success of adaptation strategies. Advisory and developmental support will be essential to ensure that forest owners and the forest industry are informed and well prepared. This planning and preparation is particularly significant in relation to the long timescales that exist in relation to forest crops.

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